

**IMPLICATIONS OF NEW TECHNOLOGIES  
AND COMPETITIVE ENTRY  
FOR TELECOMMUNICATIONS POLICY\***

**By**

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**Abstract**

*New telecommunications technologies are changing the costs of traditional services and creating a wide range of new services which could be offered by incumbent local exchange companies, unregulated subsidiaries of regional companies, or by new entrants. Incentives for network modernization depend partly on regulatory policies, including ONA (open network architecture) and rate design. Policy responses to the competitive environment include partial deregulation and increased pricing flexibility, with price caps protecting "captive" customers."*

\*This study began as part of a project for the Florida Public Service Commission (FPSC) on Telecommunications Costing and Pricing. It draws upon material originally prepared for the U. S. Congress's Office of Technology Assessment. That research addressed regulatory structures and the development of information technologies in rural America. For the purposes of the FPSC project, the analysis focused on the implications of technological developments for regulatory policies. David Sappington, Ben Poag, and Dennis Weisman provided helpful comments on an earlier draft of this study. The ideas expressed here do not necessarily represent those of sponsoring organizations.

# Implications of New Technologies and Competitive Entry for Telecommunications Policy

## 1. Introduction

Modern technologies for storing, processing, and transferring data represent fundamentally new ways to organize information, access entertainment, communicate with one another, make decisions, and create new knowledge. Boulding (1984) notes that ". . . the same information can be coded in many different ways, in structures both of matter and of energy." (p. vii) In a sense, we are discovering that the ultimate supply constraints are not so much resource-based, but knowledge-based (Lamberton, 1976). Telecommunications will become an increasingly important component of the *Information Age*, so the regulatory structures which establish incentives for innovation and rules for pricing new services will have a significant impact on economic performance. Not only are the boundaries between mass communication (getting messages out) and two way communication (involving message exchange) likely to become blurred, but both will become integral to education, health, entertainment, and other social and economic processes.

Policy analysts have examined implementation issues associated with post-divestiture telecommunications in the U.S. In one study, Fuhr (1986) found that the goal of universal local service was not threatened by the Bell break-up. In addition, Robinson (1986) argued that permitting the regional operating companies to enter the information services industry could promote innovation and bring enhanced services to customers. Focusing on the long distance (toll) market, Kaserman and Mayo (1986) identified misplaced fears (or myths) that were stalling deregulation. Since those articles were published, the FCC has moved to price cap regulation for AT&T, and Judge Greene has relaxed prohibitions which had restricted the former Bell operating companies. The way seems open to enhanced regional services--although further legal challenges stalled diversification efforts. Innovations in computer switching and fiber optics transmission continue to influence the

configuration of the telecommunications industry, as regulation delays (but seldom halts) market adjustments to technological opportunities.

The purpose of this study is to examine the implications of technological opportunities for regulatory policy. Without an understanding of economic and engineering trade-offs, analysts are unlikely to identify policies which promote efficiency over time. The economic and technical engineering concepts are developed in several stages. The first section surveys the relationship between regulation and innovative activity. For example, the shift from basic to enhanced services expands the potential role of alternative telecommunications suppliers. Least-cost provision of enhanced services may involve dramatically different industry structures--which in turn requires careful development of regulatory policies towards entry. As is argued later, ultimately, incentives for plant modernization and the introduction of new services by local exchange carriers hinge upon the nature of the regulatory contract--including risk-sharing mechanisms. There is no doubt that our historically vertically integrated national system is rapidly becoming a decentralized market with many new participants beyond the reach of present regulatory structures. The question is, what policies are appropriate for such a situation?

The last half of this study focuses on how specific types of regulation affect innovation. For example, cost allocation procedures inherited from previous eras can stymie the introduction of beneficial services. Similarly, quality of service regulation warrants a re-evaluation, as price caps (or other forms of incentive regulation) replace traditional rate of return regulation. Finally, we examine the diffusion of new telecommunications technologies: fiber optics and microprocessors change the incremental costs of communication channels and message switching. Changes in relative costs raise questions of pricing flexibility during what is likely to be a prolonged transition to a more decentralized market. Carrier of last resort obligations and private/public network interconnection further complicate the choice among regulatory policy options.

Given the potential gains to the economy as a whole from regulatory/deregulatory policies which encourage innovation, it is not clear that setting prices way above incremental costs for sophisticated telecommunications users is the best way to meet today's overall revenue requirements. The long run impact may be to induce uneconomic bypass which promotes neither efficiency nor fairness for core customers.<sup>1</sup> Some maintain that regulators are justified in allowing greater pricing flexibility--protecting core customers of basic service using price caps, while encouraging enhanced services. Others argue that a multivendor environment promotes innovation, so that limits need to be placed on rates and service offerings by local exchange companies.

While no one can accurately forecast how modern society will be transformed by advances in computers and communications, the post-AT&T divestiture era will continue to involve economic dislocation. Disentangling the politics from the economics of the situation may be impossible. Nevertheless, domestic industries will rise or fall, depending on the ability of labor and management to adapt to new opportunities. In a global economy, firms and individuals can abandon regions or nations that attempt to fight the tide of technology. Hopefully, an understanding of the forces at work will contribute to regulatory decisions which expand our production possibilities.

## **2. Innovation, Regulatory Policy, and the Achievement of Telecommunications Goals**

The fundamental rationale for economic regulation is the presence of a natural monopoly: a service is provided at the lowest cost when there is a single supplier. The capital-intensive nature of traditional local telephone service involves substantial scale economies--given the required investments in poles, wires, and switching systems. The need for rights of way also involves justifying investments in terms of public need and convenience. Price and entry regulation was established partly to protect

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<sup>1</sup>Phillips (1991) argues that regulatory and legal lags have stifled innovation and encouraged uneconomic bypass: "The institutional responses to new needs and opportunities have been too limited in scope, too late in coming, and too insensitive to the underlying problems." (p. 49)

consumers from monopoly power and from price instability stemming from so-called *destructive competition*. The latter is characterized by a cycle of inefficient (duplicative) entry, excessive capacity expansion, precipitous price reductions, negative profits for firms, quality-of-service deterioration, industry consolidation, and higher prices again. Such price instability makes planning difficult for consumers and suppliers.<sup>2</sup> The problems with monopoly--restricted output, excessive profits, and *undue* price discrimination--have resulted in intervention at the national and state levels.<sup>3</sup>

Of course, fairness can come into conflict with the goal of efficiency. For example, economic efficiency requires that (absent externalities) price equal marginal cost. Regulators might set price greatly above incremental cost in one market, and just slightly above incremental cost in another in order to achieve the broad social goal of universal service. Consumers in the first market bear the primary burden of covering shared costs--allowing the firm to cover its total costs. However, new technologies could make the first market susceptible to entry; for example, stand-alone costs could fall dramatically for serving the first market. Unless regulators are able to prevent entry (or self-production), the price structure predicated on achieving fairness may not be sustainable. In addition, innovations which reduced economies of scale or scope could negate the natural monopoly justification for regulation. This is precisely what has happened in the toll (long distance) market; the possibility of enhanced services for local exchange customers raises similar questions regarding the optimal industry configuration (Zajac, 1990).

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<sup>2</sup> Note, however, that concern over such instability is generally voiced by incumbent suppliers who seek "protection" from new entrants. Alleged gains to consumers can be lost if regulation only cartelizes the industry, raising the costs of doing business and dampening incentives for innovation.

<sup>3</sup> Undue price discrimination is another term subject to problems of definition. Under some demand and cost circumstances, a uniform price will not cover costs, while different prices to different customer groups allows the firm to break even. Differential prices are clearly to be preferred in such situations. In addition, preferential treatment of a customer group can lead to deviations from Ramsey pricing--price discrimination which minimizes (unweighted) misallocations. "From the economic viewpoint..., undue price discrimination occurs when the efficiency cost of achieving a particular degree of preference becomes too high. Precisely when discrimination becomes unacceptable cannot be answered by the analysts." (Henderson and Burns, 1989) For a comprehensive economic and legal analysis of undue discrimination see Henderson and Burns (1989).

## **2.1 Toll, Basic, and Enhanced Service**

The changing technologies of telecommunications raise numerous pricing issues. Prior to the advent of competition in customer premise equipment (CPE) and to the deregulation of inside wiring, such investments (plus components of the local loop) comprised part of a telco's "non-traffic sensitive" (NTS) plant and equipment. Although the assignment of costs to local, intrastate, and interstate jurisdictions has historically been a political process, competition and divestiture have altered traditional allocations. Past cost allocation procedures have had a veneer of rationality to them, but the process, codified in separations and settlements procedures, had resulted in almost thirty-four percent of local exchange costs being covered by transfers from toll customers.

The cost allocation formula changed over the years, transferring some of the efficiency savings in long distance technology to local callers. In late 1984, the Joint Board (representing state commissions) and the FCC agreed to cap the allocation to jointly-used NTS local loop plant at twenty-five percent--phasing in the reduction over eight years, beginning in 1986. A carrier common line charge (CCLC) now provides the vehicle for collecting revenues from toll usage. In addition, there is a line termination charge (covering the interstate portion of the cost of terminating a local loop in the central office), a charge for the provision of intercept service, and a local transport charge for covering the costs assigned to transporting the call from the local exchange switch to the inter-exchange carrier's (IXC's) "point of presence" (POP). Determining these costs can be almost as problematic as the previous NTS cost allocations, although there is greater effort to identify cost-causation than in the past.

Kahn (1987) reports that about eleven billion dollars per year was transferred from interstate and intrastate toll callers to local exchanges in the mid-1980's. Over time, these transfers helped the real price of local service decline in real terms fifty-five percent between 1940 and 1980. These price declines and real income growth led to a dramatic increase of household telephone penetration in

this period (from thirty-seven percent to over ninety-two percent, Kahn, 1987, p. 195). Many state regulators fear that the reduction in the contribution from long distance will hurt states (and localities) with higher NTS costs of service.

We should note that the term "subsidy" is used too freely when characterizing the process of requiring long distance calls to contribute to covering a "fair share" of the NTS costs of providing access to the local exchange. Kahn and Shew (1987, p. 195) and others are hesitant to view the transfers of funds from long distance carriers to local exchange companies as subsidies in the technical sense of the term.<sup>4</sup> Prior to recent technological advances, most long distance callers were not paying more than the stand-alone costs of serving them. However, most analysts would agree that the higher long distance prices necessitated by such cost allocations have resulted in inefficiencies since toll prices greatly exceeded incremental costs.

As plain old telephone service (POTS) is augmented by pretty amazing new services (PANS), there is some concern that the nation will be split into the information haves and have-nots. If this scenario comes to pass, the goal of extending enhanced services to citizens will have been frustrated by national (and state) regulatory policies. Of course, for this concern to have validity, we need a better understanding of the underlying issue: who the "poor" are and whether proposed policies target the problem in a cost-effective way. As Myrick (1984) states, "What is needed is the coordination of action and research so that the term 'information poor' becomes a useful construct and not just a confused slogan," (p. 342).

In the past, state and national regulatory agencies were concerned with access to basic telephone service by the poor. One of the primary objectives of national telecommunications policy

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<sup>4</sup> If a set of services is priced at less than incremental cost, they must be subsidized by other services if the firm is to cover its costs. Alternatively, if a service (or group of services) is priced so that revenues exceed stand-alone cost, then that service (or group) is subsidizing other services. These points were raised by Faulhaber (1975) and have been applied to telecommunications by Larson (1989) and Berg and Weisman (1991). Recently, Gabel (1991) calculated the stand-alone and incremental costs for Michigan Bell. He found "...that toll service is not subsidizing local exchange services; on the contrary, the new enhanced services are the greatest beneficiaries from participation in the common exchange network." (p. 75)

has been to ensure universal basic voice telephone service. Now that new services have been developed, does the definition of universal service change? Extension to enhanced services is partly a matter of timing and partly a matter of price. However, one can question whether it is socially cost-effective for the poor to have access to sophisticated services without access to quality education, housing, or good nutrition.

One example of dramatic technological change that has not by-passed low-income consumers is the videocassette revolution. Recorders allow consumers flexibility in the timing of viewing--for entertainment and education. There has been a dramatic number of entrants by stores with movie inventories: from large chains specializing in videocassettes to independent service stations adding another service to their expanding product line. No government agency had to mandate this transformation. Market developments and competitive pressures expanded the home entertainment opportunities available to citizens. An interesting commentary on the *Information Age* is that more videocassettes were rented last year than books loaned by free public libraries. Who would have predicted this a decade ago?

Such technological diffusion was not planned by government nor subsidized by particular customer groups. Of course, it is not clear what lessons can be drawn from the VCR revolution. Enhanced telecommunications services may not be similar--from the standpoint of income distributional concerns, rural/urban splits, or access to new services (including telephone-based home diagnostic medical systems). Nevertheless, the VCR example does illustrate how demand for new services calls forth a supply--complete with niche suppliers, dominant firms (like Blockbusters), and vertical distribution chains, including complementary inputs. In the case of telephony, some policy options presented to the U.S. Congress (1990) by the Office of Technology Assessment emphasize equitable access to enhanced services and increased government funding for low income and disadvantaged consumers. However, a national focus on universal enhanced service could actually

delay ultimate achievement of that goal.

The issue of enhanced services can be addressed in the context of incentives for innovation. Local exchange companies will be unwilling to invest in facilities which generate low returns--particularly in an era of increasing competitive pressures. What kinds of incentives do regulators have at their disposal? First, enhanced services can be mandated statewide. However, if uniform pricing is adopted, the high density/high volume customers will probably be covering some of the costs of low density/low volume customers. In the long run, alternative suppliers may "skim the cream" and attract demanders whose cost of service is relatively low, but whose prices have been set high in order to obtain funds for less profitable investments. Such developments would deter innovative activity by incumbent LECs.

State approaches are constrained by Judge Greene's decrees, although rate of return bands and price caps for basic service are two mechanisms used to share the gains from introducing new services and to protect core customers from bearing risks associated with diversification activity. It is still not clear that such mechanisms will, in the absence of greater leniency, lead to innovations in information services by incumbents. Of course, if economies of scope and network externalities are minimal, other firms will take up the slack.

## **2.2 Multiple Suppliers and the Encouragement of Innovations**

Potential entrants can also promote technological change. Historically, vertically integrated AT&T was the driving force behind telecommunications innovations (Noll, 1987). For example, Bell Lab's annual budget rose from half a billion in 1971 to over two billion in 1982. Although R&D performance in the post-divestiture world is still being evaluated, Noll concludes that no major changes have occurred as a result of the Bell break-up. However, AT&T Bell Labs may be tilting away from basic research as it focuses on short term development projects. Greater secrecy and an

emphasis on proprietary information are both likely to characterize Bell Labs in the future.

Bell Communications Research, Inc. (Bellcore) was formed to meet the common research, development, and engineering needs of the seven Regional Holding Companies (RHCs): "Bellcore supplies such technical services to the RHCs as software development for the automation of operations, maintenance, service provisioning, engineering and planning; network planning and standards proposals; generic requirements for new equipment; vendor product analysis; and applications for new technology." (Noll, 1987, p. 174). Depending on the lines of business the RHCs are allowed to enter, Bellcore could face great internal pressures as the various companies adopt business strategies that put them into conflict with one another.

The other key players include the many computer and telecommunications firms that have expanded their operations in the market. Alliances (IBM/MCI) and mergers (AT&T/NCR) have characterized the industry. The plus side of these developments is that multiple centers of initiative promote diverse approaches to new technologies. While the demands for new services are difficult to predict, the presence of competitive suppliers can speed the exploitation of new technological and commercial opportunities. Creative applications of new technologies is stimulated by the presence of entrepreneurs looking for new ways to do things, and new things to do. Perhaps even more important is the identification of new markets -- as with the development of "800" Service. As Faulhaber (1991) noted, "Perhaps it is the marketeers and not the 'men in the white coats' who will be the principal source of innovation in the coming decades." (p. 425).

Running counter to these gains to competition are the possible negative impacts of lost economies of scope by LECs when entrants capture market share from incumbents. In addition, historically, unitary control permitted technical standards to be developed by a single supplier. No one can say for sure whether divestiture has decreased innovation or decreased compatibility in the telecommunications industry. However, most would agree that it has not reduced the pace of

technological advance. How the pattern of change will affect the low versus high volume customers is another issue. Large customers, in particular, are in a position to shift business to entrants on the basis of price, quality, or new services.<sup>5</sup>

### **3. Alternative and Enhanced Service Providers**

The discussion of innovation underscores the potential importance of alternative service providers in the changing telecommunications industry. Innovations in computing and communications have altered the possible network configurations available to users. Large, sophisticated users have responded by substituting for portions of the locally-provided telecommunications system when their own costs are below regulated rates or when specialized needs warrant firm-specific investments. Alternative service providers have entered niches created by new technologies.

#### **3.1 Access Vendors, PBXs, STS**

First, we need to define the services provided by new players in the telecommunications industry. Alternative access vendors create networks which allow a company to offer carriers and end users (primarily business and government) direct connection to a long distance interexchange carrier (IXC). Such connections can support a wide range of services, including dedicated Wide Area Telecommunications Service (WATS), private lines (voice grade, or analogue or digital data), and video. Potential new services could require greater bandwidth capacity than might be available on the local network. These alternatives to the local exchange company can cut into its sales.

Other services provided by new entrants also compete with those provided by incumbent local exchange companies. A private branch exchange (PBX) is essentially a small telephone office--

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<sup>5</sup>Phillips (1991, p. 80-81) argues that current prohibitions have not harmed large businesses and high-income customers. However, he believes that the benefits of new technologies are not trickling down to others.

manually operated or automated. PBXs provide connections within a business complex and provide access to the public network. Such systems substitute for local exchange services. Similarly, alternative operator services can be hired by units that aggregate demands--hotels, airports, or government agencies.

Another example of alternative service providers is shared tenant services (STS). Tenants within a commercial building can obtain telephone service through shared switching and/or billing arrangements. Such demand aggregation can reduce the number of lines needed to connect to the local loop. Furthermore, long distance rates can be reduced through demand aggregation. Such possibilities affect the revenues of local and long distance carriers. Finally, so-called smart buildings centralize controls (water, gas, and electric meters, alarm systems, and comfort controls) so that telemetering becomes feasible.

Enhanced service providers (ESPs) are LEC customers who provide information services or other value-added functions, often drawing upon LEC network features. However, thanks to Judge Greene and regulatory policy, such features need to be accessible to users at unbundled prices. While this allows end users, IXCs, and ESPs to utilize features in a cost-effective manner, it also could make the price offerings of a natural monopolist unsustainable.

### **3.2 Regulatory Responses to Potential Entry**

The existence of alternative and enhanced service providers can create tensions between regulators, suppliers and customers. Additional regulatory problems arise to the extent that local exchanges lose revenues. However, some of the services are truly new--and do not displace current uses. In fact, some services increase the value of the local network to groups of subscribers, which potentially increases what can be charged to those customers. The key point is that local exchange prices for services that are available from alternative suppliers must track costs. In addition, prices

for network features need to be carefully determined. In the past, cost allocation concepts like fully distributed costs (FDC) were used to establish revenue requirements for various services. Now, potential entry (including self-production) is a threat to incumbents. Regulatory costing and pricing procedures will affect the ability of LECs to respond to competitive pressures. Note that incremental costs are the correct measure of resources going into the production of new services, so these (not FDC) provide the basis for efficient pricing.<sup>6</sup>

It is important that we understand how the regulatory environment promotes or restricts these new offerings. If a service has become competitive, it is not clear that tight regulation will be able to protect LECs--especially if they are not least-cost suppliers. Furthermore, regulation which does not promote innovations (such as new network features) and cost reductions is not fulfilling its obligation to the public. The issue is how to encourage innovative service offerings by new entrants without the LEC losing potential economies of scope. The FCC's push for Open Network Architecture (ONA) and Comparably Efficient Interconnection (CEI) reflects the viewpoint that consumers can benefit from enhanced service offerings by LECs and their competitors.<sup>7</sup> These raise more questions: whether the resulting prices will be sustainable and the playing field is truly "level."

Given the dramatic changes in telecommunications technology in recent decade, we need to be aware of parallel changes in regulatory policies. The pre-and post-divestiture industry structure and corporate behavior look very different from one another. Most economists would agree that the issues we are facing would have emerged whether or not AT&T had been broken up. The technological forces associated with fiber optics and digitization would still have been operating;

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<sup>6</sup> This point is developed in Berg-Weisman (1991b). For a comprehensive examination of costing issues see Pollard (1991).

<sup>7</sup>The FCC has required the regional companies to disaggregate network capabilities--reflected in the network architecture. ESPs can request the unbundling of specific services or technologies, so their offerings can build upon system elements: basic serving arrangements (BSAs), basic service elements (BSEs), complementary network services (CNSs) and ancillary services (ANSs). The latter include deregulated services like billing or collections, while the first three elements are inputs into the provision of the service itself. Basic service arrangements and complementary network services enable end to end access from the ESP to its customers, while basic service elements are features and functions associated with network software and switching. Clearly, the evolution of ONA will have a profound effect on entry conditions and industry performance. For a comprehensive overview of ONA issues, see Ganiere (1989).

telecommunications users would be pushing for rate re-structuring and new services to take advantage of these technological opportunities. However, to the extent that regulation has artificially restricted offerings by incumbents and maintained unsustainable price structures, the impact may have been to delay the introduction of new services and distort investments in R&D and facilities.

#### **4. Regulation, Innovation, and Diffusion**

What are the linkages between regulation and innovation? Regulatory lag has been viewed as one feature providing incentives for cost reduction, but new services generally required regulatory approval (Bailey, 1974). The process limited returns to risk-taking associated with new service development. Nevertheless, the industry experienced dramatic technological progress in recent decades. The rate of technological change can be identified by growth in total factor productivity advance. Of course, the changing mix of services means that weights for determining the overall rate of change need to be carefully identified: index number problems arise from changing weights. In addition, to facilitate analysis, the direction of technological change can be categorized several ways: impacts on economies of scale, scope, or sequence; whether the changes are capital or labor saving; or in terms of relative productivity advance in different telecommunications services (such as switching, transmission, or enhanced services). Such changes can affect the structure of the industry (as the optimal sizes and product mixes of firms change). They also affect optimal regulatory policies towards entry, pricing, returns, and service quality.

##### **4.1 Regulatory Incentives**

The nature of regulation affects incentives to develop and adopt new technologies. Some analysts believe that rate base regulation has led to the adoption of relatively capital-intensive technologies and the promotion of services based on more capital-intensive production processes (Averch and Johnson, 1962). From such a perspective, there may have been a bias towards labor-

saving innovations in the telephone industry if the allowed return on the rate base was greater than the actual cost of capital. However, the empirical support for the so-called Averch-Johnson (AJ) effect is mixed at best and the assumptions of the AJ model may not apply to telecommunications (Berg and Tschirhart, 1988, pp. 323-384). Some analysts have even suggested that characteristics of the telecommunications industry support undercapitalization (Albery and Sievers, 1988).

Regulators are still concerned with possible biases in the adoption of new technologies, although one could argue that other factors have had greater influence on the pattern of change. Historically, the separations and settlements process has affected the relative costs of modernizing different parts of the local network. Since a LEC's share of pooled NTS costs determined its share of the settlements pool, there could have been overinvestment in certain types of facilities (Grace, 1986). Recently, the desire to insulate themselves from competitive pressures may have lead LECs to invest in technologies which raise entry barriers or lower their own costs at strategic points in the network. However, there are no solid empirical studies supporting these theoretical hypotheses regarding the pace and pattern of innovation.

#### **4.2 Depreciation Practices and Modernization: Channel Capacity**

Consider the case of signal transmission. A communications channel provides a path between two or more points. Channels can be dedicated or switchable and can be classified in terms of the types of signals they are capable of carrying. Analog facilities accept a band of frequencies: narrowband (eg. 100 Hz, 200 Hz); voiceband (4 Khz); or broadband (eg. 48 Khz, 240 Khz). Broadband services are particularly appropriate for computer-to-computer transmission of data bases. Also, television broadcast requires broadband (Rey, 1984, p. 198). If digital signals are carried, the channel is described in terms of its "bit rate", from low speed (under 300 bits per second, bps) to high speed (over 9600 bps--9.6 kbps).

LECs must decide which investments in communications channels will be most cost-effective over the economic life of the alternatives. The expected net revenue stream will depend on demand and technological forecasting, and on how regulators treat transmission capacity investments that are not fully depreciated, but are economically obsolete--given the patterns of demand and cost of broadband facilities. The upgrade to broadband may be delayed if unused capacity is disallowed from the rate base. Of course, what is "used and useful" is a matter of regulatory policy.

The depreciation numbers illustrate the sheer size of the problem. In 1987, the FCC oversaw plant investment of nearly \$200 billion--\$177 billion owned by LECs and the remainder primarily owned by AT&T (Lawton, 1988, p. 30). The portion of this investment which was underdepreciated (relative to its true economic value) has been the subject to much debate. FCC estimates of depreciation reserve deficiencies ranged from \$21 billion in 1983 to \$13 billion in 1987. Industry estimates tended to be higher, as LECs argued that the rate base on which allowed returns were calculated was underdepreciated. The larger rate base resulted in greater revenue requirements. Competitive entry posed a threat, since the price LECs would have to charge to earn a fair return (and cover its costs) could invite bypass.

The links between depreciation practices and modernization are clear in theory, although there are few quantitative studies. In one study, Branch (1979) found that higher realized rates of return lead AT&T to make greater investments in plant modernization in the '60s and '70s. At the state level, regulatory commissions have adopted a wide range of approaches for dealing with the problem of depreciation reserve deficiencies and the allocation of network modernization costs.

Another aspect of depreciation practices has been identified by Egan (1991) as leading to inefficient investments patterns: "...regulations prevent LECs from creating sinking funds, so they may invest suboptimally because they must spend cash flow in the year received" (p. 130). Regulatory depreciation rates can result in a mismatch of cash flow and optimal modernization outlays. For

example, LECs may be unable to delay investments so as to adopt equipment which is expected to embody the next generation of new technology.

Thus, regulatory constraints enter via depreciation practices (which affect the timing of investments, revenue requirements and price levels). If additions to capacity pay for themselves, they would be made by unregulated firms. However, if past investments are disallowed from the rate base when modernized facilities make old facilities obsolete, regulated firms will not make socially beneficial investments in network modernization. In addition, the financial community will tend to interpret disallowances as a signal of asymmetric regulation. For regulators, such a policy is a "heads I win, tails you lose" approach to firms who make good (or lucky) decisions.

Asymmetric regulation lowers realized returns and raises the risks to investors. When investments prove to be cost effective, the regulated telco is allowed to earn a "fair" return, but when demand does not materialize, or an unanticipated technological development arises, regulators can disallow the investment (or drop the underdepreciated portion of the original cost from the rate base). If such a pattern emerges, the telco does not earn that "fair return" on average. Investors will be unwilling to provide the financial capital necessary for capacity additions. Such a development would deny (or at least delay) the potential benefits of advanced services to core customers. Non-core customers (technologically sophisticated business demanders) can create their own private networks--further reducing the likelihood that new services will become available to household demanders.

#### **4.3 Risks Associated with Modernization**

This problem of delayed modernization is partly due to increased real risks in the industry. Competitive pressures from cable and radio spectrum technologies place long-lived investments at risk. The old regulatory contract that insulated monopoly providers of local and long distance service

is no longer operative. Regulators are responding to the new situation. Across the nation, they are in the process of developing procedures for a partially competitive environment. For example, allowing regional holding companies to enter unregulated telecommunications markets is one way to encourage managers to identify services which will utilize local exchange facilities. However, many regulators (and policy analysts) are worried about allowing entry into nontraditional markets. Such entry raises issues of cross-subsidization, predation, and the diversion of managerial attention away from meeting the needs of core customers.

Given the rate and direction of technological change, and risks associated with new services, new production processes, and new markets, policy-makers face very difficult choices. To what extent can traditional rate base regulation promote the efficient delivery of new telecommunications services? Who is best suited to bear the risks associated with new service offerings--core customers or investors? Are cost historical allocation procedures adequate for dealing with the pricing problems facing telcos? Will price cap regulation promote cost reductions and the introduction of desired new services? Is it best to wait for customer perceptions to drive new investments ("demand-pull"), or should regulators encourage a "technology-push" approach to new services? Answers to these questions require careful policy analysis. Given the pace of technological change, prudent policies will encourage incumbents and entrants to explore alternative ways to meet customer needs.

## **5. Transformation of a Vertically Integrated National System**

Telecommunications systems are now comprised of many components. Interoperability is an important feature of components of such systems. Historically, AT&T provided unitary decision-making with respect to system design, service offerings, and technical features of the various system components; developments at one stage of the system had implications for other phases. The broad experience with technologies and markets meant that the uncertain outcomes of the research program

had a greater chance of being applied at some stage of the production process--from durable materials for wire jackets to new ways to store information. So end-to-end control had some advantages. Few would argue that telecommunications was not a dynamic industry when it was dominated by AT&T.

There are also limitations to vertical integration in a gigantic firm. Familiarity with existing production technologies may be analogous to wearing blinders. Dominant suppliers are unlikely to upset the status quo: they may prefer low risk projects that are narrow in scope. Such projects are unlikely to alter the existing market structure to any great extent. The numerous instances where major breakthroughs come from outside an industry testify to management's physical and psychological ties to existing technologies and products. Familiarity can breed contempt--for new ways of doing things. Or, it can breed indifference--to customer needs or to new technological opportunities: for example, AT&T did not have a Vice President for Marketing before the '70s. Customers got plain old telephone service--the black rotary dial instrument seemed to meet customer needs.

Even prior to divestiture, the vertically integrated system was being eroded. However, regulatory responses at the federal and state levels have differed. State regulatory commissions have tended to react negatively to change. As Manley Irwin (1986, p. 285) noted: "State public utilities commissions, which neither perceive nor acknowledge the imperatives of an information economy, have opposed virtually every attempt in the last twenty years to introduce diversity, change and pluralism into U.S. telecommunications." His Table 1 illustrates the pattern, based on policy statements from the National Association of Regulatory Utility Commissioners. Of course, not all states had the same thrusts, but state regulation, in general, could hardly be viewed as encouraging new entrants or expanding the discretion of regulated firms. State commissions wanted new technologies, but saw regulation as the mechanism for ensuring that all consumers shared in the cost

savings. The disruptive nature of technology was not to be celebrated by those who viewed their task as maintaining low prices for local users.

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**Table 1 - Regulatory Policy--NARUC  
State Regulatory Policy:  
National Association of Regulatory Utility Commissioners**

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<b>ISSUE</b>	<b>POSITION</b>	<b>REASON</b>
Carterfone	Opposition	Jurisdiction Preempted
Equipment Certification	Opposition	Jurisdiction Preempted
MCI	Opposition	Jurisdiction Preempted
Specialized Carrier	Opposition	Jurisdiction Preempted
Value-Added Carrier	Opposition	Jurisdiction Preempted
Line Sharing	Opposition	Jurisdiction Preempted
Cellular Radio	Opposition	Jurisdiction Preempted
Multipoint Distribution System	Opposition	Jurisdiction Preempted
Xerox's X-10	Opposition	Jurisdiction Preempted
Private Radio Interconnection	Opposition	Jurisdiction Preempted
Deregulation of Dominant Carriers	Opposition	Jurisdiction Preempted
One-Way Paging	Opposition	Jurisdiction Preempted
Competitive Equipment Procurement	Silent	Unstated

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Source: M. R. Irwin, *Telecommunications America: Markets without Boundaries*,  
(Westport, CT: Greenwood Press, 1984).

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As the examples of Nebraska and Vermont indicate, however, state commissions are beginning to take very different approaches to regulation in the post-divestiture era.<sup>8</sup> Perceptions of technological opportunities and regulatory limitations have changed in some jurisdictions. In a sense, we now have fifty laboratories--experimenting with different regulatory procedures. The outcomes of these experiments are as yet to be determined. In fact, a sort of Social Heisenberg Effect may be at work. Various stakeholders know they are being observed--which affects their behavior. It is hard

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<sup>8</sup>Teske (1991) has analyzed state choices regarding prices and entry using an empirical cross-section study and case studies. He finds that interest groups and institutional variables affect state policies. More innovative state commissions tend to be better funded and are often more insulated from political pressures.

to disentangle the effects of regulatory policies specific to one state from impacts on neighboring jurisdictions.

At the national level, the FCC has tended to promote greater competition in telecommunications. For example, meeting the needs of new entrants was addressed in the Computer Inquiry III which required Comparably Efficient Interconnection (CEI): the regional operating companies were required to unbundle and separately price the functions and interfaces required for each enhanced service. However, to provide long distance carriers with equal access, software and equipment upgrades were necessary. The mandated introduction of programmable switches complements other modernization programs at the level of the LEC.

The ONA requirements of Computer III provided a further spur to modernization. Telcos are in the process of reconfiguring networks to make individual network components available to ESPs. However, the introduction of sophisticated digital switching technology has two other impacts which complicate traditional regulation: nontraffic sensitive (NTS) costs rise as a proportion of total costs and the interaction of multiple functions raises complicated cost allocation issues.

## **6. Types of Regulation Affecting Innovation**

Given the importance of continued innovation for industry performance, regulators must address a number of issues: cost allocation, quality of service, entry, and potential introduction of price caps. The resolution of each issue will affect incentives for innovation in the future. To these issues we turn.

### **6.1 Cost Allocation Regulation: from Separations and Settlements to Residual Pricing**

The problem of cost allocation is a key issue for capital-intensive industries which serve different customer groups or produce services using shared inputs. Currently, exchange carrier cost categories are separated into intrastate or interstate jurisdictions. At the local level, some state commissions are

trying to convince the FCC that its decisions to unbundle basic service may lead to a mismatch of revenues and costs between interstate and intrastate jurisdictions. Depending on how the FCC chooses to price interstate basic service elements, however, local callers may face price hikes to cover allocated costs. The arbitrary nature of NTS cost allocation formulae and fully distributed cost procedures has been noted already. Clearly, inappropriate cost allocation rules can yield inefficient price signals, unfairly burdening particular customers.

The problem is particularly difficult for pricing new products. Two intertemporal factors suggest that typical regulatory practice may be quite inappropriate: when there are customer "demonstration effects" on the demand side and "learning curve" effects on the firm's cost function (Faulhaber and Boyd, 1989). Both can be illustrated fairly easily. One way people become familiar with the capabilities of new technologies is by observing how their cohorts benefit from a new service. Some people will wait--observing how others utilize some new service. Such diffusion models characterize new service penetration patterns. In addition, some new services are valued on the basis of number in the network: having a fax machine is much more useful if many others have compatible equipment. Thus, over time, there is a demonstration effect and a network externality effect that both cause future demand to be a function of current consumption levels. A high price during the early phase of a service life cycle can ensure that the new service is nonremunerative.

The production learning curve is another well documented phenomenon. Longer production runs in earlier periods promote learning which tends to lower costs in later periods. Such intertemporal production interdependencies imply that a simplistic intertemporal cost allocation scheme can doom a new service. Regulators could reduce the rate of new product development and introduction if the demand and cost interdependencies noted here are ignored in favor of, say allocating start-up costs to the initial period's revenue requirements. Period-by-period cost recovery can be very detrimental to both telcos and consumers.

Of course, regulators are trying to protect rate-payers when they require particular time patterns of cost recovery. In addition, unregulated providers of substitute services will want to keep introductory rates high for their regulated counterparts. They will charge predation, or that other regulated services are providing cross-subsidies for the service in question. Excluding regulated firms from such markets could deny consumers lower prices, and deny investors maximum opportunities to take advantage of shared inputs. Some analysts call for "residual pricing" of core services, using revenues from new services (with market-based prices) to cover a portion of shared costs. However, the share covered by new services would not be based on some arbitrary "fully allocated cost," but on what the market dictates.

Regulators face extremely difficult policy choices in this area. Since incentives for innovation are central to encouraging the introduction of new service, it would be best to avoid arbitrary bans on services where there are genuine economies of scope. The provision of information services raises just this type of trade-off. Prohibiting the regulated LEC from participating in new markets may simplify a regulator's life, but it does not necessarily make economic sense.

## **6.2 Quality of Service Regulation**

Note that quality of service issues still warrant attention. Service regulation has involved setting service standards and monitoring them to assure compliance. So long as price is above marginal cost, the firm does have an incentive to enhance quality which expands demand (Brennan, 1989). However, the quality improvements associated with network modernization are likely to be valued differently by different customer classes, and those valuations will change over time as residential subscribers become familiar with new services. Quality regulation is made more complicated by enhanced services.

Even basic service involves many dimensions of quality. Measuring quality and estimating its

effects on costs and demands represent difficult tasks for engineers, economists, and psychologists. For example, the Florida PSC evaluates local telephone companies on the basis of dial tone delay, call completions, meeting telephone installation appointments and thirty-five other performance standards (Buzas, et. al. 1990).

In addition, telcos had been identified as natural monopolies: prior to the last few decades, they were protected from incursions by entrants. In exchange for giving up the exercise of monopoly power, utilities had franchises. However, new technologies have altered economic opportunities. The *Information Age* has caused a great erosion of protected markets--first telephones and attachments, then computer switching capabilities (PBX), and now long distance. Satellite communication, private microwave systems, fiber optics, cellular telephone, and other high technology alternatives potentially threaten the viability of the local exchange--particularly if telcos are not allowed pricing flexibility in response to competitive entry.<sup>9</sup>

Regulators and managers alike are trying to determine the least-cost mode of delivering services to homes, businesses, and governments. The optimal industry configuration seems to be a moving target. While no one is suggesting a return to the days of detailed administrative control of entry, prices, and returns, analysts are monitoring developments to ensure that components of our telecommunications infrastructure remain dynamic and accessible.

Regulatory policy is likely to be different from the past if affordability and innovation are to continue. Consequently, the role of the regulator will continue to adapt to changing conditions. Regulators must look for ways to encourage competitive forces and remove barriers to competition where feasible. Regulators will address complex cost allocation and depreciation issues affecting the price of competitive services. Given its critical position in the economy, the telecommunications

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<sup>9</sup> Egan (1991) provides an in-depth analysis of broadband network economics. he examines the demand for integrated services digital networks (ISDN) and the institutional constraints erected by the regulators, Congress, and the courts. While some observe a polarization of positions between telephone and cable television, Egan (1991, p. 158) argues that emerging patterns of cooperation has been the result of changes in corporate strategies and regulatory constraints affecting a universal broadband network.

industry is likely to become even more important to national economic performance.

The balancing act will continue: "At least within the local exchange company, services which are valuable and can be provided by the LEC at costs considerably below providing them through nonLEC alternatives will continue to exist. Services with those characteristics will include both the natural monopoly services based upon the location-specific advantages of the local loop and services for which the LEC has the benefit of economies associated with their provisioning of the local distribution system." (Lawton and Borrows, 1990, p. 111) Instead of regulators determining in advance which enhanced services have true cost complementarities with basic service, they may need to provide ways to let firms experiment with the introduction of new services--with price caps protecting core customers from cross-subsidizing the new services.

### **6.3 Price Cap and Incentive Regulation**

In a sense, price cap regulation is not new. It has been argued that price--rather than rate of return--regulation characterized the electric utility industry in the '50s and '60s (Joskow, 1974). Rapid demand growth allowed the achievement of greater scale economies, and technological change shifted the cost structure downwards. Under these economic conditions, regulators focused on price rather than rate of return. However, the version of price caps introduced by the FCC provides an explicit break from past practice in telecommunications.

In March 1989, the FCC issued an order imposing its price cap scheme on the operations of AT&T and issued a Further Notice of Proposed Rulemaking for application of the plan to the operations of the Bell operating companies. Their expectation is that price caps will provide more of an incentive for AT&T to lower operating costs in order to maximize their return on investment. Some states have also moved in this direction. In the quest for potentially higher returns, companies would also pursue innovative technologies and introduce new services for customers.

This alternative approach to regulation establishes a base period price (which initially is derived from the firm's own costs). That price changes over time based on inflation (reflecting changes in the prices of inputs), which is partially offset by projected increases in productivity. There can be many variations of price cap regulation depending on various factors: which input price index to use? how to forecast technological advances? how to alter the weights to be given various services? which services to include? However, the basic idea is to break the link between allowed revenues and the firm's own costs: cost savings beyond those allowed for by the productivity offset are retained by the firm. Investors may face greater risks, but the reward structure is now symmetrical.

Many economists support price caps as substitutes for rate base regulation. Braeutigam and Panzar (1989) conclude that ". . . rate-of-return regulation gives the firm incentives to misreport cost allocations, choose an inefficient technology (in some cases, undertake cost-reducing innovation in an inefficient way, underproduce in a noncore market, price below marginal cost in a competitive market which happens to be included in the set of core markets regulated by an aggregate rate-of-return constraint, and view diversification decisions inefficiently." (p. 390).

Their litany of negatives is not a total condemnation of traditional regulation, but their points suggest that alternatives can offer advantages from the standpoint of production efficiency, new product introduction, and cost reduction over time.<sup>10</sup> The administrative burdens of regulation will not disappear, but decision-makers ought to be able to focus directly on the policy issues of concern, rather than on detailed historical data which can clutter up regulatory proceedings--diverting attention from how utility activity affects industrial performance.

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<sup>10</sup> Cabral and Riordan (1991) also conclude that price cap regulation is superior to cost of service regulation from the standpoint of promoting innovation--so long as future price caps are not excessively low. Giving some pricing flexibility for noncore services also promotes innovation. Taylor, Zarkadas, and Zona (1991) analyzed the impacts of incentive regulation plans. They provide empirical support for these points: "Adoption of some form of incentive regulation, for a given year, is associated with an advance of approximately one year in the modernization of switching and transmission facilities, and approximately six months in the diffusion of ISDN and SS7 technology. Among the different types of incentive regulation, banded rate of return regulation and pricing flexibility are most strongly associated with increased modernization." (p. 1) Note that causation is complex; many state modernization plans were accelerated as the *quid pro quo* for the regulators' adopting incentive plans.

Braeutigam and Panzar (1989) show that, "... at least in principle, [price cap regulation] can induce the firm to minimize costs, produce efficiently in noncore markets, undertake cost-reducing innovation as an unregulated firm would, and diversify into a noncore market if and only if diversification is efficient. Incentives to misreport cost allocations and choose an inefficient technology simply disappear..." (p. 390). Such an endorsement must be tempered by a recognition of remaining implementation issues: What price levels are appropriate as a starting point? What is the role of multipart pricing in this process? Would the introduction of usage-sensitive prices be appropriate in some circumstances? What productivity index should be used to (partially) offset inflation adjustments? What items should be in the regulated bundle and what items should be essentially unregulated? What is the best regulatory lag before revisiting and evaluating the new regulatory mechanism?

Of course, regulatory oversight does not disappear under such a regime. Brennan (1991) identifies two problems: quality deterioration and bundling which promotes price discrimination. Quality of service must still be monitored for capped services. The argument is similar to the case of poor maintenance for an apartment under rent control. The second problem, discrimination against competitors in access to its regulated services, is addressed by ONA and CEI--but bundling (or defining) services may allow the LEC to exploit market power associated with bottleneck facilities. Regulators would need to address both issues.

In addition, special attention may need to be given to politically powerful consumer groups, with the firm's pricing discretion constrained vis a vis customers with few options. Whatever happens, the firm is still subject to potential re-regulation: regulators (and legislators) cannot pre-commit not to intervene again in the future. In fact, some sort of a re-evaluation and "true-up" after a given time period is often specified in negotiated price-cap agreement. Alternatively, a banded rate-of-return results in a share of the savings being passed on to core customers.

## **7. Technology Diffusion in Telecommunications**

Who wins and who loses under non-traditional regulation? The modernization of telecommunications facilities and the introduction of new services are most likely to benefit relatively sophisticated customers, primarily large businesses. However, the subsequent diffusion of technologies and services can occur rapidly, as production volumes enable lower costs and as consumers become aware of the advantages available through new technologies. For example, the microcomputer became the personal computer as individuals found nonbusiness applications for advanced microprocessing capabilities.

The case of telecommunications is complicated by the infrastructure nature of the investment needed to provide advanced capabilities. Even this point ought not be viewed as too constricting, however, since digital systems are, by definition, capable of interconnection (at some cost). Interoperability may require compatibility standards, but the transmission of zeros and ones provides a remarkable basis for ubiquitous availability of cost-effective services.

### **7.1 Timing and Deployment of Enhanced Services**

Of course, there are different high speed and high volume transmission requirements associated with voice, data, and video. Storage and retrieval capabilities will also affect the financial viability of new telecommunications and information services. However, technological change can be expected to continue to relax the technical constraints. The fundamental technology adoption issues might be more closely linked to issues of privacy, customer preferences (affected by education, job requirements, and time constraints), and the incomes of various consumer groups. Such issues also depend on the nature of regulation and role of competition in the provision of new services.

Two fundamental regulatory issues have been identified by Lawton and Borrows (1990, p. 77):

- (1) Is access for advanced communications services desired through the segment of the public switched network?
- (2) Does the public switched network (or segment) have the facilities necessary to provide access to advanced communications services.

"Yes" answers to both questions leads to the issue of who pays. Presumably beneficiaries should bear the costs. If the answers to both questions are "no", then demand and deployment can be monitored, but no regulatory initiatives are called for. For the other two cases, regulators must determine why deployment is too rapid or too slow. Ubiquitous provision of advanced capabilities only makes economic sense if business (and residential) valuations warrant the investments. Since it may be impossible to know these valuations in advance, the regulatory problem becomes one of risk allocation.

The cost and availability of high tech services raises important issues. However, the key point is that first users will be paying premiums for these technologies. At some point (possibly with a politically unacceptable delay) the technology, data base, or enhanced service offering will be available to most segments of the population. From the standpoint of efficiency, delayed introduction to the residential market is to be expected. However, the full benefits of the *Information Age* will not be denied citizens for an extended period. The same types of penetration patterns that have resulted in virtually universal basic service will push enhanced services to residences. However, past systems of financial transfers are unavailable. Public policymakers could choose to accelerate the pace of telecommunications modernization, but they should consider possible benefits from alternative uses of direct telecommunications subsidies, such as additional funding for education or low income housing.

## **7.2 Competition in the Local Exchange: Channels and Switching**

How insulated are LEC finances from competitive pressures? We know that many bypass technologies exist. It is interesting to note, however, that technological change has induced both decentralization and centralization in the industry. Telecommunications networks could be characterized as having two primary components: lines (or channels) and switching nodes. Innovations in switching technology have promoted decentralization: PBXs and Key Systems allow businesses to utilize fewer local lines. Large users are less dependent on the LEC for telecommunications services because of such capabilities (Lawton, 1988, p. 19). The demand for centrally provided utility switching services is reduced.

On the other hand, developments in glass fiber run counter to the decentralizing tendency of remote digital switching. The scale economies associated with fiber optics support centralization of service provision. The data transmission carrying capacity of this wire-based technology far exceed the demands of most users. Fiber is becoming the backbone of many cable systems and serves the trunking needs of LECs. A glass cable network appears to be a natural monopoly--particularly with regards to the last one-hundred feet. Path length becomes less important as network intelligence permits a range of route configurations.

Also, innovations in radio spectrum-using technologies could displace wire-based channels. These changes could promote centralization (utility provision) or decentralization (competition), depending on the capital intensity of the technologies. Microwave and satellite channels have tended to facilitate entry, but cellular radio is relatively capital intensive. Forecasts are not difficult to make--but they are generally difficult to justify.

## **8. Rate Design and Financial Viability**

Closely related to incentives for innovation are the rate design philosophies adopted by firms

and regulators. The issues outlined here should not be taken as the only ones relevant to the financial viability of LECs or to incentives for modernization. However, they illustrate the types of issues facing state commissions. The four issues are pricing flexibility, telecommunications costs and pricing structures, carrier of last resort obligations, and the interconnection of private and public networks.

### **8.1 Pricing Flexibility**

Pricing flexibility applies to a wide range of telephone company activity--in both regulated and unregulated services. In particular, the degree of market discipline is difficult to estimate in the area of new services. Potential competitors will want to see telephone companies offering competitive services at high prices, while providing complementary services (such as access) at low prices. Sorting through these issues will require the careful development of appropriate measures of the need for pricing flexibility.

Regulators have been uncomfortable with providing utilities with discretion. How are firms to be held accountable for their actions? What cost allocations are implicit in the final mix of prices? Are projected or actual outputs the better weights to determine these implied allocations of shared costs? Are incremental costs as price floors adequate protection against undue discrimination and predatory pricing? It is clear that regulatory analysts and their utility counterparts are going to need substantial technical training if policy issues are going to be resolved in ways that promote efficiency.

### **8.2 Telecommunications Costs and Pricing Structures**

Telecommunications costing methodologies have implications for pricing structures. The movement towards cost-based prices in telecommunications introduces a number of regulatory dilemmas--long-run vs. short-run considerations, access (or option) costs vs. usage costs, network modernization for new services vs. costs associated with universal service. Regulators will not "solve"

these dilemmas in the near future, but their resolution has consequences for alternative regulatory approaches to rate design.

We have already noted how time patterns of cost recovery affect the prices of new services. Modernization is an expensive process, with much of the demand appearing in the later part of the product life cycle. Thus, short run opportunity costs will tend to be extremely low, particularly given the importance of NTS costs. Firms must have forecasts of future demands, but these demands may be unrealized. Regulators will have to find ways to provide firms with pricing flexibility for new services, while avoiding cross-subsidization by demanders of basic service.

### **8.3 Carrier of Last Resort Obligations**

The existence of non-compensatory pricing by a carrier of last resort raises additional issues in a partially competitive marketplace. The obligation to serve has been a traditional regulatory requirement, with the quid pro quo being entry restrictions which prevented what was perceived as "uneconomic by-pass" (or cream-skimming). Given the emergence of alternative access providers and private network operators, continued back-up (or default) responsibility raises tough issues for regulated local operating companies (Weisman, 1988). It is important that policy-makers develop pricing principles which are consistent with regulatory goals, lest customers with few options be left with significant financial burdens.

Creating ways to charge for "option demand" or backup capabilities could involve some bundling of services. Alternatively, self-selecting multipart tariffs could be utilized to identify groups with different valuations for the service. Such options conflict with cost-based pricing on the surface. But they may reflect the true opportunity costs of serving different types of customers. It is inefficient to offer free stand-by service for customers who have by-passed the LEC. It is also inequitable since it represents an insurance policy which is paid for other customers. Weisman (1990) argues that

"...LECs are thus presented with a twofold opportunity--they are positioned to play a major role in the emerging market for faultless networks on the one hand, and to discourage economically inefficient bypass of their own network services on the other." (p. 341)

#### **8.4 Interconnection of Private and Public Networks**

The last issue, interconnection of private and public networks, raises concern over access to information services by the general telephone subscriber. This area raises a number of complex regulatory questions currently addressed under ONA and incentives for the introduction of new services. For example, the provision of gateway services will affect the diffusion of information services. What are the formats and protocols for an initial catalogue of services? How regulators respond will be important to the economic vitality of local exchange companies.

Changes in switching technology and in transmission capabilities would seem to preclude a return to the style of regulation that seemed appropriate in the 1950s. No one seriously calls for such a dramatic policy reversal. Telecommunications has come of age, and consumers face options that would have been unavailable in a vertically integrated network. Despite the jurisdictional issues which arise in the context of ONA, new investments in intelligent digital switching will open up opportunities for potential suppliers to provide enhanced services. The question is whether current national and state regulations will promote network modernization at an appropriate pace.

#### **9. Concluding Observations**

Eventually, the national telecommunications system seems likely to be based on fiber optics and digitized signals. We know that broadband systems can carry much more information than paired wires. Pieces of the system may well be radio spectrum-based for rural areas. In addition, it is not premature to speculate on whether telcos are likely to be in the cable television and/or database services businesses in the near future. Given their technological capabilities, we are likely to witness

the transformation of telephone companies into broadband service companies. Nevertheless, the outlines of common carrier/content split are likely to continue. Whatever the organizational form, every phone customer becomes a potential customer for additional services. Just as we do not now regulate what can be plugged into electrical outlets, we will probably not attempt to constrain the uses of our future information system.

Deregulation is partly a response to the conviction that the pattern of innovation is best determined by responses to economic rather than political forces. Efficiency, as reflected in commercial and technological opportunities, drives technology change. However, equity is also relevant. Given the social importance of developments in telecommunications, policy-makers must continue to monitor the situation so that captive or technologically unsophisticated customers are not harmed by new developments.

Throughout this survey of regulatory structures and the deployment of information technologies, issues warranting further analysis have been identified: the likely costs (and performance characteristics) of different technologies, the best regulatory policies for promoting innovation, the timing of the introduction of new services to commercial and residential users, and the best organizational structures for responding to new technological opportunities. Our state and national goals are diverse and sometimes in conflict with one another. Developing mechanisms for identifying the true opportunity costs of alternative policies is probably the most important task facing our political and social institutions today. In particular, the journalists and policy-makers who frame public policy questions have enormous power: perceived "problems" can be framed in such a way that a narrow set of "solutions" come to mind. When the issues are as complex as those in telecommunications, we need to examine a much wider set of policy options.

Ours is a nation of numerous constituencies. We have conflicting policies in many arenas either because we lack consensus on which objective is more important, or because the fundamental linkages

between policies and objectives are not fully understood. The possibility of deploying new information technologies in telecommunications is a case in point. Plant modernization, the introduction of new communication services, and rate designs which reflect opportunity costs all affect economic performance. The purpose of this study has been to underscore the need for re-thinking traditional rate of return regulation. New technologies and competitive entry require new approaches to telecommunications regulation.

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