1 Interconnection as the Key to the Network of Networks

1.1 Breakdown of the Centralized Network and Emergence of the Network of Networks

This book is about the transformation of telecommunications from national network monopolies to a new system, the *network of networks,* and about the glue that holds it together, *interconnection.*

We find that control over interconnection was used by governments for very different purposes in different stages of telecommunications. Initially, to establish monopoly; then, since the late 1960s, to open markets to competition; and most recently, to control the emerging telecommunications markets.

For more than a century, telecommunications around the world followed a classic model: a national monopoly owned or controlled by the state, centrally managed and providing a common public network. By their very nature and tradition, these networks provide a small number of standardized and nationwide services, carefully planned, methodically executed, and universally distributed. But over the past two decades, first in the United States and subsequently in much of the developed world, the forces of centrifugalism began to unravel this traditional system. The driving force behind the restructuring of telecommunications was the shift toward an information-based economy, which resulted in the rapid growth and reliability of telecommunications as the medium for the electronic transmission of information. Especially for large organizations, the price, control, security, and reliability of telecommunications became variables requiring organized attention. In a series of steps, each controversial and painful, monopoly began to give way to the "network of networks," as a foundation to today's diverse telecommunications and Internet infrastructure.

Because several of the changes in telecommunications policy originated in the United States, they were often viewed as the product of particularly American business interests, wrapped in a laissez-faire economic ideology. But subsequently other industrialized countries began to adopt similar policies. Japan opened markets to competition entry and reorganized its major carrier, Nippon Telephone and Telegraph (NTT). Europeans, following the UK's lead, privatized and liberalized communications. A global trade agreement was reached under the aegis of the World Trade Organization. These developments demonstrate that change has explanations more fundamental than the nature of the respective governments in power. Of course, there are unique aspects to each country and they will keep national telecommunications system distinct. However, the variations should not obscure central themes that repeat themselves elsewhere.

For many years, the conventional scenario for the evolution of telecommunications, offered by the traditional state monopoly carriers as their vision of the future, had been the *integrated single superpipe,* merging all communications infrastructure into a single conduit controlled by themselves and interconnected internationally with similar territorially exclusive superpipes. This scenario of integration took no account of the organizational centrifugalism that was taking place at the same time. Instead of consolidating, the network environment kept diversifying, in both infrastructure and network applications, as illustrated by the Internet backbone system. Take, for example, local transmission, once widely considered to be a natural monopoly. Yet today we can identify a wide variety of rival participants in rival local transmission: fiber-based metropolitan area networks, cable television providers, wireless fixed and mobile carriers, electric utilities, computer local area networks, long-distance companies extending their distribution plant, and other local exchange companies crossing territorial borders and invading each other's turf. On top of the physical carriers, there are resellers, integrators, DSL providers, and Internet service providers. Similar lists can be made for all other segments of the network, whether they are domestic, long-distance, international, mobile, or Internet backbones.

As these dynamics unfold, the centralized monopoly network system is being replaced by a *network of networks.* Telecommunications have emerged as a system of great institutional complexity. At present, the focus of attention is on restrictions—technological, regulatory, political, and financial. Yet in the developed world, the day is ap-

proaching, historically speaking, when many of capacity bottlenecks will be overcome; when entry by various service providers is wide open; when wireless carriers fill in the white spots in the map of telecommunications ubiquity; when global carriers operate widely beyond their home territory; and when Internet providers operate with full transparency as to the underlying carrier. In such an environment, what market structure can we expect? And what regulatory environment need we erect?

The tension between the convergent forces of technology and the centrifugal forces of business competition is most pronounced on the front where they intersect: the rules of interconnection of the multiple hardware and software sub-networks and their access into the integrated whole. As various discrete networks grow, they must interoperate in terms of technical standards, protocols, and boundaries. In the networks of networks, their *interconnection* becomes critical. Control of interconnection by any entity, whether by government or by a private firms, is the key to the control of the telecommunications system and its market structure.

The regulation of interconnection is therefore becoming the paramount tool of government into the reasonably foreseeable future, replacing the regulation of telecommunications retail pricing, the rate of return, or competitors' entry. It provides government with a tool for extensive micromanagement of markets. Based on trends of recent years, such powers will be exercised and expanded.

The most traditional form of interconnection has been what might be called *parallel* or *cooperative* interconnection. In such arrangement, carriers that dominate their territory link up with carriers similarly dominant in other regions. Their relation is that of partners and joint maximizers, and each partner depends on the other for some services. This relationship still characterizes international telecommunications. Because of its cooperative advantages, interconnections issues rarely become a problem, except when the partnership becomes too oligopolistic in behavior, such as fixing prices and excluding others. This type of interconnection is in the process of a breakup, and the dynamics of change, and the emerging new patterns are important to observe.

The second classic interconnection arrangement can be characterized as *vertical,* between a provider that possesses a bottleneck facility in one stage of the transmission chain and another provider that requires use of the bottleneck in order to provide service. An example would be a long-distance company interconnecting into a local exchange carrier.

This type of interconnection has been contentious since the early days of telecommunications. It has been studied and analyzed over the years. However, new permutations continuously arise, associated with different arrangements as the use of telecommunications has expanded enormously. For example, the interconnection by Internet service providers into cable TV and of fixed into mobile networks raises a whole range of questions that are partly familiar and partly entirely new.

More recently a third type of arrangement has been taking center stage, that of a *horizontal* interconnection, in which competitors for the same markets and customers link up with each other. One example is that of incumbent and new local phone companies. (Here the vertical element is also strong.) Another example is the peering of Internet backbone providers (with strong vertical as well as parallel elements). It would be incorrect to characterize this type of interconnection as new. It existed from the beginning of telecommunications networks. But in the past it was suppressed by the stronger of the two parties, with the support of the government in return for the fulfillment of a number of social obligations of redistribution. More recently, with a focus on efficiency, governments have enabled and even enforced the emergence of such horizontal interconnection.

In the real world of a network of networks, most interconnection arrangements combine elements of all three approaches, and will be thus discussed.

The term "interconnection" covers a wide matrix of relations. On the physical level of transmission *conduits* they include linkages within and among various types of entities and industries:

- Incumbent and new local telephone companies
- Traditional and competing long-distance carriers
- Mobile and radio carriers, including their access to spectrum
- Domestic and international carriers
- Internet backbones
- Dedicated "private" networks of organizations and user groups
- Computer local area and wide area networks
- Telephone, computer, and video equipment
- Cable television, satellite, and broadcast networks

On the higher levels of *applications* and *content*, interconnection becomes an issue of access and interoperability for entities such as:

- Internet service providers
- Enhanced (value-added) service providers
- Video program channels and information providers

On a *geographic* level, interconnection issues cross boundaries and involve many carriers, service providers, and national policy makers.

Given the multitude of entities, their points of intersection are even more numerous and growing, and so is the number of disputes and issues—technical, financial, operational, regulatory, international, and contentwise. Their common thread is the transfer of information streams from network facilities of one communications entity to those of another. This we call *interconnection,* and it is the focus of this book. The term *access* is also often used by many people for the same or related transfer of information streams. But it tends to be used in haphazard fashion, for example for the interconnection into local telecom networks, for the connectivity of users to networks in general, for the flow of information as opposed to connectivity of hardware, or for the actual use of another network once interconnection is achieved. In some cases, there are regulatory reasons for the distinction in terminology, and partly for that reason some people feel strongly about a difference. But conceptually, nothing is gained by the distinction, and this book will use the term *interconnection,* with *access* serving as a close synonym.

The term "interconnection" encompasses the directions of traffic ("terminating" and "originating") and its symmetry (unilateral vs. bilateral bottlenecks). It is defined in various ways officially:

Organization for Economic Cooperation and Development (OECD): "The way in which different networks are connected to allow traffic to pass between them including the conveyance of traffic on the network of one carrier on behalf of another carrier or service provider."

European Union (EU): "The physical and logical linking of the facilities of organizations providing telecommunications networks and/or telecommunications services, in order to allow the users of one organization to communicate with users of another organization, or to access services provided by another organization."

International Telecommunication Union (ITU): ". . . arrangements under which service providers connect their equipment, networks and services to enable customers to have access to the customers, services and networks of other service providers."

World Trade Organization (WTO): "The linking with suppliers providing public telecommunications transport or services in order to allow the users of one supplier to communicate with the users of another supplier to access services provided by another supplier."

Many interconnection issues will be discussed in this book. Disputes over them are as old as telecommunications (as chapter 2 shows, discussing the first stage of interconnection policy). They have in recent years become a central focus of policy reform in the United States (chapter 3), as well as around the world (chapter 5). Dimensions of the issues are interconnection prices (chapter 4), unbundling of interconnection (chapter 6), technology (chapter 7), the flow of content (chapter 8), and the social impact on universal service and privacy protection (chapter 9). Chapter 10 provides the outlook to the future.

This coverage is broader than that of any single academic discipline. Economists, for example, tend to focus on the pricing issue and to view other issues as institutional detail. Lawyers are interested in the regulatory evolution. Political scientists look at the international and universal service dimensions. Technologists focus on the interoperability. And the list goes on. While no single book can fully satisfy all of these constituencies, the issues of interconnection deserve an integrative treatment—interconnecting the academic disciplines.

Concept of Network

Networks are a key concept in the communications field. These networks abound not just as *physical* facilities, such as those of electric utilities, communications, and transportation. They also exist as *relational* systems, such as those of old-boy networks, political support organizers, and intelligence agents.

The term "network" goes a long way back; it is used, in the King James translation, by the Supreme Regulator: "And the Lord spake unto Moses, saying. . . . You shall also make it a grating, a network of brass . . ." (*Exodus* XXVII, V, 4). In the original Hebrew, the word is *reshet*, ("net") similarly used today for telecommunications and other networks.

The term is used by most academic disciplines, and with a variety of meanings. Chemists apply it to arrangements of molecules.[1] Biologists to cell structures.[2] Mathematicians to topology.[3] Electrical engineers to distribution system (for high voltage), or for circuit configurations of components (for weak voltage).[4] Operations researchers use a network terminology to solve shortest path problems, maximum flow models,

and optimal routing.[5] Computer scientists apply the term for computer interconnections in hardware, and to implementation algorithms in software.[6]

In the social sciences, political scientists use the concept of networks in discussing hierarchies, interactions, gatekeepers, and policy communities.[7] For sociologists and social anthropologists, networks are a major way to see the world; a basic point is that the nature of linkage affects behavior.[8] Among economic theorists, those working on public choice and group formation are often close to network group analysis,[9] while a growing body of literature deals with the economics of networks.[10]

It is hard to draw a general conclusions from such multidisciplinary attention to network arrangements, except that one must not look at a network merely as a technical facility. Networks are reflection of underlying interaction. Technical facilities exist in order to serve such interaction and to facilitate new forms of interaction. Being a reflection of society, networks are subject to the same conflicting forces of integration and centrifugalism common to many social processes. Wherever one looks, people break up all kinds of social networks of interaction and form new ones: For example, in the United States, public education, mass transit, public safety, stock exchanges, department stores, or universities. Telecommunications networks are merely one major example for such breakups.

Breakup of Networks

This then raises the question, why has the traditional system of telecommunications networks monopoly broken down in recent years? There are several explanations.

First, according to the *technological* view, the merging of telecommunications and computing technologies eliminated traditional lines separating industries, thereby undermining monopoly power. This partly true but does not account for the diversity of organizational structures around the world. Some countries use the latest technology but maintain entrenched monopolies. There is no evidence for a technological determinism at work. Technological change has provided the precondition for change but is not a sufficient condition.

Second, the *economic* explanation has been that a monopoly is inevitably inefficient, which eventually leads to the emergence of competition. A multicarrier market structure emerges because of failure of the traditional system. Yet this view conflicts with the strong performance of traditional networks in those countries where structural

changes in networks began first, the United States and Japan. Therefore a more elaborate economic view is that a monopoly, even if efficient, cannot protect itself from entry into some lines of business.[11]

Third, a *political* explanation for the demise of telecommunications monopoly is that in the information age, any single entity would become simply too powerful in its sectors, and its scope needs to be limited. This too is not a full explanation because an alternative response to power might be a stricter or more effective regulation, or a nationalization, or a size-reduction along geographical or functional lines, while maintaining monopoly and discouraging the admission of new carriers.

None of these perspectives provides and adequate explanation for the breakdown of the monopoly system and the emergence of multiple networks, though they all contain some truth. This leads us to an alternative view, based on the reason networks form in the first place and the dynamics of their evolution; that of *group formation.* Networks form as economic sharing arrangements. But as they expand, group dynamics leads to their breakup from a single coalition to separate subcoalitions.[12]

A good way to look at a network is as a *cost-sharing arrangement* among several users. Since fixed costs are high and marginal costs are low, a new participant helps the users of the networks to lower their cost. Also the new user adds to the utility of the existing users by increasing the reach the network. This can be seen in figure 1.1.

The benefit (utility) of joining a network rises, though at a declining rate. Average cost declines initially with more members, but eventually it rises as high-cost subscribers are added to the network, in the way cost curves normally do. Where the network is small, average cost is high and utility is small. In that range, below a "critical mass"[13] (point n_1), a network will not be feasible unless supported by external sources. Such sources might be subsidies from government (as in the case of the early Internet) or from other parts of the network organization, as in early mobile networks. They could also be provided by *regulatory* means, for example, through advantageous terms of interconnection to other networks.

Beyond the critical mass point, a network's growth is self-sustaining. But when growth reaches n_2, marginal net benefits are zero. Left to themselves, the existing subscribers of the network would not accept members. From a societal point of view, however, the optimal network size diverges from the private optimum, because social welfare still increases beyond n_2 due to the benefits to the new members. The political process therefore tends to expand the size of the network beyond the private optimum, to n_3 under policies of "universal service connec-

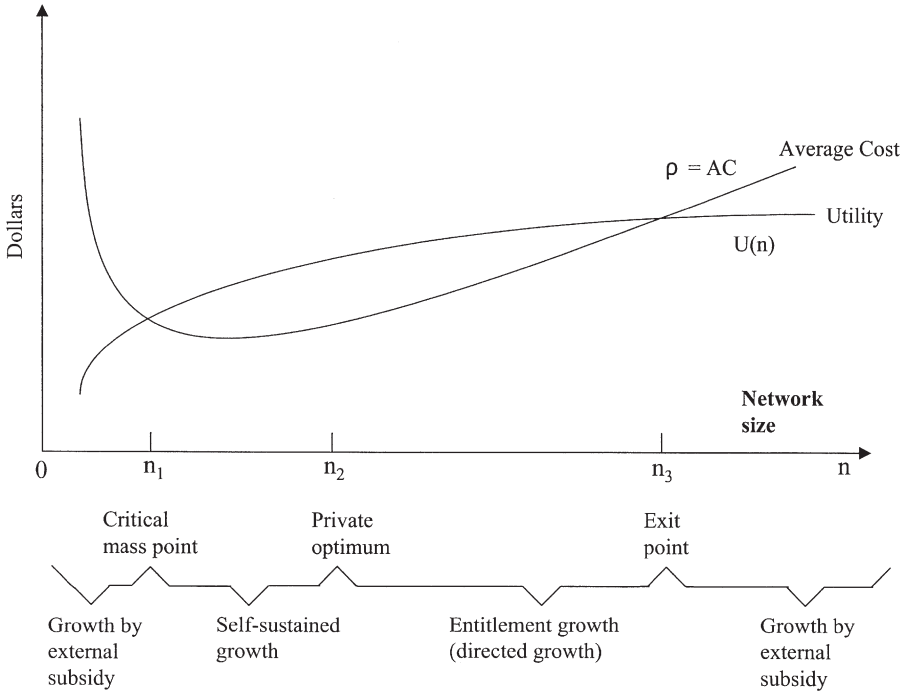

Figure 1.1
Model of network expansion and breakdown

tivity." Furthermore it is likely that if there is a decision mechanism that permits a majority of network members to exercise control over pricing which means that, the equal sharing of costs will not be maintained. Majority coalition will re-allocate cost shares away from itself by imposing higher cost shares on the minority.[14]

As this process takes place, the minority finds itself better off in forming a new network and abandoning the old one, if it can do so legally. This leads to an unraveling of the existing network.

This means that a network coalition, left to itself under majority-rule principles, would expand beyond the size that hold under rules of equal treatment of each subscriber. Such an arrangement is stable only as long as arbitrage is prevented, as long as the minority cannot exercise political power, and most important, as long as the minority has no choice but to stay within the burdensome network arrangement.

But beyond that point, the pro-expansion policy creates incentives to form alternative networks. The more successful network policy is in terms of achieving universal service and "affordable rates," the greater

the pressures are for fracture of the network. Thus the success of network expansion bears the seed of its own demise. This may be called the "tragedy of the common network" (tragedy in the Greek drama sense of unavoidable doom), and borrowing from the title of J. Hardin's classic "Tragedy of the Commons"[15] on the depletion of environmental resources.[16] In the case of telecommunications, the tragedy is that the breakdown of the common network is not caused by the failure of the system but rather from its success—the spread of service across society and the transformation of a convenience into a necessity.

Many people have been greatly worried about this process. The traditional fear is that the loss of cost-sharing and externalities brought by a second network would reduce social welfare.[17] However, where mutual interconnection is assured, the externalities benefits remain (or even increase). Static costs may increase when economies of scale are lost, but the cost curves themselves may well decline dynamically with the ensuing competition and reduction in *X*-inefficiency. Moreover redistribution can be easily accomplished across a network rather than within a network, in the same way that we can feed the poor without requiring a monopoly over the production and distribution of food.

Conceptually, economists engaged in club theory have shown that it is generally more Pareto-efficient to attempt income transfer by allowing sub-groups to form their own associations and then re-distribute by imposing charges on some groups and allocating these charges to others. In other words, differentiated networks plus taxation, or another system of revenue shifting such as access and interconnection charges, is more efficient than a monopoly and internal redistribution.

The unraveling of a network would commence sooner if a new network has the right to interconnect into the previous one because in that case, it would enjoy the externality benefits of a larger reach while not being subject to redistributory burden. Interconnection therefore facilitates the emergence of new networks by lowering barriers to entry and exit.[18] But interconnection also facilitates the integration of the disparate networks into a whole, a "network of networks." And the interesting question which this book repeatedly addresses is whether a single interacting network emerges without outside coercion or inside control.

1.2 Why Regulate Interconnection?

Before we move to the details of interconnection, the fundamental question needs to be raised: Why should the interconnection of a diverse and complex matrix of interrelations among numerous carriers

be an issue for public attention, any more than the relation among the various participants in the manufacturing, distribution, and service of say, automobiles or computers? Need government enter the picture? Is it necessary to assure interconnection, to establish markets in intermediate inputs, or to define rights and obligations for them?

Antimonopoly Rationale

There are two major explanations for government's role, coexisting uneasily, and each encompassing subrationales. The primary explanation for a governmental role in assuring interconnection starts with two assumptions: (1) that telecommunications are a service essential to society and economy and (2) that the provision by a single monopoly organization is undesirable. This then leads to the regulation of interconnection of telecommunication based on the monopoly power of an incumbent providing an essential service. Given the incumbent's head start of a full century, a new entrant cannot hope, it is argued, to succeed as a stand-alone entity. Yet the entrant must reach the customers of the incumbent and, in turn, be reachable by them. An alternative for an entrant would be to replicate a full-fledged, stand-alone, end-to-end rival network and tough it out until it has caught up with the incumbent in size and scope, but this is a much costlier and riskier strategy than gradual entry and rollout. Thus, if one wants to encourage competition to a strong incumbent, one must accompany it with an assurance of interconnection. And if the survival of fledgling competition is at stake, this rationale can be expanded to justify interconnection on terms that are favorable to the entrant as an "infant company."

The antimonopoly rationale is similar to the *essential facility* doctrine of antitrust cases in which exclusion of a rival from a critical element of service has been deemed an illegal act in restraint of trade. The essential facilities doctrine—in a view disputed by proponents of the "Chicago" view of law and economics—holds that when facilities cannot be practicably duplicated by potential competitors, those who control these facilities must allow them to be shared on fair terms.[19] They must give access to the facilities on similar terms if the "the admission of rivals is consistent with the legitimate purposes of the venture."[20]

Four elements are required.[21] A monopolist must have control over such a facility. The competitor is unable either practically or reasonably to duplicate the facility. The monopolist has denied use of the facility to the competitor. The monopolist can provide the competitor with access to the facility.

Philip Areeda, an authority on U.S. antitrust law, offered some guidelines concerning the application of the essential facilities doctrine:

> There is no general duty to share. Compulsory access, if it exists at all, is and should be exceptional . . . no one should be forced to deal unless doing so is likely to substantially improve competition in the marketplace by reducing price or increasing output or innovation. Such an improvement is unlikely . . . [when] the plaintiff is not an actual or potential competitor . . . Even when all these conditions are satisfied, denial of access is never per se unlawful; legitimate business purpose always saves the defendant.[22]

The roots of this doctrine can be traced back to the *Terminal Railroad Combination* case.[23] There, the U.S. Supreme Court ruled that a consortium of railroad companies that controlled the railroad junctions traveling through Saint Louis, had to allow competing companies to join the association. Similarly, in the *Associated Press* case, the U.S. Supreme Court ruled that since the Associated Press controlled such key news-gathering facilities, competing newspapers had to be admitted into the Association and obtain access to the same facilities.[24] The doctrine has also been used in telecommunications interconnection cases. MCI used the essential facilities argument to win a $1.8 billion judgment from AT&T.[25] MCI brought charges against AT&T because AT&T had denied or obstructed MCI interconnection to Bell local exchanges. By legislation, certain rules, known as "must carry" were included in the 1992 Cable Television Act and required cable television operators to transmit local TV stations.[26] On appeal, the U.S. Supreme Court ruled that the operator's control of essential facilities warranted such intrusive regulation.[27]

Closely related to the antimonopoly argument is what might be called the *common carriage* rationale. A common carrier must provide service to any interested customer, even to its competitor. It must carry all traffic brought to it for carriage, whether from a small user or from a large one that aggregates the traffic of several users. The common carriage rationale is similar to that of the antimonopoly explanation, but it does not logically permit an infant industry treatment of the entrant that is more favorable than that afforded to other users.

The flip side of the antimonopoly rationale and its common carriage variant is that if a carrier had no market power, it would owe no interconnection or nondiscrimination to anybody. In this case the carrier is a normal commercial entity doing business as it sees fit. This seems quite reasonable, until one recognizes that this means an asymmetrical

arrangement among carriers. A small carrier can interconnect and reach a large carrier's customers, but not vice versa, because only the large carrier has market power. Similarly the entrant can use the larger carrier whenever the latter has a service element that is cheaper or better, but when the entrant carrier itself has such superior service, it need not reciprocate unless it has achieved bottleneck power itself. This creates a "heads-I-win-tails-you-lose" situation.

Furthermore, not only does this asymmetry skew competition, but also it is unstable. If there are no more interconnection right when the bottleneck power of the incumbent is gone, then the determination of that point becomes all-important, and will no doubt be fiercely fought over. The question, after all, is not an easy one to answer conceptually or empirically, and it may vary by location, service, customer class, and year. For example, suppose that one carrier has a national market share of 60 percent. Its rival is much smaller overall but has 70 percent of San Francisco and 80 percent of interairline communications. Could we tell who has market power? Who must grant interconnection to whom?

Transaction Cost Rationale

Next to the antimonopoly explanation, the other major theory for the regulation of interconnection might be called the "transaction cost" rationale. This view centers on the positive externalities of networks. Interconnection is designed to provide an element of integration to the increasingly disparate network environment. Whereas monopoly carriers in the past provided such integration inside their own organizational sphere, now integration must take place across carriers. Information flows across numerous pathways, in a chain of transmission involving half a dozen carriers. Indeed, with packet-switched communication, which is the mainstay of much of Internet communications, information between two points may travel simultaneously over a wide variety of paths. In such an environment, interconnection rules are a transaction–cost reducing arrangement, and as such are similar to legally imposed arrangements aimed at reducing transaction cost in other parts of the economy, such as legal tender for currency, the law governing commercial paper, or the first sale doctrine in copyright. The interconnection rules may reduce some freedom of negotiation, but they also facilitate commerce and transactions. They establish symmetry in the treatment of various carriers, and eliminate continuous market power tests.

1.3 Regulation of Interconnection and Unbundling in a Competitive Market

In traditional telecommunications, regulation by government existed partly to effect the balance of power between huge monopoly suppliers on the one hand, and small and technically ignorant users on the other. It inserted the political and administrative process to alter unconstrained market outcomes. In return, the dominant carriers, whether private or governmental, received protection from competition by other providers. The key policy tool, as will be shown, has been the rules of interconnection, which first established the monopoly, then opened it to competition, and then was used to control the market structure. In a competitive system, the imbalance among carriers changes drastically. The fundamental question then is: In such an environment, is it still necessary to control interconnection by government regulation, or will a competitive market provide it optimally?

The experience with interconnection around the world (chapters 2, 3, and 5) shows that interconnection is not made available freely by an incumbent to its competitors. Nor is interconnection as a right ever given up voluntarily by new entrants once competition emerges. On the other hand, interconnection is voluntarily initiated with collaborating carriers, such as with carriers in different countries, or regions, or where the positive contributions of reaching a large number of network participants outweighs the negatives of having to share the market with them. It is therefore possible that market forces would eventually lead to interconnection among competitors, too, once they have become large enough to create a mass of subscribers who are attractive to reach by the other carriers as they serve their own customers.

Often, the terms of interconnection are left nominally to the parties' negotiation. Yet regulatory intervention is frequent where there is an asymmetry in bargaining strength and in the urgency of need for interconnection between the incumbent and the competitive entrant. For this reason regulatory intervention in interconnection occurs whenever a pro-competition policy for telecommunications is implemented. Even where formal regulatory intervention does not take place, the negotiations are shaped by the expectations of what the regulator's decision would be. These decisions, in turn, depend on fundamental policy priorities. In the past, it was to speed telecommunications service across society. Later, economic efficiency and technological dynamism had priority. More recently, the goal of such intervention was also to help the entrant in its operational and financial viability.

As a matter of empirical fact, interconnection is regulated everywhere where competitive telecommunications exist. Even in New Zealand, which ostensibly is without telecommunications regulation, the courts and their interpretation of the laws of general competition regulate cite connection. The difference is one of a general regulatory body, in contrast to a specialized agency, and it is not clear whether their decisions would be different or better.

Regulation was essential to the old system, partly to protect against monopoly, partly to protect the monopoly itself. In the transition to competition, what was left of regulation was seen as temporary, shrinking reciprocally with the growth of competition. In time, it would diminish to nothing. Yet can one expect the network of networks to be totally self-regulating when it comes to interconnection? Even a free-market advocate like Milton Friedman recognizes the possible need for intervention in cases where externalities prevail, and in the case of "natural monopoly."[28]

> When technical conditions make a monopoly the natural outcome of competitive market forces, . . . there are only three alternatives that seem available: private monopoly, public monopoly, or public regulation.

He writes, in a pragmatic vein, that

> If the technical monopoly is of a service or commodity that is regarded as essential and if its monopoly power is sizable, even the short-run effects of private unregulated monopoly may not be tolerable, and either public regulation or ownership may be a lesser evil.[29]

Today the antimonopoly and the transaction cost views coexist uneasily, partly due to fuzzy regulatory thinking, but they differ in their perspectives of the future. In the antimonopoly view, the regulation of interconnection is an essentially transitional task that will fade away with the emergence of competition. Interconnection regulation will therefore become less important with time. In contrast, the transaction cost rationale comes to the opposite conclusion. As open entry permits more and more carriers to offer services, the need for basic rules for their interaction becomes increasingly important if the overall network infrastructure is not to fragment into incompatible network parts. The antimonopoly view is asymmetric, requiring interconnection by large carriers, but not by their competitors. In contrast, the transaction cost view is symmetrical, applying concepts of interconnection to all carriers.

The transaction cost perspective has its conceptual problems. Fundamentally, wouldn't competition and markets take care of interconnection by way of commercial agreements? That question is discussed in this book. Part of the problem is its chicken-and-egg nature: Competition might make the regulation of interconnection unnecessary, but without such regulation competitive market structures may never evolve. That would justify the regulation of interconnection based on the antimonopoly rationale, during the early emergence of competition. And then? Suppose that full competition has indeed been established. At that point any residual interconnection regulation is based on transaction cost. This book concludes that only one such residual rule is needed, that one principle suffices to establish interconnection and thereby maintain integration in the networks of networks. This principle is *third-party neutrality (TPN).* Once a carrier accepts traffic from another carrier to transmit, it cannot accept only selected parts of that traffic. It can select its customers and not enter into an interconnection arrangement with them. But it cannot discriminate against a customer's customer by carrying traffic only selectively. TPN preserves nondiscrimination access and free flow, which are of major advantage to society, without making private carriers into common carriers by creating service obligations. And the arrangement reduces transaction costs in the same way that the law of commercial transactions does.

1.4 Consequence of Interconnection on the Network System

Similar centrifugal aspects affect the rest of society, accelerated by electronic communications. Communications define communities, and the changed network environment encourages the formation of new types of interaction—new living patterns, new types of work relations, new economic regions, new political arrangements, new jurisdiction. As communications technology (e.g., the Internet) connects people in new ways, it also disconnects them, in often problematic ways, from traditional patterns. Thus the breakdown of the centralized national communications network merely reflects a fundamental centrifugalism that is affecting countries and societies in many ways. We are merely at the beginning of this evolution. In such an environment, arrangements of social and economic interconnectivity are being reshaped at every level. Thus the creation of rules for the interconnection of telecommunications networks stands for broader societal efforts at integration in the midst of the information revolution.