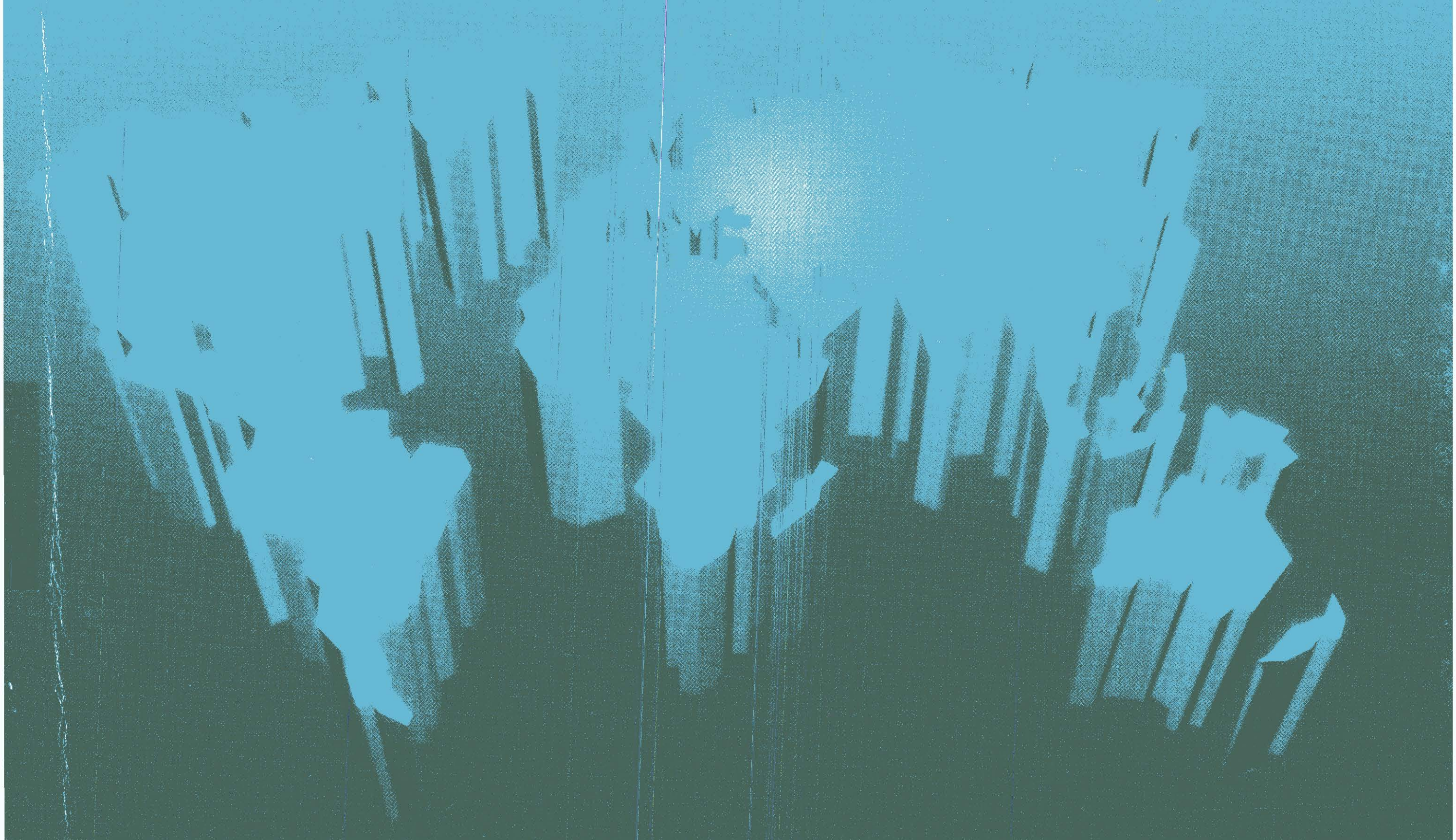
Information networks and Competitive advantage

Comparative reviews of telecommunications policies and usage in the US and Japan



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INFORMATION NETWORKS AND COMPETITIVE ADVANTAGE

Volume II: Comparative reviews of telecommunications policies and usage in the USA and Japan

From public access to private connections: Network strategies and competitive advantage in US telecommunications.

François Bar and Michael Borrus; Berkeley Roundtable on the International Economy, University of California.

Telecommunications policy and usage in Japan.

Taizo Yakushiji.

Report presented at the final seminar on Information networks and business strategies, held at the OECD headquarters in Paris, 19-20th October 1989.

Foreword

The use of telecommunications in industry and commerce is an increasingly important part of corporate strategies in all Member States of the Organisation for Economic Co-operation and Development (OECD). However, both the technologies available and the regulatory regimes that dictate how these technologies can be used, are changing rapidly. To explore the issues involved, a set of comparative national and company-specific studies has been carried out from 1987 to 1989 by the OECD-BRIE telecommunications user group, under the technical direction of the Berkeley Round table on the International Economy (BRIE) at the University of California, Berkeley, and the secretariat of the information, Computer and Communications Policy Division, Directorate for Science, Technology and Industry, OECD, and with the support of DG XIII of the Commission of the European Communities:

Two questions lie at the heart of the studies:

- To what extent do variations in the regulation of telecommunications affect how technologies are used to gain competitive advantage? and;

- how successfully are technologies used to gain competitive advantage under different regulatory regimes?

This volume describes telecommunications policies and usage by major companies in the US, Japan. Volume I of the report contains an overview of the key issues for government policy and corporate strategy developments and Volume III describes telecommunications policies and usage by major companies in five European countries: France, the FRG, Italy, Spain and the UK. These reports are based on case studies of telecommunications usage in 30 major companies and the co-operation of these companies is most gratefully acknowledged.

The reports are distributed as a contribution to ongoing discussions about the future strategies for development of advanced communications in Europe, the USA and Japan. It is hoped that they will support the development of a better common understanding of the trends and opportunities for telecommunications usage in Europe, the USA and Japan and will serve as a basis for the strategic orientation of research and technology development initiatives. The views and recommendations in the reports are those of the authors.

From public access to private connections: Network strategies and competitive advantage in US telecommunications.

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Like Molly Bloom, U.S. policy-makers just can't say no to their infatuation with an old love. For over three decades, U.S. telecommunications policy has courted market competition. U.S. policy-makers have been enamored of the innovative techniques the market fosters, and jealous of the apparently effortless way that it satisfies the feverish demands of major users. How simple to abandon the troubling thoughts and difficult choices in favor of the market's apparent fairmindedness; how easy to relinquish control to the market's invisible hand.

The urge has never been stronger, as the government's blue-print for telecommunications policy in the next century affirms: "Effectively competitive, unregulated communications and information markets....are the best guarantee that the public will have the communications and information facilities and services they want and need."[1] Yet, in the cold light of morning, the choice of abandoning policy to the market looks less and less like a well-conceived plan. It appears much more like the easy way out of the difficulty of guiding the evolution of the nation's telecommunications infrastructure in a time of rapid change and substantial uncertainty.

To be sure, the old regulatory policies are plainly inadequate to the task. And to an even greater certainty, the market must play a broad role in shaping the development of modern communications and allocating its use.[2] There are, however, continuing critical roles for national policy to play in the telecommunications arena if the best prospects for the U.S. economy and polity are to be realized.

We argue in this paper that the nation's economic prospects are increasingly intertwined with the accessability, flexibility, and widespread use of the networks that digital communications technology makes possible. Digital communications networks have become the critical foundation for an empirically observable, on-going transformation in modern industrial production. Modern production of both goods and services is increasingly computerized and automated. Management of the production process requires intimate and integrated control over the associated information flows, whether in the form of voice, data, or images.

Consequently, corporate strategies are ever more tightly bound to digital network facilities, whether for the production of cars and clothes, insurance policies and financial flows, or melons and medical services. In every major industry the aim is managerial control over network facilities, the ability dynamically to allocate integrated network resources in real time on an as-needed basis in pursuit of corporate strategy.

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[1] National Telecommunications and Information Administration, *Telecom 2000, Charting The Course For A New Century*, (Washington D.C.: U.S. Department of Commerce, October, 1988).

[2] Stanford University's Roger Noll makes this and the preceeding points cogently in the course of arguing for the eventual elimination of regulation in his "Telecommunications Regulation in the 1990s," *CEPR Publication* #140 (Stanford: Center for Economic Policy Research, August, 1988).

The network resources available to firms both constrain and enable corporate strategy choices.[3] Network availability, in turn, is a function both of policy and market forces. By favoring market forces, U.S. telecom policy has helped to create a wide-open, essentially unconstrained choice of network resources for those with the knowhow who can afford the investment. But open choice does not automatically lead to the best match with corporate strategy objectives. Indeed, only a select few of the largest producers in the U.S. are close to realizing the goal of linking strategy formation and implementation to dynamic network allocation on-demand. For most others, and particularly for those whose choice is limited to the public-switched network by their lack of investment resources and knowhow, the use of telecom in pursuit of corporate strategy is decidedly constrained.

The differentially available strategy choices of users change the dynamics of competition when firms interact in markets and shape the outcomes of the interaction. Who wins and who loses, and the economic gains to be had, can all be fundamentally altered as a consequence. Partly as a result of these indirect impacts, available network resources shape far more than corporate strategy choices. They shape as well opportunities for national economic growth.

Here the arguments are more complex and admittedly more speculative. We make the case, in essense, that the digital communications networks underlying industrial production, from privately controlled corporate by-pass networks to the public switched telephone network, together comprise a modern economic infrastructure supporting the evolution of the economy.

In particular, our analysis suggests that different infrastructure arrangements differentially support two kinds of beneficial economic processes. The first of these is the coordination of (static) resource allocation through both markets and administrative hierarchies. Here, different network configurations can radically destabilize existing allocating mechanisms, re-enforcing market efficiency here, promoting hierarchical control there, and mixing and matching the two in ways that alter possibilities for productivity growth.

The second process we call 'dynamic performance', by which we mean the ability to adjust to changing economic circ umstances and to grow and prosper over time. Different network arrangements influence dynamic performance by enabling or frustrating the experimentation and learning critical to technological advance and essential for increasing rates of demand growth.[4]

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3 As we elaborate more fully below, by network resources we mean the network facilities, methods of control, and applications (i.e., services) that together comprise a functioning network.

4 As we elaborate more fully below, we draw these aspects of 'dynamic performance' from different sources. Notions of experimentation and learning are drawn in particular from the work of Nathan Rosenberg, *Inside the Black Box: Technology and Economics*, (Cambridge University Press, Cambridge, MA, 1982) and Richard Nelson and Sidney Winter, *An Evolutionary Theory of Economic Change*, (Belknap, Cambridge, MA 1982); ideas of technological advance are drawn in particular from Joseph Shumpeter, *The Theory of Economic Development*, (Harvard University Press, Cambridge, MA, 1934) and Christopher Freeman, *The Economics of Industrial Innovation*, (Penguin, Harmondsworth, England, 1974) as well as Rosenberg; the demand growth emphasis is drawn directly from Giovanni Dosi, Laura Tyson and John Zysman, in Chalmers Johnson, Tyson and Zysman, eds., *Politics and Productivity*, (New York: Ballinger, 1989), at chapter 1..

We argue that the available network arrangements -- that is, the network infrastructure itself -- influence the extent to which these economic benefits get generated and diffused within the economy. How the network infrastructure is organized and controlled will determine whether those benefits are internalized in limited ways by a few economic actors, or widely externalized and diffused to the benefit of an economy as a whole.

Although U.S. telecommunications regulatory policy has never been much concerned with supporting these economic processes, the pre-divestiture Bell System nevertheless did so as an *unintended* byproduct of its integrated, universal, monopoly character.[5] Ubiquity and accessibility generated more perfect information throughout the economy, thereby favoring efficient resource allocation. Opportunities for experimentation and learning were widespread, if limited by the constraints of the technology and the single application (i.e., voice). Integration and universality helped to make the Bell System a traditional economic infrastructure.[6]

The introduction of competition and then the break-up of the Bell System have led to increasing fragmentation of the infrastructure. Competition, continued restraints on ATT and the Bell companies, and the development of new applications have led to increasing differentiation of infrastructure capabilities. There is fragmentation of network ownership, control, access, and of the network itself; differentiation of uses, providers and clients. The network infrastructure is becoming "open and loosely interconnected, resembling a federation of subnetworks."[7] Competition increasingly drives its evolution -- although traditional regulation and court order continue to exert critical influence -- and final demand primarily determines which facilities, management mechanisms, and applications are provided via its many parts.

This evolution has served very well the very largest business users. It has also drawn distinct boundaries around the many parts of the confederation of subnetworks that comprise the whole: Ownership and control, configurability, access, functionality, data generation and usage, all differ in different parts of the overall network. Those differences dramatically affect the network's utility for the corporate strategy choices of smaller users. Equally important, they have exacted unforeseen tolls on allocation and dynamic performance for large segments of the economy.

As we shall see, fragmentation and differentiation have created substantial market imperfections that frustrate the widespread diffusion of the economic benefits a digital network infrastructure makes possible. Our case studies demonstrate the ability of sophisticated users to coordinate market outcomes through their network strategies: The infrastructure is used to create barriers to certain kinds of economic activities rather than to generate more perfect information to make markets work more efficiently. Similarly, opportunities for learning and experimentation have been skewed in ways that potentially disfavor those who rely primarily upon the publicly controlled parts of the network. In essense, in gaining the benefits of market-led diversity, U.S. policy risks sacrificing the benefits of an integrated infrastructure.

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5 National policy towards telecommunications stemmed from two main principles embodied in the Communications Act of 1934, that the network was a natural monopoly which required a single provider, and that it was socially desirable to offer universal and homogeneous telephone service.

6 As we define more fully below, the Bell System qualifies as an economic infrastructure because it provided a ubiquitous input, characterized by indivisibility, and generating substantial external economic benefits capturable primarily by those who used rather than produced it.

7 Eli Noam, "The Public Telecommunications Network: A Concept in Transition", *Journal of Communication*, Vol. 37, No. 1, Winter 1987.

We build our case by analyzing sequentially two inter-related variables. These are: (1) U.S. telecommunications-related policies toward network resources – toward that is, the network facilities, methods of control, and services that comprise those resources; and (2) corporate strategies that employ such network alternatives in industrial production.

As hinted above, policy matters to the analysis for obvious reasons. Communications policies shape the development, deployment and configuration of the network resources which comprise the nation's communications infrastructure. Simply stated, policies shape the available network alternatives to which users have access. In section I, we analyze several decades of U.S. regulatory policy to show how the availability of network resources has evolved.

The available network alternatives in turn represent a pattern of constraint and opportunity facing economic actors as they develop their strategies.[8] In section 2, we show how the network resources available to leading edge business users shape company strategy choices.

We focus on leading edge users for several reasons. First, the networks of leading users are part of the communications infrastructure and provide precise case studies of how networks influence economic behavior. Second, leading users represent the cutting edge of communications demand in the U.S., and by their choices strongly influence the development and availability of all network resources whether employed publicly or privately. Large private users account for 40% of the switch market, 20% of microwave and fiber-optic transmission equipment and electronics, 80% of the market for satellite transmission services.[9]

Third, as BellSouth's Richard Snelling implicitly confirms, leading user needs and strategies shape the evolution of the public network:

> ...the important reason to [employ advanced network intelligence is] if you don't do it, somebody else will – and the intelligent network will leave the public network. If you really want to be in business at the turn of the century as a telecommunications organization... then the intelligent network is simply a revenue protection deployment strategy.[10]

In short, a significant part of the investment strategy for the public phone network is dictated by the need to offer a resource that is continuously relevant to those who supply most of the revenues.

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8 For an elaboration of how such structural alternatives constrain and promote strategies, see the discussion in Michael Borrus, *Competing for Control: America's Stake in Microelectronics*, (Cambridge: Ballinger, 1988), at chapter 3.

9 Huber, Peter, *The Geodesic Network: 1987 Report on Competition in the Telephone Industry*, Antitrust Division, US Dept. of Justice, 1987 at p1.11.

10 Quoted in "Experts Look Behind the IN Concept," *Telephony's Transmission Special*, October, 1988, p.18.

The choices of major users are, then, a prime force behind the evolution of the network infrastructure, directly as they build networks, and indirectly as their demands influence other private and public network decisions. The evolving infrastructure, in turn, offers new kinds of network resources and influences overall economic performance. Section 3 makes the case that different network alternatives indirectly shape economic performance by opening and foreclosing opportunities for more effective coordination of resource allocation and by favoring or frustrating the experimentation and learning that shape dynamic performance.

Our argument, in short, can be summarized as follows. Regulatory policy shapes the availability of network resources. Available network resources constrain and shape corporate strategy. Corporate choices shape the continuing evolution of the infrastructure. The evolving infrastructure influences economic performance. Since policy helped to set the original menu of network alternatives that constitute the infrastructure, policy can intervene to re-shape the infrastructure to ensure better economic performance. The concluding section proposes appropriate policies toward that end for the U.S.: The question for U.S. policy -- the subtext of the current debate on an Open Network Architecture (ONA) -- is whether it is possible to gain the benefits of a uniform infrastructure by re-integrating its diverse fragments through a unified scheme for network management and control.

I. REGULATING THE EVOLUTION OF THE TELECOMMUNICATIONS INFRASTRUCTURE

What do we mean by "the telecommunications infrastructure"? Traditional approaches usually treat as "infrastructure" only the physical facilities, the hardware that constitutes the network. In that view, the purpose of the physical network infrastructure is to support a range of telecommunications services[11]. By contrast, our definition includes all three distinct functions performed by a telecommunications network: transmission, management, and applications[12]. In this view, the telecom infrastructure (the physical facilities, their management mechanisms, and the services that ride on them) supports the rest of the economy as it fulfills the necessary function of communication.

The network facilities, lines, trunks, switches and terminals, perform the transmission function as they carry coded information from one point to another. The second function, management, refers to the set of rules and mechanisms required to make use of the transmission facilities: finding a physical route between two terminals, establishing a connection, keeping track of which user will pay which transmission facility provider, diagnosing breakdowns, and the like. Third, the application is the delivered form of the service provided by the telecom infrastructure to the user: a telephone call, electronic mail, or a data transaction.

We view the network infrastructure as composed of three layers, that correspond to these three functions. Each layer "rides" on top of the preceding one, in a way conceptually similar to the OSI model. At the bottom is the transmission layer, representing the physical plant of the infrastructure. Directly above it is the management layer, containing a set of "rules of the road" that regulates how information transits through the lower layer. Atop these two is the application layer, the only one the final user directly deals with[13].

These distinctions have not typically animated U.S. telecommunications policy. In the course of dealing with other concerns, however, U.S. policy has treated the various layers of the telecom network infrastructure quite differently. During the Bell System's heyday, from the Communication's Act of 1934 to roughly the 1970s, the bottom and middle layers (transmission and network management) were strictly regulated and provided by the monopoly. The Bell System was limited to providing basic phone service at the application layer, but few rules constrained the development of applications and the use of the network to carry those applications by users standing outside the Bell System.

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[11] see for example: Bruce, Robert R. Jeffrey P. Cunard, and Mark D. Director, *From Telecommunications to Electronic Services: A Global Spectrum of Definitions, Boundary Lines, and Structures*, Butterworths, 1986.

[12] This model is inspired from Curien, Nicolas, and Michel Gensollen, "De la Théorie des Structures Industrielles a l'Economie des Réseaux de Télécommunications", in *Revue Economique*, No 2, March 1987, p.521-578, where they distinguish the three functions of *transmission*, *acheminement*, and *traitement*.

[13] This model is not only valid for telecommunications, but applies also to other network infrastructures. For example, the railroad system can similarly be viewed as composed of a physical transport layer (tracks, switches, stations, etc...), a management layer (a set of schedules, pricing mechanisms, rules for handling foreign cars,...), and an application layer (different classes of travel, refrigerated transportation,...).

This tension between constraint on the lower layers of the infrastructure and on ATT's service provision, combined with freedom of use of the top layer, eventually undermined the Bell System as a whole. As users pushed for more and more control over the bottom layers of the infrastructure in order to implement more completely their freedom at the top layer, ATT responded by demanding more and more freedom to manuever at the applications layer in return for being exposed to competition at the lower layers.

In typical U.S. fashion, these battles were fought administratively in the major telecom policy-making arenas and in the courts. They provide the sub-rosa stories behind the evolution of US telecommunications policy over the past thirty years. One story is of gradual deregulation, presided over by Federal Communications Commission (FCC), in which more and more of the Bell System was gradually exposed to competition. The other story is of divestiture, fought largely in the courts, which ended by rending the Bell System and formally eliminating ATT's monopoly over the bottom network layers in order to give it freedom to play in the top layer.

Deregulation and Divestiture

Deregulation and divestiture arose from two interrelated efforts. The first dominant and successful effort was, at the level of industrial development and firm strategies, waged by major users and producers of telecommunications equipment progressively to remove control over the structure, evolution and uses of telecommunications from regulatory and judicial constraints. They considered this a prerequisite to the implementation of the networking strategies described in the next section. While major users needed to control their increasingly information-oriented environments and major equipment producers were eager to meet those needs, neither was fully able to accomplish this within the organization of the then-existing national telecom infrastructure.[14]

The second drive, at the policy level, was the gradual abdication of government responsibility over the equitable development of the nation's telecommunications infrastructure and the delegation of that role to market competition (i.e. to the control of major users and producers). The desire for rapid and efficient exploitation of technological change, in particular the development of new transmission technologies and the convergence of computing and communications, served two purposes. It provided the opportunity for AT&T, its competitors and major customers to push government policy toward deregulation and divestiture. It also provided the necessary justification for U.S. policy-makers to turn toward the market as their easy way out of the difficulty of maintaining control over the national telecommunications infrastructure in a time of rapid technological change.

[14] The interventions of major corporate and public users, that provoked change and determined its form, in the regulatory and judicial decisions leading to deregulation and divestiture, are amply documented in Dan Shiller, *Telematics and Government*, Ablex Publishing, NJ, 1982, part one, p. 1-96.

From 1934 on, telecommunications policy in the United States sought to "make available, so far as possible, to all the people of the United States, a rapid, efficient, nationwide and world wide wire and radio communication service with adequate facilities at reasonable charges"[15]. Policy stemmed from two main principles. First, was the belief that the construction and operation of a telecommunications network was a natural monopoly. Because of its inherent economies of scale and scope, the job was done better and more cheaply by a single entity. Second, it was believed socially desirable to offer universal and homogeneous telephone service. In essense, the telecom network was considered and treated primarily as a public good.

The intent of regulation, consequently, was to control monopoly power and provide universal service at affordable rates for all Americans. Its principal instruments were rate-setting and the power to compel interconnection to the Bell system. The purposes of such controls were to prohibit discrimination in the availability and price of services -- except in the pursuit of socially desirable cross-subsidies -- and to prevent the monopoly carrier, AT&T, from earning monopoly profits.

Although there were some 1500 independent telephone companies in the US (together constituting some 15% of the national network), the Bell System's monopoly over 85% of the nation's network meant that AT&T's decisions on network evolution, equipment and services were adopted as de facto standards throughout the national network. In effect, AT&T controlled the planning, operation, structure and evolution of the nation's telecommunications network infrastructure, under regulatory constraints imposed by the FCC and state-level policies. Overall, regulation was essentially reactive to AT&T's behavior and dependent upon its data.

Telecommunications policy really had no motive beyond the goals of monopoly containment and universal service. However, the vision of the telecom network (largely framed by AT&T) corresponded closely with the traditional definition of an infrastructure although it was never explicitly articulated in such terms: The Bell System looked alot like a ubiquitous input characterized by externalities and indivisibility, that could only be provided on a monopoly basis. During this initial phase in the United States, the transmission and management layers of the network infrastructure were mostly under the absolute control of AT&T. The application layer was then essentially limited to telephony and rested entirely under the users' control.

Divestiture and deregulation introduced competition within this integrated infrastructure and progressively, but thoroughly, led to its fragmentation. Two pressures on the infrastructure, from the bottom-up and from the top-down, converged on the path of increasing fragmentation. The first was the idea that competition in telecommunications services and equipment over the Bell system network was not only tolerable, but ought to be encouraged by the FCC. With the demise of the natural monopoly status of the network, this brought about increasing fragmentation of the US network infrastructure from the bottom layer up.

The second was the dramatic development of the application layer, as the telecommunications network supported a growing variety of uses addressing the multiple needs of users. Intense competition for the provision of these applications, which had never been considered a natural monopoly, reinforced the fragmentation of the network infrastructure, this time from the top layer down.

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[15] The Federal Communications Act of 1934, 47 U.S.C. 151.

Four sets of FCC decisions in particular have been critical to the introduction of competition in the national telecommunications network and the restructuring of the terms of access and interconnection to, and use of the network it entails. These have 1) permitted the sale and interconnection of terminal equipment manufactured by suppliers other than Western Electric; 2) permitted the establishment of competitive long distance service providers and ensured their access to the local switched network for origination and termination of their services; 3) permitted the resale and shared use of lines leased from AT&T and other common carriers; and 4) acknowledged the blurring of industry lines between communications and computing, and permitted enhanced communications services and equipment to be offered on an unregulated basis.

In parallel with these deregulatory moves, and setting the context within which they operated, the Bell System was also judicially constrained by the terms of the 1956 Consent Decree between ATT and the Department of Justice[16]. That decree enjoined AT&T from entering any market other than regulated common carrier communications (except in the area of defense contracting), prohibited its production arm, Western Electric, from manufacturing any equipment other than used by the Bell system, and required AT&T to licence Bell Labs' patents and provide technical know how to all applicants upon payment of reasonable royalties. Thus, while AT&T's traditional business was regulated, it was barred from entering new markets entirely, and was forced to provide substantial amounts of its technical research, development and expertise to potential competitors (whether producers or users) in both its traditional and related markets.

As the FCC moved to permit competition in telecommunications, and when it could no longer maintain the fiction of a clear line between traditional telecommunications and closely related markets like data processing, the obvious quid pro quo was going to be the permission for AT&T to enter new markets. To achieve that, a revision of the 1956 Consent Decree was necessary, and this is exactly what divestiture achieved in 1984.

The next subsections examine the major regulatory and juridical decisions along the intertwined paths of deregulation and divestiture. Rather than interpreting those decisions in a traditional manner, the intent is to filter them through the lens of the three layers of the network infrastructure model. In the process, we show how the pressures emanating from below and above the three layers led gradually to fragmentation of the infrastructure as a whole.

Competition at the lower layers: Facilities and Management

The FCC decisions over the past 30 years to permit competition in different segments of the national network, have provoked the progressive fragmentation of the physical layer of the network infrastructure. Two sets of decisions in particular have been critical to this fragmentation of the infrastructure from the bottom up. First the "interconnect" decisions, "Hush-a-Phone" (1956) and "Carterphone" (1968), opened the way to provision and interconnection of customer premises equipment manufactured by others than Western Electric. After requiring the use of an AT&T-supplied connecting device for a period, the FCC adopted a registration and certification program in 1975, permitting direct connection to the public network upon meeting technical standards.

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[16] *United States v. Western Electric Company*, 1956 Trade cases (CCH) 68246 (D.N.J. 1956).

These interconnect decisions had two important consequences. First, they transferred control over the ownership and uses of interconnect equipment from AT&T to the users. This directly permitted the users themselves, acting through their choices in the market, to determine what kinds of equipment serving which ends would be interconnected to the national network. The decisions opened a small loophole for users through which they would eventually push their development and use of entire private networks.

Second, substantial control over the development of terminal equipment was transferred from AT&T to rival suppliers, who could later underwrite the emergence of competitive service supply. Taken together these two consequences were the culmination of mounting pressure from major users and producers on the FCC to give them increasing responsibility for the customer premises portion of the telecommunications network, and to permit a wider range of choice in equipment than AT&T was willing to offer.

A second set of FCC decisions further promoted the fragmentation of the physical network infrastructure, this time by introducing competition in the transmission area. With "Above 890" (1958), the FCC authorized certain large, private corporate users to set up microwave networks for their own use. The "Open Skies" (1972) and the "Execunet" decisions (1977-78) permitted the supply and usage of public network facilities competing with those of the established monopoly. Taken together, these decisions represented the next crucial step in devolving responsibility for control and development of the nation's telecommunications infrastructure to major users and suppliers of equipment and services.

Behind these decisions was the argument that new network technologies based on microwave transmission or microelectronics made it technologically and economically feasible for several firms to provide competing network facilities and services. Moreover, even if telecom networks were still to be considered as a natural monopoly, precluding competition restricted innovation and denied network users potential benefits of diversity that far outweighed the benefits of scale and scope economies[17]. In consequence, the physical network infrastructure was no longer considered indivisible, and rival network providers were allowed to compete with AT&T.

Indeed, private networks (or networks designed for a specific set of users) made it progressively easier to internalize subsets of the external economies traditionally associated with the infrastructure: Those building the networks were increasingly able to reap a larger share of the benefits the networks generated. The telecom network(s), regulators believed, behaved less and less like a traditional infrastructure, and resembled more and more a set of competitive products and services, more fit for market mechanisms than for government regulation.

[17] This set of arguments is put forward in the set of decisions concerning MCI, most notably *Execunet*.

Of course, management of this fragmented physical infrastructure was equally fragmented, with each competitor controlling its own network. However, the management layer also became somewhat more fragmented as outsiders to the Bell network were allowed increasing control over the management of the lines they leased from the public network. The third set of FCC decisions "Resale and Shared Use" (1976-1981), substantially amplified the impact of the above decisions by eliminating restrictions on the resale of leased circuits, and on the sharing of bulk rate leased circuits. It gradually eroded AT&T's monopoly over the management of its own network facilities as it permitted users to manage circuits that were owned by Bell but no longer controlled by the monopoly.

In effect, these decisions further devolved to users control over the proliferation of new networks that together constitute the nation's telecommunications infrastructure. They permitted users to further fragment the network and to gain added control over smaller pieces of the network for dedicated uses, this time through the more open access it granted them to the management layer of the network. In essence, this prefigured the "unbundling" of the network that would be developed later in the third Computer Inquiry (see below).

The introduction of fragmentation into the management and facilities layers of the network was given a dramatic and radical boost with the break-up of the Bell system. The divestiture settlement, as modified and approved on August 24, 1983 (the Modification of Final Judgment, or MFJ), marked the beginning of a new era of competition in telecommunications services and equipment, and represents a new charter delimiting the terms and dynamic of that competition.

The divestiture took effect on January 1, 1984, carving the old Bell System into the new AT&T and seven regional holding companies encompassing the 22 existing local operating companies. AT&T retained the long distance network and services, Western Electric, Bell Labs, ATT-Information Systems, and AT&T-International. AT&T remained regulated only in its long-distance business, and was left free to enter any other market (except local service) on an unregulated basis.

The Regional Holding Companies own and control the embedded local public switched telephone network over which they retain a monopoly. They may enter new businesses (except long distance and manufacturing), but must first obtain a waiver from the MFJ restrictions by convincing the Court that they can not abuse their monopoly power to gain unfair advantage in the market they seek to enter. To date, the court has more or less barred the Regionals from participating in the provision of information services at the applications layer. Paradoxically, the Bell System remnants remain the only major entities without freedom to operate on top of their own networks.

Competition on top: The diversification of Applications

The dramatic proliferation of applications reinforced the fragmentation of the network infrastructure, this time from the top (application) layer down. The telecom networks were no longer used simply to transmit telephone conversations, but supported a growing variety of uses, made possible by the convergence of data processing and communications. The fourth important set of FCC decisions, the first two Computer Inquiries (1971 and 1980), acknowledged this convergence and attempted to draw the line between the traditional telecommunications services, which remained regulated, and the rapidly growing new data processing services, which were unregulated.

Computer I adopted an ambiguous and untenable "relative use" standard to draw the line -- was the relative use of the service in question mostly telecommunications or computing? Critically, it acknowledged that AT&T was barred by the 1956 Consent Decree from offering services the "relative use" of which was mostly computing. AT&T responded by refusing to lease its circuits to data processing service companies, on the ground that their use of these lines was an impermissible resale of circuit capacity. The subsequent resale decisions forced the removal of this roadblock, and cleared the way for AT&T's entry into the new competitive data services market after Computer II.

The Computer II decision eliminated the definitional problems and moved substantially toward complete deregulation. The FCC adopted a distinction between basic transmission and enhanced services. Only basic transmission was to remain regulated, while enhanced services remained fully deregulated.

The FCC's decisions in this area were a product of intense but conflicting pressures from users and AT&T. From the user side, there were enormous pressures to acquire data networking capabilities and services necessary for their own competitive strategies, but unlikely to be provided in a tailored way by AT&T alone. For the FCC, the desire to create a competitive market in enhanced services was the justification. AT&T, in turn, was willing to permit further devolution of control over the evolution of the network in return for freedom of play in the fastest growing markets -- data communications and information processing.

Critically, the application layer -- and primarily data applications -- typically grew "outside" of the traditional conceptual framework governing telecommunications policy, characterized by monopoly, mandated connectivity, and universal service obligation. This was partly because the application layer had been outside of AT&T's realm, but also because regulators did not wish to bring it within the traditional regulatory framework, for fear that this would stifle innovation and diversity. From the beginning, competition ruled the provision of all applications that went beyond basic telephony, and fragmentation was therefore pervasive.

The diversification of applications fostered further fragmentation of the lower network layers. Providers of specific applications sometimes believed the existing public network was not perfectly adapted to the service they sought to offer. In turn, they chose to build and operate their own facilities. In fact, it was precisely to provide applications and services not available through the monopoly Bell system that MCI was authorized to build its own facilities and compete with the Bell network. In this way, many of the decisions creating competition in facilities were intertwined with pressures emanating from the top network layer. Indeed, as argued above, the break-up of the Bell System itself was the culminating response to those pressures.

The problems of fragmentation: roots of ONA

Radically transformed by deregulation and divestiture, a new network infrastructure has emerged, characterized by increasing fragmentation and differentiation: fragmentation of ownership, control, access, and of the network itself; differentiation of uses, providers and clients. The operation, management, and evolution of this infrastructure has become less and less regulated, increasingly ruled by market competition. While competition galvanizes innovation and gives users better control over their communications resources, the concomitant fragmentation of the national telecommunications infrastructure imposes two main limitations on the applications and services it delivers, posing problems for the companies and economy relying upon these for competitiveness. These two limitations are (1) the inability of the largest network operators, the BOCs, to provide information services, and (2) the difficulty --sometimes the impossibility-- to develop integrated applications spanning various segments of a fragmented underlying facilities and management infrastructure.

First, the largest providers of the two lower network layers, the post-divestiture BOCs, have been mostly barred from the provision of enhanced applications through restrictions imposed by the MFJ. The regulators' intent was to preserve open and fair competition in the enhanced applications markets by keeping the Bell Companies out of it so long as their networks represented bottle-neck monopolies at the local level. There is however another way to understand this argument: the BOCs would have an advantage in the enhanced services market not simply because they could unfairly --and inefficiently for the users-- abuse their monopoly power, but rather because it is more efficient to provide some enhanced services as an integrated part of the basic network.

ATT and the BOCs are the main proponents of this second view, and were able successfully to argue that Computer II's separate subsidiaries requirements barring them from providing enhanced services as an integrated part of their basic network entailed excessive costs and resulted in inefficient use of the public network. This was one of the FCC's main reasons for seeking further de-regulation through its Computer III inquiry. In the FCC's words, "the Computer II structural separation requirements have denied the public the benefits of enhanced services that cannot be offered unless they are integrated into the public network" [18]. The FCC's Report and Order cites as examples of such services "protocol conversion, VMS services, and innovative routing and switching functions."

Another parallel current in US regulatory politics is seeking more freedom for the BOCS, this time through elimination of the MFJ restrictions. In this effort, the Bell Companies are joined by the FCC (for the reasons explained above), the Department of Justice (DoJ), and the Commerce Department through its National Telecommunications and Information Administration (NTIA). As part of the DoJ's first triennal review of the divestiture, it argued that the proliferation of bypass alternatives had eliminated the local network bottleneck, and therefore made the MFJ restrictions superfluous[19]. The NTIA has taken the lead in that coalition, for a number of reason that include its desire to see the manufacturing restrictions rescinded so that the BOCs may contribute something positive to the telecommunication's trade balance.[20]

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18 FCC, *Third Computer Inquiry, Report and Order*, released June 16, 1986, p. 29.

19 Huber, *op. cit.*

20 Morgan, Kevin, and Douglass Pitt, "Coping with Turbulence: Corporate Strategy, Regulatory Politics and Telematics in Post-Divestiture America", *Proceedings of the Communications Policy Research Conference*, Windsor, June 1988.

The court however refused to make any fundamental change in the MFJ restrictions, arguing that the BOCs monopoly bottleneck remained as strong as at the time of divestiture. Judge Green further expressed doubts in the FCC's ability to prevent anti-competitive behavior on the part of the BOCs without structural safeguards[21]. However, the Court's decision allowed the BOCs to provide gateways for videotex and other information services, with features limited to data transmission, address translation, protocol conversion, billing management, and introductory display and help screens. In addition, Greene's ruling allowed the BOCs to offer electronic mail and voice mail within their local access and transport areas (LATAs). These authorizations joined the more than 100 waivers already granted to various BOCs to enter an array of businesses outside basic local telecommunications, from real estate to engineering consulting services.

The combined pressures to lift the structural separation safeguards and to rescind --or waive-- the MFJ restrictions, tend to place increased capabilities within the public network. They promote a conception of the public telecommunications infrastructure as an integrated resource directly able to satisfy an increasing variety of user needs. This conception contrasts with another which conceives the telecommunications infrastructure as a reservoir of network pieces available for major users and service providers to pick and choose from, and assemble in various configurations to serve their particular needs. It is this latter vision which more directly runs into the second kind of limitation imposed by the infrastructure's fragmentation.

Indeed, the fragmentation of the underlying transmission and management layers of the network infrastructure seriously limits the development of information services in two ways. First and most obviously it leads to fragmented applications, thereby restricting their potential economic benefits. There are today, for example, some 10 major electronic mail services in the US, offered over distinct networks (MCI's MCI-Mail, AT&T's ATT-Mail, Telenet's Telemail, etc...) which are not interconnected[22]. Similarly, it is often difficult to integrate various applications which were initially developed for different economic sectors over different networks.

Second and more insidiously, lower layer fragmentation prevents Enhanced Services Providers (ESPs -- the non-regulated players of the top application layer, which could include divisions of major users which provide internal corporate information services) from fully drawing on the resources imbedded within the public telecommunications infrastructure. They are unable to integrate their applications tightly and efficiently within the transmission and management mechanisms of the regulated networks they use to deliver their applications. They are, in short, denied the benefits of full use of an integrated network infrastructure.

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21 Judge Greene, *Opinion, US vs Western Electric, Civil action 82/0192*, Washington DC, District Court, September 1987.

22 Importantly, this is not a problem of standardization: the standard, CCITT's X.400, exist and has been adopted by most E-mail providers. Rather, it is strategic decisions by the E-Mail providers, such as their understandable reluctance to share user directories, that prevent interconnection because of the problems they raise within the management layer. It is interesting to remember that similarly for the interconnection of the various railroad systems in the US, physical standards (gauge, links between cars...) posed only minor problems while interoperability within the management layer (handling of foreign cars, harmonization of tariffs and schedules...) took much longer to achieve. Chandler, *The Visible Hand*, chap 4: Railroad Cooperation and Competition.

The main regulatory thrust of the FCC today, embodied in its Computer Inquiry III, is an attempt simultaneously to overcome these two limitations fragmentation has imposed upon the infrastructure's efficiency. Computer III aims to develop a framework that can both do away with structural separation, allowing the BOCs to provide information services, and provide better access for ESPs to the public network. The FCC initially proposed the intermediary concept of Comparably Efficient Interconnection (CEI). CEI standards require that RBOCs which offer an enhanced service make available to other enhanced service providers on an "unbundled and functionally equal basis" the basic services they use to provide their enhanced service.

The current proposal, to adopt an Open Network Architecture (ONA), emerged as a response to the FCC's request for CEI. ONA goes beyond CEI: while the CEI requirement is triggered only by a BOC's decision to offer an enhanced service; the ONA proposals would promote the automatic provision of comparably efficient interconnections to all who deliver services over the public network, be they the BOC itself or competing information service providers. In essence, the FCC hopes that widely deployed ONA would "provide a self-enforcing framework" to "promote the efficiency of the telecommunications network, in part by permitting the technical integration of basic and enhanced services and in part by preserving competition through the control of potential anticompetitive behavior by the carriers".[23]

The ONA concept contains two major elements, corresponding to two meanings of the word "open". First, the network would be "open to all equally." ONA would provide a standardized, equally available interface with the public network to all competing ESPs, including the BOC itself in its role as an ESP. Second, the network's service would be cracked open, "unbundled" into its various elementary components, the Basic Service Elements (BSEs), which would become individually accessible.

Neither equal access nor fragmentation represent anything new within the US telecommunications regulatory context. Indeed, they constitute the essential basis that permits competition within the US network infrastructure. However, **what is new is that ONA carries equal access and fragmentation into the very heart of the network, its switching and signalling mechanisms, what we have called the network's management layer.**

In this sense, ONA can be seen as the ultimate step of a fragmentation process started 30 years ago with Hush-a-phone.[24] Deregulation and divestiture have fragmented the transmission facilities of the US network infrastructure, the proliferation of uses has reinforced that fragmentation, now ONA will fragment its intimate management mechanisms. Paradoxically however, ONA could also become the antidote to the infrastructure's fragmentation. If it succeeds in providing equal access to the various pieces of the infrastructure, it could offer virtually integrated management mechanisms, overcoming the infrastructure's physical fragmentation.

It is, however, a very open question whether it is possible to provide the benefits of integration through virtual management of a diverse infrastructure. Rather more certain, by contrast, are the benefits of diversity that have flowed from the fragmented infrastructure to the largest, most sophisticated U.S. users. The next section examines their experience.

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23 FCC, *Computer III Report and Order*, at p. 104.

24 Alain Vallee, "Les reseaux ouverts: Concept - Enjeux - Perspectives", in *Les Dossiers du SPES*, France Telecom, March 1988.

II. INFORMATION NETWORKING AND CORPORATE STRATEGY

Digital telecommunications networks have become pervasive facts of life at the leading edge of corporate practice in the United States. Once simply taken for granted and usually neglected in corporate strategy, privately controlled network facilities and the communications services run over them are increasingly strategic assets to the largest business users.[25] Reflecting this trend, corporate spending on information technology hardware as a percentage of total business equipment investment has at least quintupled over the past decade, while the U.S. telecommunications equipment and services industries, driven largely by business user demand, have grown to become nearly a 200 billion dollar economic sector.[26]

The dramatic and rapid adoption of this technology by America's leading corporations is in part a competitive response to radical shifts in formerly stable market environments over the past two decades. During that time, U.S. manufacturing has been jolted by vastly increased international competition and by a succession of external shocks ranging from multiple oil crises to dramatic currency fluctuations. Leading edge U.S. services have been similarly vexed, particularly in the critical financial arena, by the double whammy of increased international exposure and successive domestic deregulations that redrew established market boundaries.

Competition and external shocks eliminated the stable and steady growth America's great corporations had come to expect. Those mass producers and distributors of goods and services had developed because administrative hierarchies could coordinate more efficiently than markets the rapid, high-volume flow of goods and services to mass markets -- in effect, the visible hand of managerial coordination outperformed the invisible hand of the market.[27] By internalizing and coordinating the numerous transactions in the chain from supply to customer, the large corporation imposed stability on market relations and thrived on it.[28]

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25 By using the modifier 'privately controlled', we mean to separate issues of network ownership from issues of who controls the configuration, access, functionality of, applications delivered, and data generated over communications networks. Thus, our definition of 'privately controlled' networks would include corporate networks that combine lines leased from common carriers with wholly-owned transmission and switching, jointly owned inter-organizational networks, and software-defined networks operated jointly with common carriers, so long as the corporate customer dictated configuration, access, and applications within the available functional constraints of the network.

26 Hardware spending is from data compiled by BellSouth; total telecom sector sales as compiled by CBEMA and detailed in CommunicationsWeek, November 28, 1988, p.1 and 40.

27 This is argued persuasively in Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business*, (Cambridge: Harvard University Press, 1977).

28 The analysis of corporate hierarchies as internalizing transactions costs is developed in R. Coase, "The Nature of the Firm," 4 *Economica* 386 (1937) and expanded upon by Oliver Williamson in, e.g., his *Markets and Hierarchies*, (New York: The Free Press, 1975).

But as stable market relationships came unstuck in the 1970s, the costs of coordinating the corporate enterprise rose in hand with the inability to fully use all available corporate resources.[29] Simultaneously, the penalties associated with slow adaptation to the changed environment also rose dramatically. Indeed, as several U.S. companies -- and on occasion entire industries -- discovered, entrenched market positions could be eliminated in remarkably short order.[30] One consequence was the turn to technology which could simultaneously increase effective coordination and better utilize corporate assets, while increasing the speed and flexibility of corporate response to rapid market shifts and reducing the information costs of gauging them. Self-evidently, information network technology fit the bill precisely.

Information technology was readily available partly because most of the products were developed first in the U.S. and normally in conjunction with large U.S. customers. Of perhaps greater importance to those customers, however, was the availability of integrating and managing the technical resources and information flows through the development of privately controlled networks. Here, as the last section suggested, U.S. business was assisted considerably by the gradual devolution of control over communications facilities and services from government regulated monopoly to users expressing demand through the market.[31] For those able to exercise substantial market power, notably the leading edge large businesses of the economy, the increasing competition in U.S. communications markets meant access to dramatic and diverse innovations in communications products and services.[32]

The innovations have been put to good use, initially in better managing a company's internal processes through improved coordination and asset usage, radically increased responsiveness and flexibility, much better information access, analysis and feedback to new products and services. In turn, leading users are being transformed as they deploy the network technology of information control, gain experience with it, and learn from its development and use. Fundamental changes in the ways that firms organize internally and with their suppliers and customers, radically altered patterns of information gathering, analysis and responsive competitive behavior, dramatic consequent transformations in business strategies, are all increasingly observable phenomena on the terrain where the leading users play.[33]

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29 For an analysis that argues a similar logic of adaptation, see Cristiano Antonelli, ed., *New Information Technology and Industrial Change: The Italian Case*, (Dordrecht: Kluwer Academic Publishers, 1988) at Chapter 2.

30 For example, the U.S. machine tool industry saw its Japanese counterpart's U.S. market share for certain kinds of numerically controlled tools increase from 5% to 50% in four short years in the late 1970s, while the U.S. chip industry lost its international leadership during the early years of the 1980s. Even mighty GM has lost 10 percentage points of market share in the past few years. And the U.S. banking industry now boosts only one player in the world's top 20, compared to __ less than a decade ago. Similar evidence is obvious in most other major industries.

31 We have explored this devolution of control in Michael Borrus, François Bar, et. al., "The Impacts of Divestiture and Deregulation: Infrastructural Changes, Manufacturing Transition and Competition in the U.S. Telecommunications Industry" *BRIE Working Papers* #12, (Berkeley: BRIE, 9/84). We reinterpret it in section II below in the context of our concern with infrastructure and economic performance.

32 Fostering such diversity and innovation was, indeed, an avowed aim of U.S. de-regulatory policy.

33 The case studies of the U.S. User Group attest to these changes, as do numerous other cases drawn from the literature cited in the prior footnote. This contrasts with the conclusions for European large users drawn by T. Muller, B-A Vedin and G-M Holst in their "Large Users' Experience of Advanced Telecommunications Technology," (Stockholm: Holst-Vedin Information AB, November 1987-March 1988). As we indicate below, however, we believe that their conclusions reflect the more limited experience of and greater constraints on European large users of digital networks. As the European

USING TELECOMMUNICATIONS TO CREATE COMPETITIVE ADVANTAGE

Companies have discovered how they could use the new telecommunications technologies to streamline their operations and modify their competitive environment to their advantage. They are now using corporate networks to achieve a variety of competitive effects: to re-organize their internal operations, to fashion and better control their marketplace by linking up with their clients, or to coordinate and integrate their suppliers' production processes with their own.[34] With those strategic objectives in mind, companies have deployed complex network arrangements, combining pieces of the public networks with elements of their own, jealously guarding critical management and control responsibilities while sharing or subcontracting others.

Corporate networking is on the rise and companies setting up their own networks no longer constitute exceptions. A study by the US General Accounting Office indicated that between 16 and 29 percent of large-volume telephone company customers are bypassing their local telephone companies, and that up to 53 percent of the large-volume customers are considering plans to initiate or increase such bypass activity.[35] If anything, these figures underestimate the true extent of bypass, since they rely on voluntary surveys of companies that have no incentive to advertise the fact that they bypass.[36] Because they are only concerned with bypass of the Local Exchange Carriers, these studies also underestimate the extent to which companies are installing private networks that reach far beyond the local level.

To be sure, corporate networks are not strictly *private* networks, since they rely extensively upon a variety of public networks. They may be more accurately described as *privately controlled* networks. Indeed, what matters in the end is who controls the configuration of and access to the network, not whether a specific link is an optical fiber that belongs to the user, or a T1 rented from AT&T. Companies have many reasons for taking charge of their telecommunications: reduce their phone bill, cut operating costs through better coordination, gain market share through better links with clients, or improve products through better communications with subcontractors.

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communications scene changes, we believe large European firms will come to experience many of the strategic changes we have found in the U.S. cases.

34 A rapidly growing business literature draws from examples of the network applications installed by some pioneering companies, to guide the efforts of other businesses. We draw substantially on that literature to complement our own research. See for example: Peter Keen, *Competing in Time: Using Telecommunications for Competitive Advantage*, Ballinger Publishing, Cambridge, MA, 1986. Charles Wiseman, Strategy and Computers: Information Systems as Competitive Weapons, Dow Jones-Irwin, Homewood IL, 1985. Byron Belitsos & Jay Misra, Business Telematics, 1987. And a series of articles in the Harvard Business Review: Erik Clemons & Warren McFarlan, "Telecom: Hook up or Lose out", July-August 1986 ; Michael Porter & Victor Millar, "How Information gives you Competitive Advantage", July-August 1985 ; Warren McFarlan, "Information Technology Changes the Way you Compete", May-June 1984.

35 U.S. General Accounting Office, *Telephone Communications: Bypass of the Local Telephone Companies*, (GAO/RCED-86-66), August 1986, p 36.

36 Peter Huber, *op. cit.*, at appendix E: "A survey of Bypass Surveys".

However, while the benefits of networking seem quite obvious, there are many distinct ways to deploy a particular set of telecom technologies towards these goals. Technology offers a set of possibilities, but neither determines nor dictates the specifics of the network arrangements corporations deploy. Rather, the shape and characteristics of these networks can be traced back to the competitive strategies that motivated companies to build them in the first place. They also reflect the constraints of a particular regulatory and market environment.

This section examines the network strategies of several large American companies.[37] Through these cases, we explore how the strategic goals of these companies have shaped the networks they have built, and how these corporate networks reflect the specific constraints and opportunities set forth by the US telecommunications environment. The links between strategies and networks, as well as the impact of the US environment on network deployment, pervade the three layers of the network infrastructure: physical facilities, control mechanisms, and applications. The exploration of these links provides concrete examples of how telecommunications networks function as an economic infrastructure, and sets up the discussion to be carried out in section III.

We examine two distinct areas of information networking, placing the emphasis on different characteristics of the process. First, through an analysis of inter-company networking in the textile/apparel, distribution and automotive industries, we examine the potential of information networking to transform and restructure the market and coordination relationships among economic actors. Second, with examples from a bank, an electronics manufacturing firm and an automaker, we focus more particularly on networking within companies, and on its relationship to learning and experimentation.

Levi Strauss & Co. has built LEVINET, its corporate network, to link its San Francisco headquarters with some 50 production and distribution facilities throughout the United States. A major strategic thrust behind the deployment of Levi's network has been to better coordinate and integrate different functions, from design and manufacturing to distribution and sales. All of Levi's mainframes are located in the San Francisco headquarters, which constitutes the hub of the company's information network. They process design and manufacturing data, manage orders and inventory management, allocate production among the various plants, act as an order entry gateway, and manage the company's electronic mail. Through a mix of private and public network links, Levi's has extended LEVINET towards its markets, providing applications such as order entry and inventory management for sales representatives and retail stores.

Levi's has opted for local production: over 90% of the products it sells in the United States are entirely manufactured here. This decision has made it harder for Levi's to rely on cheap labor for competitiveness, forcing the company to focus more directly on optimizing its operations. LEVINET was considered an essential tool to achieve company-wide integration. Levi's integration effort was initially focused on its internal operations (links between plants, distribution centers and headquarters) and later extended to the development of downward links with sales offices, sales representatives, and retail outlets outside of the company.

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[37] The case studies of Levi Strauss, McKesson, Bank of America, General Motors and Hewlett Packard, are based upon extensive interviews with many of the companies' personnel in charge of networking strategy and operations. We only stress here specific aspects of these corporate network strategies. Complete descriptions are included in the case studies in appendix.

We examine here more particularly this second dimension --downward integration toward the marketplace-- for two reasons. First, it provides very interesting insights into the links between Levi's business strategy and its approach to networking, and second, its emphasis on open interconnectivity is quite original in the US context. The strategy rested on the development of industry-wide standards to facilitate communications between the retail outlets and apparel makers. At its root was the recognition that network-based integration within individual firms would not suffice to ward off foreign competition, that the full benefits of integration could only be captured through a concerted effort led jointly by the various members of the industry.

The textile/apparel industry in the United States is somewhat of a late-comer to the use of electronic links between apparel makers and distributors. Whereas the supermarket industry adopted Universal Product Codes (UPC, bar-codes), check-out scanners and early versions of Electronic Data Interchange (EDI) back in the mid-1970s, the textile-apparel-retail "filière" only started to move in that direction about ten years later. However it was able very rapidly to agree on industry-wide standards underlying the implementation of a quick response system.

Levi's played an important role in this evolution, and in the creation two years ago of the Voluntary Inter-industry Communications Standards committee (VICS). VICS is an ad-hoc group of top retailer, apparel and textile executives, established to tailor standards such as UPC, EDI, PLU (Price Look-up Architecture), and SCS (Shipping Container-marking Standard) to the specific requirements of their industry, making possible direct electronic links and the so-called "Quick Response" industry system based upon these standards.

Because Quick Response emerged in the textile/apparel as a joint response of the US industry against foreign competitors, it was typically implemented in a manner quite different from other sectors. In other sectors, companies have implemented proprietary communications schemes to lock-in their business partners through non-standard interfaces and applications. The apparel complex however sought to establish a broad consensus on standards before any single company set out to implement EDI on its own. Levi's insists that this also results from the character of the apparel business, where fashion and consumers' tastes are really what matters in the end: while it may be possible electronically to lock-in drugstores which have little choice about where the drugs they sell come from, it would be much harder to force retailers to buy clothes against their will --and the will of their clients--. EDI in the textile industry was conceived not as a competitive strategy of one firm against another, but rather as a competitive strategy for the US industry as a whole.

As part of this strategy, Levi's developed information networking applications that would help retailers better to fit within the quick response system. These include toll-free numbers (800-FOR LEVI) which the smaller stores can call to place orders or follow a shipment's status, and applications which allow "telereps" (the company's sales representatives on the receiving end of these calls) instantly to access a customer's information. For stores with higher business volume, Levi's offers LeviLINK, a store automation package, with features ranging from product-marking to facilitate data collection in retail stores and inventory management, to some direct communication services with Levi's for retailers to order products and receive invoices electronically.

All these applications adhere to the industry standards developed within the VICS committee. Moreover, except for those applications which cover business functions strictly within Levi's, the company did not seek proprietary control over the electronic link and application. In particular, retailers must obtain LeviLink software and supporting hardware through third parties, and have the option to use other comunication systems, as long as they follow the industry standard. In all cases, Levi's provides free assistance and training for retailers who want to establish on-line links. -

Levi's primary objective is not to "lock-in" its retailers through the use of proprietary communications interfaces, or to generate revenues through the sale of store automation services, but rather to encourage the rapid diffusion of electronic data interchange between the various industry actors. The three main characteristics of its approach to networking with retailers reflect this goal: emphasis on industry-wide standards and interconnectivity, a concerted approach at the industry level, and the promotion of joint learning through such efforts as the education of retailers.

This approach starkly contrasts with those adopted by companies in other sectors of the US economy. For example McKesson, the leading US distributor of drugs and non-durable consumer products, has built its success around proprietary network applications which allow its client-retailers to transmit their orders directly to the company over public telephone lines. As they walk through their store, they scan the tags of products they need, then plug the scanner into a phone jack to transmit their orders directly to McKesson's central computer. Once received, the order is automatically processed and dispatched to the appropriate warehouse. There it generates a series of "bills of lading", helping employees to optimize their routes through the warehouse as they box the merchandise, to optimize the loading of delivery trucks so that the first box to be delivered finds itself on top, and then optimize the delivery route. Thanks to its information network, McKesson can guarantee its customers that, if they dial in an order before 4:00 pm, the products will be delivered the next business day before 10:00 am.

To a large extent, the functions and benefits of this system are essentially similar to those performed by Levi's Levilink. For example, both systems shift workload towards the retailers, who become responsible for entering order data and checking their accuracy; both facilitate retailers' access to their suppliers, acting as permanent sales representatives on the retailer's premises. There are however some critical differences between the strategic goals of Levi's and McKesson, reflected in quite distinct implementations of their respective network applications. Most importantly, while Levi's has decided to promote industry-wide standardization, McKesson on the contrary has consciously designed its application around proprietary standards, as part of its effort to retain tight control over the networking application and the information generated through its use.

This choice reflected McKesson's desire to generate additional profits through the sale of information services bundled with its distribution activity. For example, the market information gathered through this ordering system enables McKesson to offer marketing advice to its retailers, or to analyze the effectiveness of various shelf lay-outs. Whereas Levi's lets third parties offer equivalent services as part of store automation packages, McKesson retains control of the information in its own mainframes. Furthermore, McKesson's proprietary standards make it harder for the retailers who use its system to switch to another supplier: they would need to adopt a new order entry system, reorganize their operations to some extent, and learn to use another order entry device.

These different networking strategies largely reflect the business environment the two companies operate within. In particular, Levi's business is to produce jeans, not to distribute them, while McKesson's is to distribute products, not to make them; McKesson's competitors are US-based companies, while Levi's mainly fears competition from low-wage foreign countries. As a result, the functions they require from their corporate networks differ, and the ways in which they chose to implement links with retailers similarly differ.

In essence, the network deployed by suppliers becomes the marketplace in which retailers order and buy the goods they sell. Over this network, retailers increasingly perform all the operations they normally go through in a market transaction. Through the network, they check products availability and prices, place orders, effectuate payment, track shipments' status. McKesson's control over this network-marketplace gives the company a decisive competitive advantage over its competitors. Levi's has chosen to forego such control, estimating there were greater benefits to be had through industry-wide rationalization and standardization.

The telecommunications environment in the United States makes both strategies possible. However, because it relies on market forces to shape network evolution, the US environment will best serve the needs of those users able to articulate clearly and express forcefully their demand for specific network arrangements. Inevitably, this tends to favor the desires of the most powerful telecom users, large companies. Levi's or McKesson's network strategies, rather than their retailers', will therefore shape the evolution of the nation's telecom infrastructure. For example, where corporate users' strategies demand interconnectivity, standards will emerge more easily than where they wish to protect their network-market behind the barriers of proprietary standards.

The automation of links between automotive firms and their suppliers and subcontractors follows yet another pattern.[38] The major automobile makers now require their parts suppliers to provide on-line information about their products, such as specifications, prices, and stock on hand. They see this as the telecommunications foundation for an American version of the "just-in-time" procurement system. Like their Japanese competitors, US automakers hope to unload onto peripheral firms the costs and responsibility of maintaining adequate stocks for parts, absorbing some of the risk connected with product development, or adjusting workforce during downturns. However, they wish to retain tight coordination among various parts of the production process. In Japan, coordination largely rests on close proximity and intricate relationships between automakers and their parts suppliers. By contrast, US production plants typically are more dispersed, and relationships looser. On-line links between firms participating in the same production process are expected to relieve some of those problems. Built around Electronic Document Interchange (EDI) standards, they allow the buyer to order parts only when needed, to review automatically the offerings of a variety of suppliers to check for the lowest prices, or to transmit working drawing and design specifications.

38 The authors' research on electronic links between auto makers and their supliers was commissioned for the State of New York by the Governor's Industrial Cooperation Council, to be published as *Infrastructure to the Information Economy: Telecommunications and Economic Development Strategy*.

39 We elaborate more fully in part III of this paper on the implementation and effect of such Electronic Document Interchange (EDI) applications.

As opposed to what now exists in the textile/apparel industry, there is still no generally accepted standard for EDI transactions in the auto sector, where each automaker dictates its own standards. This poses problem for the small parts manufacturers, who typically sell their products to several auto makers. They often find themselves in a delicate situation when their clients come to them one after the other, demanding that they implement EDI links requiring distinct configurations and standards. This often results in inefficient duplications, as they need several different software packages --sometimes different hardware-- to communicate with their clients. Their personnel must learn to operate the various systems, a challenge in many small machine shops. Perhaps more critically, this hinders integration of their customer systems backwards into their internal operations: many small firms print out the EDI orders they receive, to key them again into their own computers. Moreover, the automakers seldom provide any help for their small suppliers to adopt on-line systems.

The case of General Motors illustrates how US automakers have gone about establishing electronic links with their suppliers. GM produces approximately 70% (in value) of the components it uses in its cars, the highest such percentage among the US auto-makers. Many of those parts are produced by the so-called "allied" suppliers, which are part of the GM Corporation, such as GM's Delco and Harrison radiator component divisions. General Motors also does business with about 40,000 non-allied suppliers of materials. About 5,000 are "direct" suppliers, from which GM buys parts that go directly into the production of a automobile (brake pads, starters, fasteners,...). The remaining 35,000 are "indirect" suppliers, whose products are used indirectly by GM, but which are not incorporated into cars (office machines, lubricants, tools, banking,...).

Over the past few years, GM has developped Electronic Data Interchange (EDI) applications to automate its exchange of orders, invoices, and other business documents with these suppliers. From the beginning however, these applications were implemented independently by various GM divisions. As a result there was little consistency among the various EDI systems used within GM, and various applications sometimes followed different standards. Two years ago, an EDI group was created within EDS to serve as a central resource to the various account managers. Until this year, there was no active campaign to implement EDI applications throughout GM. The main reason for this lack of emphasis was that EDI was not perceived as a major problem at the corporate level. Early this year however, GM made a commitment to promote a concerted deployment of standardized EDI applications throughout the company.

GM has already made efforts to standardize its various EDI applications along the ANSI X.12 standard supported by the Automotive Industry Action Group (AIAG). EDS has put in place an EDI translation application available for all suppliers. They can call up a bulk data switch in one of the IPCs to transmit a "flat" file containing the EDI information under their own format. This information is then translated into an X.12 file and routed by the switch to the appropriate GM location over EDS*NET, GM's private network.

GM's allied suppliers are often those with which EDI deployment is furthest along. Some EDI applications are combined with just-in-time delivery systems. For example, the Saginaw axle plant receives direct orders from the assembly plant, which also indicate in which order to ship axles with the right sequence of options, so they can be used directly in the assembly process as they are received.

One of the current limitations of this system is that it is limited to EDS*NET and cannot reach outside, for example to connect to EDI services provided by other companies such as GE Information Services. Also, the bulk data switches handling the EDI application operate independently, and cannot, for example, consolidate orders or invoices before transmitting them.

Further, the EDI transaction must be done on GM's terms, which poses problems for the many suppliers who also do business with other companies, which use different EDI systems. For example, Chrysler runs its EDI transactions through GEISCO's FastBatch application, and Ford uses CMMS, a proprietary system, while GM's EDI requires an SNA connection to run over EDS*NET ; many of their suppliers are also suppliers to companies such as Navistar or Westinghouse which use yet other protocols. In some cases, suppliers need to use different equipment to hook-up with their different clients. Even when they are able to use common hardware, they still run into problems when they try to integrate the software packages they use, which must follow different standards. Some of these problems will be eased by the transition towards X.12 promoted by all constructors within the AIAG, but the task is not simple because of the variety of non-standard systems already in place. Indeed, for each of the past three years GM has announced it would generalize the use of the X.12 standard and three times, has missed the self-imposed deadline .

As the GM case illustrates, today's EDI links in the automotive sector exclusively reflect the demands large auto makers place on their small parts suppliers. From the supliers' point of view, they often merely represent an increasing cost of doing business and do not yield any direct benefit. However, if the lack of standardization between the different systems clearly handicaps small suppliers, it hardly benefits GM, Ford or Chrysler. Indeed, they do not need to "lock-in" their suppliers through proprietary communication links. Their power over small suppliers is usually well established and many factors matter much more to the choice of a supplier than merely its ability to interact on-line.[40] In the end, it would seem that if suppliers cannot take full advantage of information networking technologies, in particular to integrate their design and production process with their customer's, the auto-maker will likely bear the costs in the form of higher parts costs or longer product development cycles. However, it may take them a long time to become conscious of those costs. Until then, little market pressure will bear upon the network's evolution to bring about interconnectivity. Certainly the small suppliers, who today are keenly aware of the problem, cannot muster the economic clout necessary to force this evolution.

At this early stage, EDI implementation in the auto sector merely hints at the potential of on-line ties among production partners. A few companies, mostly in the electronics sector, are pushing this logic further as they interlink various firms to support a truely networked production process. They are using the network to support interactive CAD/CAM (Computer-aided design and manufacturing) applications, which allow them jointly to design products, interacting in real time with their partners. The Xerox corporation has deployed networks that link its design teams with those of its subcontractors, so that when a modification is introduced in one product, it can instantly simulate the consequences of that modification for the various parts it needs to buy, and integrate the constraints and expertise of its subcontractors (e.g. manufacturability of the

[40] Factors such as high shipment quality levels, simulataneous quality increases and cost reductions, or facilities inspection by customers matter much more directly to large manufacturers' certification of a supplier, according to: *Needs Analysis of the Customer-Supplier Link*, Factory Automation and Computer Technologies, Inc. (FACT), Troy, New York, 1987 (Funded by the New York State Science and Technology Foundation).

part, how the modification will affect cost...) into its own design and manufacturing process.

Interestingly, Xerox would rather be able to implement such interactive links over a public network, but has been forced to develop private network solutions for lack of adequate capabilities within the public network. Public links would make this scheme easy to replicate from its prototype established in Europe to all other Xerox locations. Moreover, they would permit quickly to include new participants in the networked production process at any time. This possibility is particularly important to firms in the electronics sector who need access to state-of-the-art components, and cannot always predict which firm will deliver these. This represents an important difference with the auto sector, where customer-supplier relationships are built over longer terms, and partly explains the contrast between the two sectors' networking strategies. Another important difference lies in the production approaches: While Xerox typically outsources between 60% and 70% of the parts that go into a given product, the proportion is inversed in the case of General Motors. Xerox obviously has a greater need for efficient links with the outside firms which make those parts.

Communications applications among firms increasingly embody the organization of the design and production processes, and the network which supports them incarnates the industrial organization of the emerging "network-firms". Therefore, the design and manufacturing processes they use are only as flexible as the networks behind them. For a company whose production involves many interlinked participants, how easily it can reconfigure its network will constrain how easily it can reorganize its production. How flexibly it can bring in new partners into its networked-production process will depend on how open its network architecture is.

The development of intra-company networks and applications, to which we now turn, highlights some different issues. A major factor behind those differences is that companies naturally have much greater control over the networks they build for their own use. These are usually the first focus of thei private networking efforts, while they often have to rely on more public networks for communications with other firms. How effective they are at exerting this control varies. We examine in particular how two companies, a bank and an electronics manufacturer, have used their control over their internal networks to experiment with these technologies and to learn from their experiments.

Bank of America recently had to recast its information networking strategy. Unable to summon its increasingly divided physical network to provide an ever growing number of applications, the bank's control over its corporate network was in effect stretched too thin by the fragmentation of the two outer layers of the network infrastructure. At the top layer, the proliferation of services made possible by recent banking deregulation had required a wide diversification of the bank's network applications to support these new services. Typically over the years, for each new application it had to implement, the bank had built a new network. This resulted in a profound fragmentation of the bottom (physical) layer of the network infrastructure Bank of America was operating, which at one time counted over 70 distinct networks. There was little or no central control over the development and management of these network facilities. As a result of this fragmentation, bank employees often needed up to three terminals on their desk to access the various applications they worked with.

The cost of managing this multitude of network facilities was rising fast. Perhaps even more problematic was the fact that network proliferation became endogeneous. The lack of coordinated control over the facilities in place made it impossible to mobilize them to support new applications. When the bank needed to develop a new application, it couldn't build it upon existing network(s), and had to deploy yet another network. The resulting delays frustrated BofA's introduction of new services, threatening the bank's competitiveness in the fast-moving deregulated banking environment.

The impetus for change came from BofA's intention to consolidate various branch applications into an integrated package which could be accessed from a single terminal. The bank was then faced with a choice: build a new $25 million network to support that application, or re-vamp its existing network so it could support all existing applications plus this new one. Bank of America opted for the latter, and embarked upon the construction of its Global Data Network (GDN), which by the end of 1990 will tie together BofA's 9 major processing centers, 130 major branches and 1,100 remote branches.

Having learned important lessons from the way its networks got out of hand in the past, Bank of America has thought long and hard about the best way to manage its new integrated network. It has looked for the best compromise between its need for control over the operation and evolution of its network, and the advantages it can gain from drawing on the extensive network operation expertise of outside public network operators. The result was the establishment of a quite intricate partnership with AT&T.

Ultimate control over its Global Data Network rests with the Bank's BASE (BankAmerica Systems Engineering) headquarters in Concord, CA. It will rely on two separate control centers: one for voice, and one for data. The network management functions are built around a trunk/voice testing and management package initially developed by 3M for its internal use. BofA employs 250 technicians, mostly based in Concord, to monitor its network.

While keeping overall network responsibility within its Concord headquarters, BofA decided to hand over a number of network maintenance tasks to AT&T. AT&T will thus act as the single point of contact for maintenance problems, although the network uses equipment and services from a total of 48 vendors, including IBM, Network Equipment Technologies, Inc. (T-1 facilities and multiplexors), Pacific Telesis, and US Sprint. BofA looked at the possibility of maintaining the equipment itself, but concluded it could get somebody else to do the job cheaper. Moreover, AT&T brings valuable expertise to the task. Ultimately, the Bank wants to be responsible for network testing and will work closely with AT&T which will handle the maintenance and repairs. To reinforce this partnership, AT&T has assigned eight of its employees to work at BASE headquarters in Concord.

Bank of America's networking strategy evolved in two clearly distinct stages. The first stage can be characterized as one of automation. The bank built a series of network facilities and applications to automate existing operations. These networks directly mirrored the operations they were designed to automate and as a result, separate networks were built to automate separate operations. Through its use of networking during that first stage, BofA accumulated two distinct types of knowledge and expertise: a better understanding of the potential of network technologies it experimented with, and better information about the banking processes it was automating, derived from the data gathered through each new information network.

BofA's growing experience with networking began then to underline the need for a second stage, characterized by a thorough reorganization of its network resources. Data accumulated through the automation of individual services showed the benefits to be gained from their integration. The bank's accumulated knowledge about what networking technologies could accomplish opened the way for such integration. During this second stage, BofA was still going to learn from using network technologies as it did throughout the first stage, but would gain knowledge of a different kind by masterminding the deployment of a new integrated network. Such knowledge in the first stage had been confined to the network providers who had put together networks for BofA, or remained dispersed through the multitude of divisions which ruled over its different networks. It could now become explicitely articulated and coordinated to serve as the foundation for the Bank's new networking strategy, to frame such complex partnerships as the one BofA is now building with AT&T for the management of its network.

The evolution of Computer Aided Design and Manufacturing (CAD/CAM) within General Motors provides another illustration of the tight relationship between reorganization and network evolution. GM is currently engaged in a comprehensive effort to reorganize its information processing and networking resources. Dubbed C4 (the four Cs stand for CAD/CAM/CAE/CIM), this strategy aims at deploying a coherent information infrastructure that will serve to integrate design, manufacturing and business processes throughout GM around a core of 3-D CAD data. The new C4 environment, articulated around company-wide standards and open systems concepts, is designed to let GM engineers run most software on any of the company's computers and share information among facilities, divisions and contractors.

Driving GM's C4 plans is the company's strategic thrust to cut down by 60% over the next 5 years the time it takes to bring a car from "art to part", from a new concept to the market. Today, GM needs 65 months to develop and manufacture a new model, while the average Japanese car maker only needs 43 months (Toyota leading the pack with with 24 to 36 months).[41] The objective is to bring this down to 18-20 months by the mid-1990s.

Such a dramatic reduction in development time will require more than mere automation of today's design, manufacturing and business processes. It calls for a thorough re-organization of the car making process. Indeed, the automation of manual design, engineering and manufacturing methods would simply result in "islands of automation": CAD islands, CAE islands, CAM islands, etc.. At best, GM estimates this could only cut down development time by about 20%. Further reductions will require a deeper reorganization of the auto-making process around new work methods, jointly developed with the new network which will support them. Here, the new buzzwords are simultaneous engineering, synchronous manufacturing, just-in-time, etc... This kind of production reorganization demands a unified information processing infrastructure, able to support consistent and interactive methods throughout the company.

41 data from Harvard's auto manufacturing project. GM's 65 months development time is for the GM 30 (new body and new platform); for the GM 25 project (new body, carryover platform from the N-car), the development time is 55 months. The US average stands at 62 months.

The scale of this task is staggering. Consider that in 1988, GM made 114 different car models, and that an average car consists of about 200,000 parts. Many of those parts are designed with CAD systems, which represent and store them as math models. To take an example, an average fender is represented by a 10 Mbytes math model. The shapes, dimensions, material specifications stored in this model are used repeatedly by various GM employees. Stylists, structural and aerodynamic engineers modify and refine the shape as they work on the overall line and structure of the car ; manufacturing engineers use this information to design the stamping dies used to make the part, and add to it representations of the complementary surfaces (the shapes of the left-over steel around the part itself) that will prevent wrinkles and tears during the stamping ; the tool and measuring instrument makers incorporate this information in the machines they put together to make the parts and check the accuracy of the finished product ; information such as the part reference number, how it is assembled and fastened to other parts in the car, must be attached to the part's representation if they are to be used throughout the manufacturing process ; user manuals and service bulletins for maintenance must include drawings of the part along with additional information such as reference numbers and assembly sketches.

Under current processes, when a Component's CAD file leaves the design department (and the design automation "island") to be used by production and manufacturing engineers, the data is transformed into a new format --suited to the next "island" of production automation, but now inaccessible to the designers. Subsequent changes in design can then take months, as the data needs to be re-formated (sometimes re-entered) at each iteration.

The problem is not simply to pass computer files from one team to the next in sequential order, but to allow continuous interaction between various teams involved in the design, production and assembly of a part or system. To continue with our fender example, production engineers and tool makers must work concurrently on designing the fender and the tools which will be used to produce it, provide continuous feedback to the stylists about the manufacturability of the fender they have designed, and suggest minor shape changes which could make stamping easier.

A networked CAD system able to support such interaction is the basis of simultaneous engineering: creating shapes and styling, designing the tools that will produce the parts, and organizing the manufacturing and assembly process, can then progress simultaneously, no longer sequentially. This is, according to this strategy, how the "art to part" cycle can be cut by 60%. For example with the current sequential process, it is possible to spend a lot of time designing a fender only to realize in the end, when the die maker is brought into the process, that it cannot be produced efficiently. Simultaneous enginnering aims at eliminating such surprises, thereby reducing both design time and cost. It allows a styling engineer, for example, to get feedback from costing, body engineering, structural analysis and die engineering, and to alter a design early on in the process.

The information processing network required to support such a strategy is significantly more advanced than the one in use today at GM. It must be able to transfer large files among decentralized engineering workstations to allow engineering teams to work together on-line. It must support an enormous data base of multimedia files (containing graphics, math models, text,...) representing parts, dies, tools, measuring instruments, assembly processes, or service documents. It must be able to keep track of the latest version of each part, of the changes made, and insure that all the teams involved are working on the same version of a part. It must also be able to update all the information that will be affected by a change in one of the files describing some aspect of a part.

The C-4 strategy is aimed at delivering the information networking infrastructure that can insure such consistency.. It will integrate all GM manufacturing and business operations into an "enterprise solution", in which all divisions, subcontractors and suppliers are connected electronically to central design, manufacturing and management information systems.

The strategy must contend with GM's existing computer networking environment. Typically at GM, each division and sometimes each department chose its own application software and workstations, and as many as 40 different hardware platforms are in use today throughout the company.42 Different divisions often use the same car components, but must re-create CAD files representing these same components to work on their incompatible systems.

Building an integrated information infrastructure raises many challenges. The physical network needed to support it must have broadband capabilities (switched T-1 network would be necessary today to accomodate simultaneous engineering applications at the design stage alone). The applications used by all the participants in the car making process need improvements to work together, new ones will have to be invented. Perhaps the greatest challenge is to create the tools that will make it possible to manage and control such a network.

To support the C4 vision, EDS is deploying a coherent and comprehensive communication network.43 This network will have to provide transparent transmission and universal connectivity for different users to access various applications. It will require distributed data management systems, able to integrate all relevant information with the design data. Files containing manufacturing, financial, or test information will need to be linked to the CAD file representing a particular part. The network control center(s) will have to be able to manage and control the distribution of these files throughout the company, assign access to employees, keep track of the most current revision of each file, to control the transfer of information accross plants, divisions and suppliers.

42 This is different from other companies. Ford for example uses a single CAD system, running on PRIME computers and requires that all its suppliers use the same.

43 This description draws extensively upon Lekha Rao and Greg Blount, The EDS Evolution to a Private ISDN, IEEE Globecomm, December 1986.

EDS's current network environment could not support such a vision. For example, access procedures vary with each of the EDS sub-networks, according to proprietary vendor architectures. They often require different hardware and software on the end user's side and call for different access procedures. As a result, changes and re-configurations can pose major problems. Moreover, inter-networking is not transparent, and the user must know a-priori the details of the networks he needs to connect with, such as each sub-network's numbering, addressing and routing schemes.

To overcome these problems and the limitations they impose on GM's (and other EDS clients') networking strategy, EDS is gradually converting its existing networks into a private Integrated Services Digital Netowrk (ISDN), built around OSI standards.[44] Standardization around the emerging ISDN and OSI standards will allow EDS to provide uniform user access for voice, data, and value-added services ; access to various vendor mainframes from a single user workstation ; a common backbone infrastructure and user transparent gateways between sub-networks ; and integrated network administration and management.

GM's current multi-vendor, multi-network environment raises a series of problems concerning network management and control, making this area one of the most critical challenges EDS faces. All network management areas suffer from this diversity: it is harder to keep track of network resources and deploy them effectively, harder to test the network, identify problems and correct them, harder to re-configure the network as user needs evolve, harder to keep track of who uses what in the network for accounting and billing. Various sub-networks require different --and often incompatible-- management systems, preventing coherent management of the network as a whole. Each vendor's equipment gathers various kinds of information, in various forms, preventing a comprehensive view of the network's operation at any time. The trend towards distributed intelligence has amplified these problems by dispersing network management intelligence at various points throughout the network.

Towards this goal, EDS is working on the deployment of a comprehensive network management system that can address the following areas: network planning, resource management, network performance and monitoring, inter-networking management, prolem management, change management, cost management, and security. In the short term, EDS will try to ensure that all subnetworks, from LANs to WANs, incorporate common versions of these functions. The next step will be to consolidate the sub-network management systems into a limited number of systems. For this purpose, EDS is developing applications which can integrate statistics from various network management systems, and assist their operator in identifying and correcting evenetual problems. In the longer term, as separate channel signaling (SS#7) becomes implemented uniformly throughout the EDS network, it will become easier to monitor, manage and control the network.

If mastering their internal networking is important to Bank of America and General Motors, it is perhaps even more critical to Hewlett Packard. For HP, networking technologies are not simply a design and production tool, but also the very essence of the company's products. We have just described how important experimentation and learning have been to BofA's networking strategy. Within HP, these mechanisms take on an added importance as they transform not merely the company's design and production processes, but often its products themselves. Hewlett Packard therefore constitutes an extremely interesting case, since its stakes in the information processing market have compelled the company to experiment thoroughly with networking

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44 "GM Plans Master Net", Communications Week, September 19, 1988.

technologies. To a considerable extent, HP has been using itself as a testing ground for new ideas and products.

One of the HP's major objectives in deploying a corporate network was to speed up its design and manufacturing cycle, while being able more effectively to draw on the human and technological resources dispersed throughout its many locations. Because HP's business is to design and manufacture information processing equipment, it was certainly better able than others to design and operate a network that could achieve these goals. Hewlett Packard therefore explicitely sought from the outset to secure total control over its network, with the ultimate goal of building a world-wide fully integrated digital network capable of voice, data and video transmission by the early 1990s. The company's strategy has motivated distinctive networking choices, which can be traced through the three layers of HP's network, from the applications HP employees use, to the control mechanisms which lie behind these applications and the physical facilities they rest upon.

Information networking applications pervade all activities at HP, from design to manufacturing and sales. Significantly, 94% of the company's total workforce (77,000 out of 82,000) are active users of HPDesk, its home-grown electronic messaging and conferencing environment, exchanging an average 80 messages per month per employee. HPDesk uses go far beyond the simple exchange of memos. For example, to work out the design of a new product, HP engineers routinely exchange source codes back and forth through the messaging system.

John Young, President and CEO of Hewlett Packard, once described the management of a project that involved 140 R&D engineers from 10 different HP divisions in the US, Japan, and Europe, working on the integration of HP peripherals with the HP 3000 product: "The team decided to use e-mail to manage the project. They move software code and all its documentation that way, and used electronic PERT charts for project management. If one part of the team's task is going to skip schedule, the computer automatically highlights other parts of the project that will be affected. The entire group is informed immediately, and resources are reassigned quickly. According to the group manager, the project would have been totally impossible without the electronic linkages. Information technology wasn't just a productivity tool, it was the vital glue that held the project team together."[45]

Hewlett Packard also uses its TV and video networks to hold interactive product announcement sessions for its sales force, offer training courses, or broadcast executive speeches. The broadcast network is used to offer classes on new products for service and support staff, as well as to provide HP's personnel with access to classes at several US universities, through which they can obtain advanced degrees. The company uses video conferencing intensively to pool dispersed specialists working on a common problem. These video-conferences often become a critical part of the design and production process at HP, and can bring together designers with manufacturing specialists or marketing people. In one case, three collaborating teams estimated they would have taken at least six months to solve a problem, had they had to travel back and forth ; they did it in two weeks of intensive messaging and video conferencing. The benefits of such network applications go far beyond mere savings on travel expenses. In the fast paced electronics business, shortening the time it takes to bring a product to market can make all the difference.

45 Quoted by Byron Belitsos in *Business Telematics*,

Pushed by the widening use of such applications, Hewlett Packard's needs for interactive networking have grown tremendously since 1983, when it first implemented packet switching applications over GTE's Telenet public X.25 network. HP started purchasing its own packet switching and network monitoring equipment in 1985, and since then has installed 24 private X.25 nodes worldwide. HP's private packet switching network is fast replacing its batch network for all data transmission, and now accommodates traffic that rivals in volume America's largest public data networks, Telenet and Tymnet.

One of the primary reasons why HP decided to build its own packet switching network was the severe restrictions on the amount of bandwidth available from public data networks. At the time, public X.25 networks could not offer data rates above 2.4 Kb/s. For a company like HP, which routinely needs to transmit files as large as 20 Mbytes, that would have meant spending 20 hours to transmit a single file, assuming the connection would not be dropped during that time (which, when sending files between such places as Singapore and Geneva, sometimes happened). A private packet network allowed HP to build in bandwidth that met its requirements. The final result was far greater cost-effectiveness than either HP's old network or public data networks: Between 1986 and 1987, HP was able to reduce the total costs of its interactive transmission by 6%, while traffic more than quadrupled.

Hewlett Packard's private X.25 network is fast becoming the central resource supporting all of the company's data applications. Initially, it was principally used for interaction with selected customers' data bases, urgent electronic mail, and electronic dispatch of financial reports. Now, it offers universal interconnectivity within the company. It serves as the common link between factories, design labs, corporate departments, support divisions, regional processing centers, branch offices, as well as some of HP's customers and vendors.

Hewlett Packard's packet switching network lies underneath most of the company's data communications applications and is critical to their interactivity. It also constitutes an essential management mechanism for the various physical links mobilized by HP's network, as it allocates virtual routes for data to flow between users of an interactive application. Therefore, it is an integral part of the control layer of HP's telecom infrastructure, sandwiched between the physical links it configures and the interactive applications it enables. Practically, this packet network is an overlay of HP's physical network infrastructure, embedded within the packet switches HP owns and – most important-- programs and operates. Through these X.25 switches, HP directly asserts control over the operation of the physical links it leases from various carriers. HP's network managers can therefore configure the company's network infrastructure to reflect closely the production organization its applications are designed to support.

Hewlett Packard's packet switching network, like all HP network control mechanisms and applications from telephony inteactive computer aided design[46], is built upon a single set of transmission paths, HPNET, which constitutes the physical layer of the company's network infrastructure. Two essential components make up HPNET: a set of leased lines tie together HP locations which exchange the highest volume of traffic and ATT's Software Defined Network (SDN) provides extensions towards the other locations. Traffic throughout this physical infrastructure is managed centrally and

[46] Video conferences were established over dedicated satellite links until now, but are now progressively rolled over to HP's integrated transmission network. Using data cmpression techniques, two 56kbit/s lines can adequately handle a video conference.

dynamically multiplexed, so as to constantly reallocate the available bandwidth to the applications which need it.

HP's networking approach reflects an extensive amount of experimentation with and learning about networking technologies, developed over many years during which the company was both a demanding user and a producer of many information networking technologies. Key to HP's experimentation and learning was the company's mastery of its network resources, secured through the private deployment of a sophisticated control layer. HP was thus able directly to try new ways to organize its operations and quickly to identify the resulting problems or benefits. Over time, the knowledge accumulated through this process has been mostly internalized and its benefits captured by HP, precisely because HP relied as little as possible upon the public network.

For example, HP became adept at implementing and using networks which made collaboration possible among dispersed teams of researchers and built a great deal of its competitive advantage upon that expertise. But this of course also meant that such network resources would not be directly accessible to other telecom users, were they HP's competitors or were they from entirely different economic sectors. There, some would say, precisely lies the beauty of the US networking environment: innovative network users can fully capture and defend the benefits they derive from the innovations they deploy, and their examples foster further innovation by envious imitators. However, precisely because telecommunications network constitute an infrastructure, the real story is more complex.

HP's rekindled interest in the public network, as evidenced for example in its use of AT&T's SDN, is interesting in that respect. It stems from two different factors. First, while individual companies have been busy building advanced private networks, the public network was not standing still. Public network operators have exploited their distinctive advantages: for example the scale and universality of their network facilities, or their accumulated experience with the management of complex networks provided competitive leverage against private network development. In some areas, software defined networks constitute such an example, services offered over the public network have progressed rapidly and it would be hard for HP to cost-justify using leased lines to all its locations. Furthermore, SDN actually gives HP more control over the reconfiguration of its network, as the company can for example instantly add or drop transmission lines through its direct access to the control layer of AT&T's network.

Second, companies such as HP have an emerging need for sophisticated public links to tie their subcontractors and business partners within their networked production organization. In particular, HP is extremely eager to see ISDN implemented in the public network. Indeed, electronic transactions between HP and its suppliers will involve increasingly elaborate compound documents made up of data and text along with drawings and CAD/CAM files. In many cases, HP would like to be able to use interactive CAD/CAM applications better to collaborate with other companies it works with, and more flexibly to establish new connections with partners or reconfigure older ones. Ideally, because these applications span accross individual companies boundaries, they could best be implemented over the public network. However, the US public network still has a long way to go before it can smoothly support such applications.

Large users have in the past played an important role in promoting the developement of the public network by placing high demands upon it. It was the likes of HP, BofA, Levi's or GM who pushed Ma Bell to innovate, and the innovations they prompted were in turn deployed throughout the public network, for the benefit of all. As they progressively turned to private networking, not only did pressures upon the public network to innovate decrease, but also certain types of innovation --particularly with respect to data applications-- increasingly took place within private networks and did not diffuse through the public network. Now, the public network they once deserted stands in the way of their corporate networking strategies: sophisticated in-house applications cannot easily reach beyond one company's limits to include partners or subcontractors in a renewed network-based production process.

Recognizing these limitations, Hewlett Packard is consciously looking for ways to accelerate the development of the public network --or at least those segments of the public network it needs. Therefore, HP is willing increasingly not only to shift some of its traffic to the public network, but also to transfer some of the knowledge gained through its past rounds of private experimentation back to the public network, for example by collaborating with the BOCs to help speed up the deployment of advanced technologies like ISDN throughout the public network.

Such strategic decisions highlight important issues about the evolution of private and public components of the nation's telecommunications infrastructure. The network options, public and private, available within a national environment constrain the degree to which companies can experiment with information networking technologies and whether they are able to learn and benefit from this experimentation. In particular, companies which have direct control over the deployment and configuration of their network can experiment more intensively than if they had to rely on the intermediation of a public network operator. On the other hand, public network solutions provide wider connectivity and diffusion of network applications. The patterns of learning, and how innovations become implemented within the telecommunications infrastructure vary accordingly. Section III of this paper will address these issues more directly, but we must conclude this exploration of corporate networking strategies with a look at their essential motivation: control.

Indeed, of all the reasons companies invoke to justify their private networking decisions, the most important and pervasive is their desire to have tight control over their telecommunications. In their view, this need directly arises from the changing status of information networks, from a utility to a competitive resource. Because a firm's competitiveness rests upon its network, it can no longer afford to leave it completely under someone else's control. Companies want control to understand precisely where their communications costs derive from and how they can be cut, to keep track of changes in their communications patterns so as to plan better for the future. They want to be able to reconfigure their networks quickly when needs change, to be free to experiment with them to develop new products and services.

However, there is no single and straightforward solution for a firm to assert control over its network. In certain cases, because a company's network and network applications underlie its competitiveness, it matters that the network's critical features be private, even proprietary. Competitors could more easily replicate a strategy built upon public network resources and off-the-shelf telecommunications systems, whereas it is more difficult to catch up with a company that relies on proprietary network applications.[47] In other cases, private networks have grown out of their owners' control,

[47] See Peter Keen, *op. cit.*, p 113.

who could not manage their technical complexity, find adequate manpower to run them or keep their costs in check.[48] Companies must search for the best compromise between their need for control over the operation of their network and the advantage they can gain from drawing on the extensive network operation expertise of public network operators.

"Control" means very different things at each layer of the telecommunications infrastructure, how control is embodied within each layer depends on corporate strategies and objectives. Sometimes companies find it necessary to own the physical layer of their network. For example, Levi Strauss and McKesson have chosen to deploy VSAT antennas to link their distribution centers with headquarters, which enable them better to control transmission costs. Perhaps more importantly, as is the case for McKesson, owning the physical links also enhances reliability. Because McKesson's competitive advantage rests largely on its promising next-day delivery of all orders received before 4:00 pm, it cannot afford a failure within its information system. Initially, McKesson relied entirely on AT&T's Digital Data Service (DDS) lines to connect its order processing center with its distribution centers. After five days of intermittent outage on AT&T's DDS network in February 1986 caused degraded connections and a number of missed deliveries, McKesson decided to replace its DDS-based network with a private end-to-end bypass satellite network.

However, ownership of the physical links is not a prerequesite for network control. As Hewlett Packard demonstrates, a company can maintain total control over its network through its grasp of the middle layer. Indeed, HP owns very few of the physical elements of its network. The management layer it has deployed enables the company to manage the network extremely efficiently, for example to control its costs through dynamic mutliplexing or to reconfigure the network as the needs of its production process change. One could even argue that to some extent, not owning the physical layer of its network gives HP greater control. For example, it can create or drop connections on SDN much more easily than if it had to install or dimantle physically each one. Within the middle network layer, companies also have the opportunity to share control with public operators or third parties. Bank of America for example chose to retain responsibility for testing and network planning while handing over to AT&T some network management tasks.

Finally, different patterns of control can be built into the application layer of the networks. The applications deployed by McKesson and Levi's to link up with their retailers illustrate these differences. McKesson retains complete control over the proprietary applications it offers to its retailers, and over the data they generate. By contrast, Levi's decision to promote indutry-wide standards and to let third parties provide these applications distributes control among industry participants, or at least guarantees that no single one can monopolize control over the application for its own goals.

Overall, the patterns of control the national telecommunications environment permits constitute an essential key to the economic functions the network can perform. Corporate users will judge the telecommunications environment on whether or not it allows them to deploy networks which embody the kinds of control their strategies require. In turn, public network providers need to strike the right balance between giving enough control to their clients and retaining enough to remain economically viable. Ultimately, the future evolution of the national network will reflect the distribution of control among its many suppliers, operators and users.

[48] "Problems Force Users to Retrench", *CommunicationsWeek*, November 7, 1988.

The indicative changes occurring along the leading edge of corporate networking strategies suggest the potential information networking holds for economic development and growth. Depending on how control is allocated, individual successes may remain isolated or cumulate to dramatic new possibilities for relative national economic performance. But, if the performance measure of intensive use of information technology is improved national productivity growth, the U.S. is badly lagging other countries, notably Japan and in Europe, that have not moved as aggressively to adopt the new technologies. Whether the U.S. benefits from the technology's powerful potential depends upon the effectiveness of its diffusion and use throughout the economy, not merely at the leading edge. Such diffusion, we argue in part III, is mediated to a great extent by the national network infrastructure, which channels the innovation, experimentation, and learning from leading edge corporate users and suppliers of network equipment and services, to the rest of the economy.

III. VARIED INFRASTRUCTURES, VARIABLE EFFECTS

The analysis of large user experiences suggests that digital information networks are the essential infrastructure needed to capture the vast new economic opportunities available from the exploitation, control and processing of information. Here we argue that how those networks are organized, how they coalesce into a national infrastructure, and the terms on which that infrastructure functions, is accessed, interconnected, and controlled, will shape opportunities for short-term economic gain and for long-term economic growth.

The communications networks within a region can, in the aggregate, be considered as economic infrastructure because they constitute a ubiquitous economic input that generates significant economic benefits far in excess of those capturable by the entities providing the networks. (In economic shorthand: they generate substantial external economies or externalities.) The effect is somewhat analogous to that of the transportation infrastructure underlying the industrial economy of the past century.

The emergence of mass production and distribution in late 19th century America, rested in large measure on the new transportation and communication infrastructure put into place between the 1850's and 1880s.[49] The extensive railroad and telegraph networks provided significant economic benefits to user industries by enabling vast increases in the speed, volume and regularity of movement of goods and messages at decreased costs. These benefits were far greater than could be captured by those who built the networks.

The benefits were also cumulative and self-reinforcing. They led to increasing returns for those organized to coordinate and exploit the increases in speed, volume and regularity -- the very reason the emerging great corporations developed and succeeded so spectacularly. The possibilities for increasing returns thereby provoked new investment in user industries and rapid economic growth for the economy as a whole over a sustained period of time. They helped put the American economy on a virtuous development path.

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49 Chandler, at p.207.

As we suggest below, telecommunications networks act as infrastructure to economic development in more subtle, though often no less powerful ways than did railroads and other transportation media.[50] Our analysis here is more complex, tentative and admittedly more speculative. It suggests, however, the strong possibility that different network arrangements generate different patterns of external economic gains, different opportunities for cumulative reinforcement of those gains, and thus, different degrees of capturing those gains over time for the economy as a whole.[51]

Consider, for example, the effects of privatizing substantial portions of the network infrastructure as has occurred in the U.S. Our case studies support the proposition that private network arrangements can be closely tailored to corporate strategy and can thereby generate substantial economic gains for individual companies at the expense of competing actors in the economy. McKesson's ability to differentiate its service by providing near-real time distribution and other value-added services, and H-P's ability radically to speed-up new product development time, are clear examples. Presumably, as the companies grow and prosper, the successful strategic use of those networks generates indirect gains for the U.S. economy as a whole.

Buried, however, in the positive accounts, are equally compelling examples of how different network arrangements can eliminate potential economic benefits and even stifle economic activity. Our case studies demonstrate this as well. Perhaps the clearest example is the way that small auto parts suppliers are implementing electronic data interchange (EDI) with their major customers, the major U.S. automobile assemblers. Recall that by eliminating paperwork and the delays associated with paper handling, and by permitting real-time responsiveness to changes, EDI was supposed to improve the competitive position of both suppliers and assemblers.

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50 Our perspective derives from on-going work the authors are doing on the economics of telecommunications network infrastructures and on the ways the technology can be used to competitive advantage. That work is under the auspices of the BRIE-OECD Telecommunications User Group Project, at the University of California, Berkeley.
None the less, the authors wish to make it crystal clear that there is very little systematic support in existing economic data for the proposition that information technology enhances competitive performance. There are in fact some quite embarrassing discrepancies: For example, the financial services industry has seen the steepest rise in spending on information technology as a percentage of total business investment over the past decade, but factor productivity has declined during that period.
There are several plausible reasons for why aggregate available data does not reflect anecdotal experiences of success with the technology: The data is not very accurate; much of the benefits of using the technology are strategic and not easily measured or captured in conventional data; existing data sets aggregate winners and losers (i.e., for every Ford that uses info technology successfully, there's a GM that doesn't); and the technology has changed so rapidly that learning and organizational effectiveness have lagged far behind increased spending. For those who advocate the perspective taken in this paper, however, a systematic account of why and how the data is flawed obviously needs to be developed.

51 The economic basis for our argument is that different network arrangements differentially affect the degree to which positive feedback economic mechanisms develop and widely influence an economy's growth. The major sources of such positive feedback economic mechanisms are scale economies involving large set-up or fixed costs that provide falling unit costs to increased output; learning effects which provide performance improvement and/or cost reduction to economic activities as their prevalence increases; and coordination effects (including so-called network externalities and economies of scope) which confer gains to replicating or synchronizing economic activities. See, W. Brian Arthur, *Self-Reinforcing Mechanisms in Economics*, CEPR Publication #111, (Stanford: Center for Economic Policy Research, September 1987).

In fact, most parts suppliers implemented EDI by purchasing several different computer systems mandated by their different major customers, and hooking them to the public phone network but, because of incompatability problems, not to their own internal corporate computer systems. They receive information electronically through the phone network from a customer, but are then forced manually to rekey the information into their own computer systems. The result is several redundant EDI systems, no integration of the technology with the companies' on-going business, and the addition of several extra layers of costs.

For these small auto parts suppliers, EDI is simply an added cost of doing business with GM or Ford. By contrast, the major auto assemblers are gaining much tighter control over a supplier through the network link. Indeed, this particular implementation of EDI systematically provides information that favors the choices and decisions of the assemblers over their suppliers. As infrastructure to the auto supply business, the EDI network constrains supposedly autonomous suppliers to make choices that an assembler desires -- in effect, the market is turned into an organizational extension of the assembler, a specific kind of coordination is substituted for market forces. In that substitution, the assemblers are able to capture most of the external economic gains to be had through the network's role as infrastructure to the economic processes it supports.

Ironically, however, this system may well undermine the competitiveness of the assemblers in the long-term. It certainly strains relations with suppliers and, since suppliers are not exploiting information technology effectively or efficiently, leads to a less competitive overall national system for producing automobiles. Notice, too, that for the suppliers to benefit, and for the economy as a whole to capture the available gains, at least two conditions would have to be fulfilled.

First, different network arrangements emphasizing standardized solutions, connectivity and integration would be necessary. Second, the suppliers would need to develop substantial new assets that complemented the technology's capability and made use of it. Such complementary assets would include a well-trained work force, capable of experimenting with and learning from the technology's implementation within the company. Thus, network arrangements matter, but so do the assets that enable full exploitation of the economic potential of any given network infrastructure.

From a theoretical standpoint, these examples of network-based industrial strategies and the comparison with the impacts of the old transportation infrastructure suggest that the telecommunications network infrastructure affects the economy by either supporting or frustrating the realization of economic gains. It does so in two important ways, through its effects on resource allocation and through its more dynamic impacts in helping to generate long-term increases in productivity, growth and performance.

Resource Allocation

Decisions about how best to make use of all of the resources in an economy (e.g., capital, labor, technology, energy) are made primarily through two mechanisms, through the market and through non-market forms of coordination (like bureaucracies or a corporation's management structure). We typically associate the market with resource decisions made between different organizations (e.g., between buyers like an auto company and sellers like its suppliers), and coordination with allocating resources within an organization (e.g., when management makes decisions about how to spend the company's money).[52] Telecommunications networks affect both of these market and non-market mechanisms for influencing optimal resource usage and have the potential to upset boundaries between them in unpredictable ways.

A market is essentially an arrangement of buyers and sellers and terms of exchange -- the process, in effect, through which supply and demand meet. Telecom networks increasingly support the various stages of that process. They carry information about products and prices, they provide a channel for bargaining and negotiation, they are used to finalize an agreement or an order, they can also be used to effectuate the payment (through electronic fund transfers), and in some cases can even ensure the delivery (when the product bought can be transmitted, like information from a data bases, or software). Similarly in organizations, telecommunications networks have come to embody many coordination mechanisms, ranging from simple communications via electronic mail to complex cooperative group work through networked computer applications.

The traditional view of the relationship between markets and the telecommunications infrastructure is that markets pre-exist, and that the network simply helps them to function more efficiently and transparently by facilitating the flow of information.[53] In this market facilitating view, the communications infrastructure helps to realize the economists' ideal of perfect competition based on free and instantly available information.[54]

There is a similar view about the relationship between telecommunications and coordination through non-market mechanisms. In this view, more perfect information permits more perfect coordination of the organization's activities and resources.[55] This occurs as the internal communications network comes to embody a company's organizational routines, ways of producing and decision methods. Thus, for example, GM's corporate communications network permits senior managers to access data about the progress a new car model is making in moving from design into production, and to execute decisions that affect the new car's status. In this way, the network has come more and more to reflect GM's production process and to embody the routine decision-making of GM managers as they guide new cars from concept to manufacturing.

The real world relationship between telecommunications and resource decisions, however, can be quite different from these ideal theoretical images of perfectly functioning markets and smoothely coordinated businesses. For example, in markets that use telecommunications heavily, the network is

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52 In practice, there is substantial overlap. For example, market relations are often formally coordinated to some extent, as when patent law permits the establishment of a monopoly position; and organizations are often run along market lines as when Ford's own part's suppliers must bid for Ford's business against external suppliers.

53 This is for example what Annie Bloch describes as "Videotex-Aided Markets" in *Telematics, Inter-Organization and Economic Performance*, FAST Occasional Paper No. 195, Commission of the European Communities, July 1987.

54 Arrow, J.K., "The Economics of Information" in *The Computer Age : A Twenty Year View*, Destourzos and Moses eds., MIT Press, Cambridge, 1980.

55 See, e.g., Christiano Antonelli, et.al., "Structural Impacts of Telematics on the Automobile, Textile and Clothing Industries: The Theoretical Framework," FAST Report COM-51, July, 1986 (Brussels: CEC).

increasingly the place where one finds information about products and prices, where negotiation and trading go on, where the decisions about exchange are made. As communications networks become a key to transacting business, they also become tools to coordinate market place activities in a way similar to GM's coordination of its internal activities. The neat boundaries between an organization and its markets are consequently blurred in ways that disrupt the more perfect functioning of the marketplace.

In such a world, access to the networks over which business is transacted is an essential prerequisite to participation in the economic game. Advantage rests with those who control the network, who determine who has access to it and on what terms, and which applications are used to match supply and demand.[56] Answers to these questions will determine whether the network infrastructure works to realize the economist's dream of perfect competition or to frustrate it by creating imperfections that systematically bias the outcomes of competition.

Take the example of the market for airline trips The main marketplace is now a network, the on-line reservation systems. Information about flight schedules and fares is primarily accessible on-line. The reservation network is the place where travel agents, search for times and fares, make reservations, establish client credit, purchase tickets, reserve seats, secure boarding passes. Whoever controls a reservation network can use it to its advantage, by determining which airlines display their flights and at what fee, how the flights are ordered and displayed, or which routine is used to search for the flight that best fits a traveler's needs.

When American Airline's SABRE system was the only one in the market, and before it was forced to reform some practices, SABRE systematically provided information that favored the choice of American Airlines flights. As infrastructure to the airline reservation business, the SABRE network provided anything but a more perfect market. Supposedly autonomous market participants, travel agents, were constrained to make the same choice that AA agents would have -- in effect, the market was turned into an organizational extension of AA, a specific kind of coordination was substituted for market forces.

56 It is worth noting that questions concerning the fairness and openness of this network marketplace are raised at all three layers of the network infrastructure. Facilities must provide connectivity for buyers and sellers to reach the marketplace. Management processes must allow open access on equal terms to all. In general however, the transmission and management layers matter only if they constrain applications, because as we describe below, it is there that the market transaction is embodied and can advantage some participants over others, or prefer some choices over others.

The roles as marketplace and coordinator are always latent possibilities for the communications infrastructure, depending on who controls it and to what ends. A publicly controlled infrastructure approach aiming at universal connectivity is likely to promote wider and more democratic user access to network applications. Because it supplies a core backbone network of transmission facilities, management procedures and standardized services, a public approach makes it possible for any of the network users to interact with any other user.

By providing this kind of standardized, universal connectivity, a public infrastructure can acutally stimulate demand for new services, enabling new kinds of business activities to be created between users of the network. This is true whereever dispersed, unorganized users would be unable to come together to realize their common economic interests in any other way. Indeed, the potential for permitting smaller buyers and sellers to organize themnselves and aggregate their demand has motivated the creation of new public infrastructures in other countries -- notably, the Minitel Network in France. Minitel has a growing number of professional applications that span a variety of economic sectors and combine them in unforeseen new ways. For example, small distributors have been able to compete with large distribution businesses by sharing business opportunities and coordinating their delivery logistics and purchasing needs over the Minitel Network.

By contrast, the U.S.'s private network approach makes it easier for individual users to better control and coordinate their competitive environment. As we have seen, this leads to strong individual user gains and better resource allocation *within* companies. The down-side, however, is that the attainment of better internal resource usage can simultaneously frustrate the economy-wide realization of economic benefits. This occurs as individual companies manipulate the external market-place with their internal networks. In effect, they instill market imperfections in the network marketplace they control. Optimal resource allocation is consequently distorted as the network infrastructure is fragmented into the separate networks that major users control.[57]

The bottom line, then, is that to capture the widest possible benefits from the infrastructure's ability to organize and influence decisions about resources a mix of both private and public networks is required. Private networks are needed for better coordination within organizations in the economy, public networks for better resource usage between organizations and for overcoming the worst market imperfections that private networks introduce.

Indeed, not just any public network will do: The public role must be to promote an integrated, universal, and highly functional communications network that can act as an open, accessable and universal marketplace for economic activities. In that way, resource decisions can be made more smoothly, and possibilitiies for stimulating demand among small and medium-sized businesses and consumers can be maximized.

57 Fragmentation can sometimes be bridged later on at the higher levels of the applications layer, for example through Electronic Data Interchange (EDI) gateways. However, this requires that a clear need for such gateways be perceived by users, and that they send strong enough market signals to provoke their development.

ADJUSTING TO CHANGE IN A COMPETITIVE WORLD

While facilitating today's resource decisions is critically important, long term economic success for firms and economies rests with their abilities to evolve and adapt to changing conditions. The ability to experiment with the application of different technologies and with different ways of organizing economic activities, and the ability to learn from such experimentation, are essential to adjustment in an ever more competitive world.

The telecommunications infrastructure plays a central role in enabling the experimentation and learning necessary to adapt successfully in the information economy. As we concluded above, the network infrastructure increasingly embodies both market relations and organizational routines. In order to develop and adapt those relations and routines over time, users must be able to experiment with different network arrangements and to learn about what works best from those experiments. Only by experimenting with market relations and firm routines and cumulatively learning from each experiment, can users figure out what network-based activities permit them to be most productive and effectively competitive over time.

The kind of network infrastructure accessable by firms influences the range of experiments available to them and how thoroughly they can investigate each alternative. Consequently, the learning and knowhow that is generated from experimentation, and whether that knowhow is widely diffused or limited to a few users, are also all affected by the kind of network infrastructure available. To see this, compare the characteristic impacts on experimentation and learning of a private network approach vs. a public network provider.

Private network approaches typically permit intense experimentation for those on the network. For example, an auto company comparing various ways to organize its production with a set of suppliers and subcontractors will have extensive control over the details of the network arrangement it chooses to implement. However, it will need to invest substantial time and effort in refining each arrangement and extending the network and the new capabilities to each supplier. The time and expense will limit the number of experiments attempted from the wide range available.

This is what happened with the implementation of EDI in the auto parts industry. The imposition of a single solution on suppliers expressed both the limitation on experimenting with network alternatives and the desire to use intensively the single solution chosen.[58] As we also saw, that network arrangement benefitted the network provider but not the supplier.[59] This too is characteristic of private networks: Whoever controls the network, organizes the experiments to maximize his own goals and, so far as possible, confines the learning and knowhow to himself.

By contrast, a regulated, public network approach has the potential to harmonize the needs of many more user-constituents and broadly to diffuse the learning and knowhow to them. For example, the phone company offers easily established communications links between and within firms, though from a relatively more limited menu of technological choices. That permits many more experiments to take place, although these will be less intense than a private network allows. There will be less intense experimentation because the public phone network can't be as readily tailored to any individual's needs, but more experiments are possible because the phone network has a far wider reach and can be cheaper to use in connecting and disconnecting different users.

Recall how in the U.S. textile-apparel industry, for example, EDI was implemented in a concerted, quasi-public way, with agreed standards, open third-party vendors providing the necessary software systems, and publicly-regulated phone networks providing a major part of the communications infrastructure. That open, public solution limits any individual manufacturer's (Levi's) ability to tailor EDI to its precise needs because it must conform to the standards and open systems. But it simultaneously permits much easier connection and disconnection within the entire supplier base, permitting a wider variety of economic interactions to take place, and creating the potential for successful, industry-wide adjustment to international competition.

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58 Although the public-switched telephone network provided most of the physical links between the auto company and the suppliers, this is an example of a private network approach because the choice of physical facilities and applications, as well as much of the management of their implementation and use, were all determined privately by the choices of the auto company.
59 This occurred in part because the supplier had none of the skills nor compatability – complementary assets – necessary to do his own experimentation with the network possibilities then available. We will return to this point below.

These characteristic effects of different kinds of network arrangements have even greater impact on the learning and knowhow that flow from experimentation, and that are so essential to successful competitive adaptation over time.[60] ..Network arrangements matter here because learning in an industrial context is tightly linked with productive activities -- it is, in essense, a function of iteration over time. Moreover, a great deal of knowledge is tacit, embodied in an organization and the routines its relies upon, thus in the network and network applications which embody these routines and organization.[61]

As we have seen both within and between companies, the learning associated with telecommunications typically occurs in two stages, a first stage of automation followed by a second stage of re-organization. During the first stage, firms automate existing economic processes. For example, they replace paper communications with electronic mail and paper transactions with EDI, or they put researchers on-line and electronically generate management information flows. During this first stage, the organization itself changes little, but the functions it performs are enhanced through the use of telecommunications technologies.

The first stage generates information about existing operational routines and feedback about how the technology being deployed can help the operations to be more effective. The company acquires knowledge about the processes that are being automated (e.g., more detailed information about the ordering patterns of clients, or about the way employees perform), as well as knowledge about the potential of the network technologies being implemented (e.g., what can actually be done with video-conference or EDI). That information and feedback help to shape new network arrangements which permit existing operations to be re-organized to increase their competitiveness.

Thus, the second stage is marked by re-organization, as the firm reorganizes its various processes to take advantage of the new network technologies. The knowledge accumulated by using information networking during the first phase has underscored potential benefits to be gained through further deployment of these technologies. To capture those benefits however, it has become necessary to reorganize the company's activities and re-configure the network which supports them. At this second stage, the firm essentially needs to "embody" its knowledge into a new network and a new organization.

During both stages, the companies continuously learn by using the network technologies available to them. However, as the companies re-organize operations around the deployment of new network arrangements and applications, they can also gain a different kind of knowhow: They learn about the network technology itself, how it can be changed, what its limitations are, how well it can be adapted to support the changes in operations desired based on what was learned from the original deployment of the network. In short, They learn "by doing" (that is, by actually deploying, configuring, and re-configuring their network).

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60 The model of learning we develop below, including the implicit distinction we draw between "learning by using" and "learning by doing", is drawn from Nathan Rosenberg, *Inside the Black Box: Technology and Economics*, Cambridge University Press, Cambridge, MA, 1982

61 This model of learning, including the distinction between "learning by using" and "learning by doing", is drawn from Nathan Rosenberg, *Inside the Black Box: Technology and Economics*, Cambridge University Press, Cambridge, MA, 1982.

This process is really a feed-back loop – one that requires the substantial ability to re-configure the network infrastructure to take advantage of what was learned during the earlier cycles. A company will go through a succession of stages, automating, then re-organizing around the knowledge gathered through the automation phase. How much can be learned through using the network while simply automating existing procedures will clearly affect how well the company can re-organize itself in the second phase. Similarly, how much latitude the company enjoys as it deploys a new network, and how much it is able to deploy itself (or at least to monitor and understand) will determine how much it can learn by doing its new network. And finally, the network it is able to deploy as it reorganizes (e.g. how well adapted to its needs, how flexible) will determine how much the company can learn in the next round of using this network. This succession of steps traces an evolutionary path, a technological trajectory for the company.

Critically, to learn more and employ that knowledge more effectively as it goes through these successive loop iterations, a company must be able to transfer learning smoothly between each step of the cycle. This requires from the company a substantial ability to reconfigure its network to take advantage of what was learned during the earlier cycles. Critically, such network control needs to extend below the application layer: Reconfiguration of a company's routines and organization will often not simply require a re-design of the applications it uses, but also new management mechanisms and sometimes new transmission facilities. All of the cases demonstrate this point.

Once again, whether the available telecommunications infrastructure is privately controlled or publicly safeguarded will substantially affect who gains the learning and knowhow, and how effectively it can be used to support new and changed activities. Not surprisingly, a privately controlled network permits the individual user who controls the network to garner most of the learning and knowhow, and consequently to reorganize rapidly to take advantage of what he has learned. By doing its own network, a firm has acquired a better grasp of what the technology will be able to do, of how it can best fulfill the firm's requirements. Because it controls directly the reorganization process, it can best adapt its network to the needed changes in its operations.[62] This, again, is the auto-EDI case, where the major auto companies acquired most of the learning and knowhow, and were able to optimize their own organization needs as they implemented EDI in their networks.

By contrast, in the public phone network a user has no direct control over either the facilities or the management layer of the network itself. The public service provider always intermediates between the user and the network. What any individual user can do is subject to the limitations of technology (i.e., the vast public network can not be easily adapted for the needs of that user) and of solutions that do not badly disadvantage the needs of other users.

62 But to capture the benefits of these successive rounds of learning, users must master sophisticated skills to implement their telecommunications strategies. This has become evident in the post-divestiture US world, where companies' telecommunications managers and chief information officers need large and skilled staffs to find their way through the multitude of options they face.

More importantly, the public network provider retains most of the network and technology knowledge, while the user gains most of the knowhow from using the network for its own needs. It is generally very difficult for a user and the network provider to transfer the two kinds of learning to each other. Consequently, it is difficult for either to make changes (in the user's operations or the phone company's network) that capture the benefits of combining the two kinds of learning.

This means that the public network is never likely to embody all of the learning associated with increasing any individual user's economic performance.[63] However, the public approach does provide important learning benefits to those users unable to draw on -- or, as with the EDI example, control -- a private network. The public network provider brings valuable expertise to user firms who do not have the skills or the resources to manage their own network. Perhaps of even greater significance, the public network cumulates experience and learning from a wide range of different users. Innovation and knowledge generated anywhere in the network can be made available to all users on the network.

That is critical, because as with experimentation, learning rests on the existence of skills and other assets which complement the existing technology and permit the knowhow to be captured and used effectively. The integrative role played by the phone company is potentially a very significant asset in these terms -- if the operator devotes sufficient resources to meeting user needs.

More broadly, for learning and experimentation to be effective, a broad range of such assets are necessary complements to advanced network capabilities. One obvious asset is adequate user training in and familiarity with communications technologies. A critical related asset is an appropriate standards mechanism that can ensure timely compatability between different information technologies. It was particular lack of these latter kinds of complementary assets which prevented the auto parts suppliers from incorporating the learning from their use of EDI.

Other complementary needs are for easy access to data and facilities that lie outside the user's business but which are reachable through the communications infrastructure. For example, taking the auto case one last time, some of the more sophistocated parts suppliers, those who produce complicated electronic and mechanical systems, could substantially improve their performance if they had access to a supercomputer and to trained researchers for purposes of dynamic modeling of system design and performance. If these are available only outside of the firm, but reachable through the communications infrastructure, a substantial amount of learning can still take place. A parallel kind of asset for smaller businesses would be technology demonstration centers, particularly if combined with industrial extension programs.

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63 An advanced public network providing the capability for users to define virtual sub-networks and services that are tailored to its needs -- such as ATT's Software Defined Network (SDN) offering -- would come closest to solving this set of learning problems.

The existence of such supportive complementary assets would go far toward ensuring that the learning and experimentation critical to long-term economic performance get broadly diffused throughout an economy – not limited to those few large users capable of implementing complex private networks. The very need for such assets, along with the integrative role that a universal, integrated and highly functional public network plays, suggests the degree to which differentially available network arrangements – i.e., the network infrastructure itself – influences the realization of dynamic economic gains.

How the network infrastructure is organized and controlled influences the extent to which the economic benefits that accrue to learning and experimentation get generated and diffused within an economy. Private networks ensure that those benefits are internalized by a few economic actors who can realize dramatic success in long-term adjustment to competition. Public networks, along with complementary public policies, provide a means for more widely externalizing and diffusing gains to the advantage of an economy as a whole. Much as with resource allocation, the bottom line is that a reasonable mix of both private and public network approaches appears to be required to realize all of the available gains.

IV. CONCLUSION: POLICY AND PERFORMANCE

How the network is deployed -- how the issues identified above are settled -- creates constraints and opportunities for network users. Our analysis suggests that different network infrastructures affect the efficiency of resource allocation amd the generation and diffusion of the experimentation and learning that are central to successful competitive adjustment in a changing world economy. In other words, as a medium, the network is not neutral: How boundaries are drawn concerning network ownership and control, access, functionality, usage, and the availability of assets that complement the technology, will influence the kind of network infrastructure available to users and their economic performance.

As we have also argued, U.S. telecommunications regulatory poicy has never been much concerned with these issues. However, by originally advocating an integrated, universal, monopoly phone network, the Bell System, U.S. policy unintentionally promoted an economically effective communications infrastructure. The transmission and management layers were tightly integrated with the primary application, voice telephony, and the whole package reached throughout the U.S. Efficient resource allocation was favored through cheap, universal phone service, and opportunities for experimentation and learning were similarly cheap and widespread, (if also limited to telephony).

Over the last thirty years, several legal and regulatory decisions have drastically altered the national network infrastructure. They have done so without paying any attention to the consequences on economic performance.

The introduction of competition and then the break-up of the Bell System have led to increasing fragmentation of the infrastructure. Competition, continued restraints on ATT and the Bell companies, and the development of new applications have led to increasing differentiation of infrastructure capabilities. There is fragmentation of network ownership, control, access, and of the network itself; differentiation of uses, providers and clients. Competition increasingly drives the network's evolution -- although traditional regulation and court order continue to exert critical influence -- and final demand primarily determines its accessability and capabilities.

Ownership and control, configurability, access, functionality, all differ in different parts of the overall network. Those differences dramatically affect the network's utility for economic performance. The largest users are well-served. But smaller users have neither the resources nor knowhow to take full advantage of the diversity of options confronting them; and regulatory decisions have denied them the fully functional, integrated, public network that could at least partially compensate.

Fragmentation and differentiation have also created substantial market imperfections that frustrate the widespread diffusion of the economic benefits an advanced network infrastructure makes possible. Most critical, current policy badly under-exploits opportunities for economy-wide realization of the learning and experimentation that underlie long-term economic performance. In gaining the benefits of market-led diversity, U.S. policy is sacrificing the benefits of an integrated infrastructure.

Thus, the largest network providers, the post-divestiture Bell Companies remain mostly excluded from providing a wide variety of new information services which they are uniquely suited to provide.[64] Similarly, the fragmented structure of sub-networks represents a serious limitation for a number of applications: examples range from separate e-mail systems unable to exchange messages, to the difficulty of integrating applications from different domains of the economy (e.g. combining banking and manufacturing).

Under these circumstances, current regulatory policy in Computer Inquiry III, with its emphasis on Open Network Architecture and Comparably Efficient Interconnection, can be understood as an attempt to provide a framework through which a fragmented lower layer infrastructure can be used in an integrated fashion by a number of actors. It does so by introducing terms for progressively allowing the BOCs to offer applications, while simultaneously giving various users and application providers equal access to essential components of the BOCs' transmission and management network layers. The challenge facing US telecommunications policy today is to reconstitute a "virtually" integrated infrastructure for the nation's economy.

ONA's dual approach, as it simultaneously attempts to put more into the public network and to allow service providers to draw more out of it, mirrors the on-going tension in the US about whether regulation or competition, is best able to guide the evolution of the network infrastructure. In this debate, the two approaches are usually seen as contradictory rather than complementary: the first aims at the provision of more services through the public network, the second wants to consider the public network as a reservoir of basic building blocks (Basic Service Elements, as ONA calls them) to be drawn upon by private networks and service providers.

To a large extent, these conflicting trends reflect two contrasted conceptions of the network infrastructure, which can be characterized as the opposition between an integrated approach which may sacrifice the benefits of diversity, and a diverse approach which may sacrifice the benefits of integration. If our analysis is credible, neither approach alone will be insufficient to promote the full potential of the existing network infrastructure for economic development.

The goal of efficient resource allocation can best be achieved by policies that ensure that the public parts of the network infrastructure are as open, accessable and universal as possible. Achieving this will require changes in emphasis in traditional regulatory policy, but no drastic policy revolutions.

The attainment of widespread experimentation and learning, however, must be encouraged partly by policies that fall outside of the traditional regulatory domain and in part by the achievement of a new regulatory bargain between the U.S. and the public network providers. As we have seen, those economic actors who rely primarily on the public network will lose the benefits of certain kinds of learning and experimentation. On the one hand, pushing the public network toward an advanced, intelligent, software-configurable, capability can help to rescue many of those benefits – but only if the broad, cumulative knowledge base retained by the public network provider is diffused to the economic actors in question. On the other hand, diffusion of that broad knowhow base and of advanced network capabilities will only be effective if

64 This is demonstrated, for example, by the success of France's Minitel. It is also a point that Judge Green firmly believes. See his decision comments on Minitel in U.S. vs. Western Electric, Civil Action 82/0192, (D.C. District, September, 1987).

Telecommunications policy and usage in Japan.

Taizo Yakushiji.

Report presented at the final seminar on Information networks and business strategies, held at the OECD headquarters in Paris, 19-20th October 1989.

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Chapter 1 Telecommunication Market and Policy In Japan

Overview

The peculiar policy environment in Japan is better captured if one looks at the unique structure of business relationships among major companies. Given this unique business structure, we need a careful look at the relationship between new development in legal reschufflings of telecommunication policy in Japan and its effect on the use patterns of telecommunication by companies. In this chapter, we will illustrate severla key characteristics in comparison with the case of the United States.

First, we should note that Japan's regulations on telecommunication are traditionally not perceived of as an obstacle for business activities. Rather, users' fees, for example, have been regarded as something like an inevitable tax imposed for making use of state-owned telecommunication. In this regard, in Japan, telecommunication has been perceived as one of public utilities, which is similar to water supply and electricity.

Second, the liberalization of telecommunication regulations in Japan anteceded before the users captured the merits of such liberalization. In other words, the recent relaxization of telecommunication regulations did not result from a market pull based on strong demands from telecommunication users, but from a supply push or politically-driven.

Since Japanese telecommunication users have been accustomed to state regulations for many years, they have taken it for granted that the state should provide common carriers and private enterprises are dependent on these common carriers for their telecommunication use. Therefore, the liberalization did not alter business behaviors of companies so considerably as expected. This is a marked difference from the case of the United States.

In American history of business enterprise, companies have long fought, in both courts and politics, against federal regulations in order to maximize their profits under the laissez faire principle. The federal government has then been confronted with these aggressive private corporations. A good example can be seen in bitter confrontations between the federal government and railroad companies in the late 19th century, which later resulted in the promulgation of the Sharman Anti-Trust Act of 1890.

Japan is not such a pluralistic state as the United States where government and private business are puluaristically separated. So long as policy environment is concerned, Japan is more or less a state-centric country where companies have long regared government regulations for granted as a part of public goods in service for private business. This so-called "developmental regulatory state" is a prevailing concept with which we can acurately understand the regulatory environment of telecommunication policy in Japan. For instance, there was no strong motivation by Japanese companies to install private networks, separetely from the state-provided common carries. Rather, what Japanese companies requested vis-a-vis government policy was not lowering users' fees, but enhancement of the quality of common carriers.

For installing a private network, companies have to encounter too many legal obstacles in Japan. For example, if companies want to construct a private telecommunication line between two factories across a road, they have to file many documents to obtain a permission from the Ministry of Construction. The current law of the right of way is very strict and it easily discourages private parties to lay out a private line. In the United States, the price of land is relatively cheap, so that it is not a physical and legal constraint to lay out a private network encompassing a vast distance, while in Japan it is not the case.

The unique business structure, coupled with a lagged response of the user companies to the state-initiatiated liberalization of telecommunication, created a unique VAN market in Japan. In statistics, it is reported that there are more than 700 companies in VAN business in Japan today, while, in the United States, there are largely three VAN companies. However, the concept of VAN business in Japan differs from that in the United States. In Japan, a VAN company is merely a small spin-off of a large corporation, which was originally its mother company's telecommunication or data processing division. In other words, it is not a newly-emerged company to sell a sophisticated VAN service, but rather, it accidentally became a separate company from a mere division of a large corporation when the telecommunication law was enacted and set forth the Type II Telecommuniction Enterprisers.

Although, legally speaking, these mini VAN companies can sell their VAN service outside the mother companies, their service still remains within the mother companies and affiliated companies. This is the reason why there are so many VAN companies in Japan. To illustrate in a pictorial way, American VAN companies are providing VAN sevice horizontally by covering different business sectors in a nation-wide network. But, Japanese VAN companies give limited service to their mother companies, so that, they are vertically structured without a horizontal connectin. This is simply due to the difference in business structure between the United States and Japan, and not due to the difference in the concept of VAN service itself.

Since most Japanese companies are formed in a coalition group, such as old "Zaibatsu's" or new assembler-suppliers' relations, there are hypothetically the same number of VAN companies as the number of business groups. In the United States, a service provided by a VAN company is a packet-exchange service with data-base sales, while in Japan, a primary business run by a VAN company is to sell terminal equipment to link up host companies with a VAN company. Then, for outside markets, Japanese VAN companies attempt first to sell terminal equipment and second to provide a limited VAN service through these equipments.

With respect to future possibility to develop the private wireless telecommunication networks in Japan, there are also many political constraints. The wireless communication industry is a gifted territory for ex-bureaucrats of the Ministry of Post and Telecommunication (the MPT). After retiring from the ministry, high-ranking officials normally find equally high-ranking posts at the private broadcasting companies, which means that it is hopeless that this ministry will submit the right of way to install a private wireless network without their consent. This indicates that future conflicts will emerge if American companies will try to enter the private wireless telecommunication business in Japan. The recent incident of the Motorola's attempted entry into cellular telephony business in Japan is a case in point.

In short, the current liberalization of telecommunication regulations in Japan does not affect considerably the behaviors of the user companies. The real liberalization might accompany not with liberalization of existing regulations, but rather with physical liberalization of telecommunication means such as free installation of a network across roads or public properties. Until the time comes for such full liberalization of telecommunication means, real liberalization will not come out yet in Japan.

1.1 Japan's Telecommunication Market

1.1.1 The Uniquness of Japan's VAN Market

The definition of VAN service which is commonly understood in Japan is as follows: a concern first leases a bundle of telecommunication channels from a common carrier such as NT&T, and next resells them by adding new values. Thus, VAN service is basically a device to pool a limited channels for common use. Here, new added values are classified into two categories. The first category embraces the supply of new service such as softwares and data bases. The second category includes the supply of hardware service such as packet exchangers and protocol adjustment. Customers then find merits in cheaper prices for leased channels with "a-la-carte" softwares and data service. They can gain clear added values to compare with otherwise table-d'hote flain service provide by the NT&T.

Profits of a VAN company come from segmented retail sales of these services by leasing a part of channels from a common carrier. If we designate a horizontal coordinate for a number of channels to be sold by the NT&T and a vertical coordinate for their prices, a convex curve is drawn. This means that if a user leases multiple channels from NT&T, the prices become saturated, so that if they resell them at further cheaper prices plus value added profits, an individual customer can gain value-added service at the same cost it would pay for leasing a channel from the NT&T. Since the hitherto ban of resale of channels of the NT&T was relaxed at the time of promulgation of the new telecommunicatio law of 1982, a new VAN business has flourished very quickly in Japan.

The recent statistics released by the MPT are rather confusing. According to them, the market size of Japanese VAN market ammounts to 670 billion yen, while the American VAN market totals to 300 million yen. This does not indicate that Japanese VAN market is much larger than that of the United States, since the definitional concept of VAN service differs between Japan and the United States.

As shown in Figure 1-1, American VANs such as GTE-Telenet and Tymnet, are defined in such a way that they fulfill two functions simultaneously, namely to resell communication channels and to add enhanced service. Historically, until 1973, the resale of AT&T networks was banned. Then, a lawsuit case was put to the Federal Communication Commission (the FCC) by insiting that if enhanced service is added, the resale of channels should be permited. After long legal debates, the FCC finally granted a license for VAN service under the rationale that if a new value added service would contribute itself to public welfare, which could not otherwise be provided by AT&T, the resale of the AT&T's networks could be permitted. Then, American VAN service emerged as a legal excuse to open up reselling of the common carrier's networks. Later, the definition of VAN was extended to be one which has either resale of network channels or enhanced data service, not simultaneously but separately.

In Japan, the VAN service is loosely defined. It encompasses American definiton of VAN, but adds something else that contains enhanced communication service. Then, intramural data networks and private communication lines of electricity utility companies and railroad companies, if added with enhanced data processing, are all classified as a VAN business in Japan.

Now, it is apparent that, since Japanese definition of VAN businees is so loose, its market size of 670 billion yen is also misleading. On the contrary, we can say that there has been not yet a real VAN service in Japan which provides enhanced network services in a horizontal scope.

One MTP's report points out that Japanese VAN companies have not yet been in business success with a full swing of market expansion. One reason to account for this business staganation is that since, as shown in Figure 1-2, the majority of Japanese VAN companies are still within their mother companies with respec to financial relationships, and intramural VAN service is classified as an expense by these mother companies. Therefore, in a balance-of-payment sheet level, these intramural VAV companies can sirvive even with all reds in account sheets.

1.1.2 The Overview of Japan's Telecommunication Market

1) The_Number_of_Telecommunication_Enterprisers

The number of companies which are engaged in telecommunication business in Japan is shown in Table 1-1. Before 1985, there were only 80 VAN companies in a small and medium size. They could enter the VAN market under the approval of the 1982 law. So that, in Table 1-1, these small and medium-size VAN companies are categorized in the General Type II Enterprisers. A sharp increase in the number of the Type I companies in 1987 was primarily due to an increase of entries by the wireless paging companies. The number of the international VAN companies has increased since the 1987 revision of the law permitted entry in this market. The General Type II companies usually mean the VAN companies whose number has increased even before the NT&T was privatized in 1985.

2) Market_Size_and_Future_Forecast

Table 1-2 shows the size of telecommunication market in Japan. It is forecasted that an increase in the Type II (primarily VAN) enterprises is three times faster than an increase in the Type I (common carrier) enterprises. Future forecast in this table is based on a rough regression analysis applied by the MPT.

3) Equipment_Investment_in_the_Telecommunication_Industry

Figure 1-3 shows equipment investment by the type of enterprisers. Naturally, investment by the common carriers is large since network building requires huge euqipment

Exhibit 1

Figure 1-1

The Definition of the VAN Service

VANとは何か（VANの定義）　図1

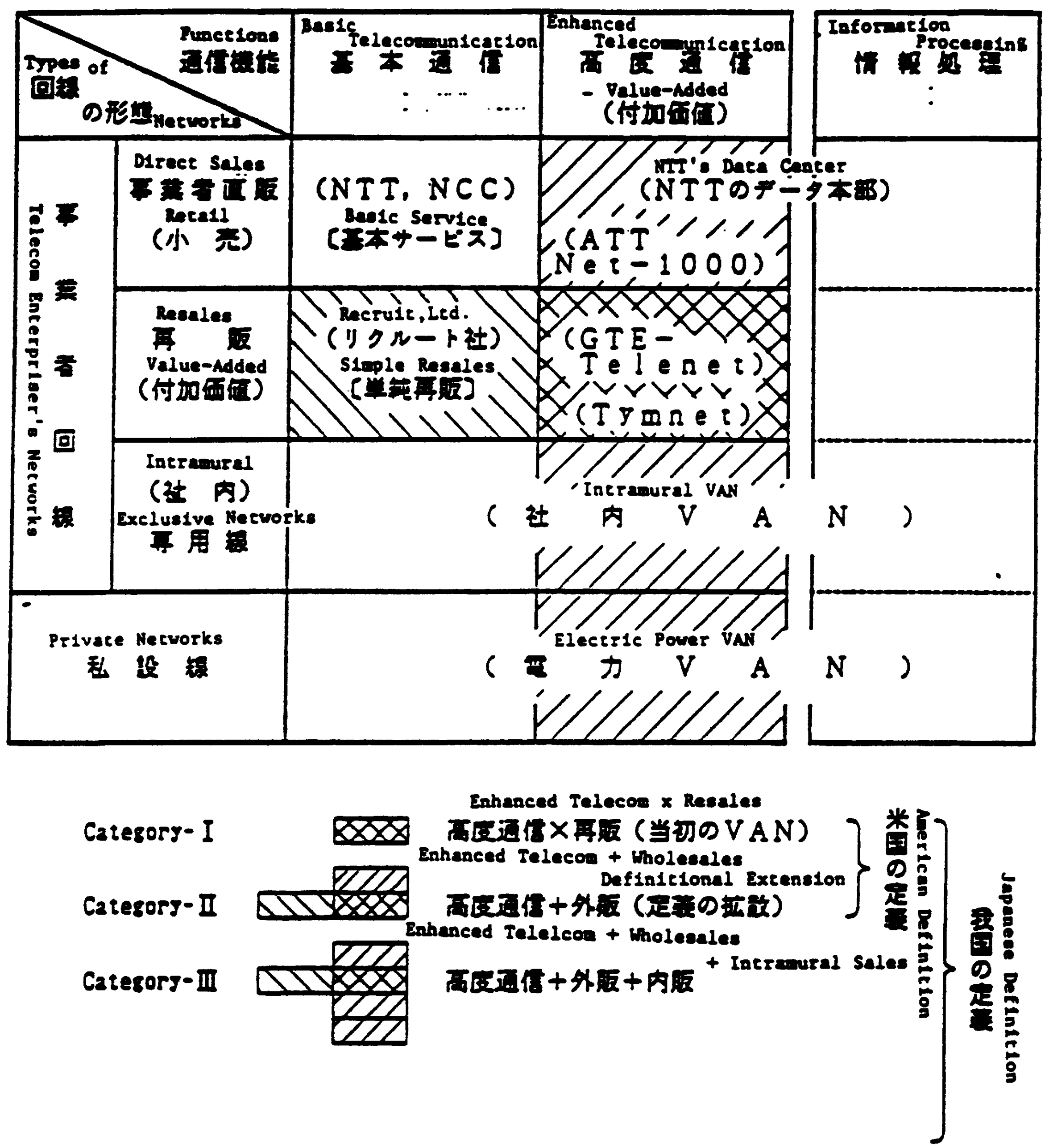


Exhibit 2

Figure 1-2

Japanese VAN Companies

VAN事業の位置づけ 図2

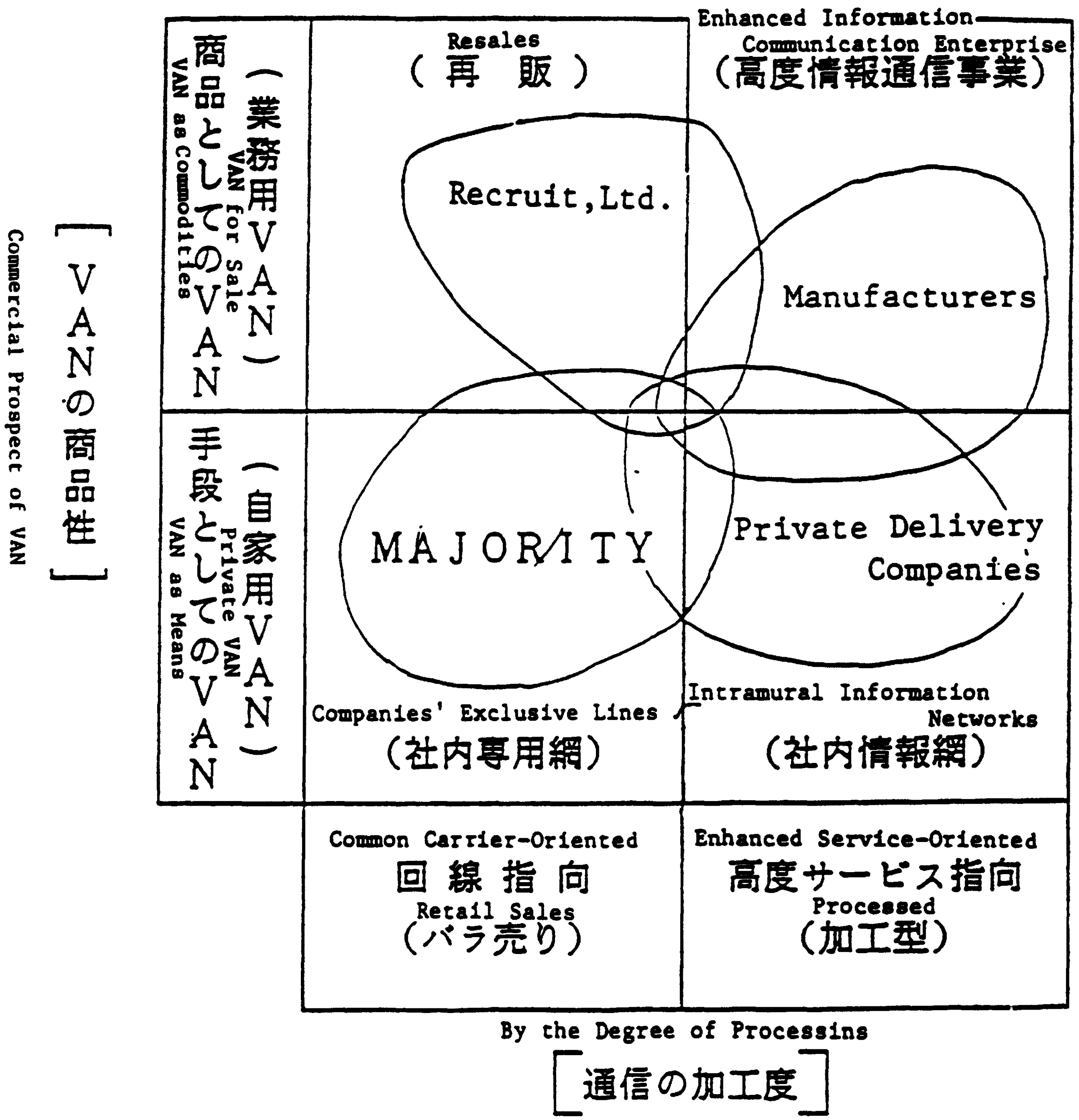


Exhibit 3

Table 1-1 The Number of Telecom Enterprisers

表１－１ 電気通信事業者数の変遷

	Befor 1985 1985年以前	1985 1985年	1986 1986年	1987 1987年	1988 1988年
The Type I Enterprisers 第１種電気通信事業者	2	7	13	35	39
Wireless Paging Companies うち 無線呼び出し	-	-	2	18	24
Mobile Telephones うち 自動車電話	-	-	0	3	3
The Special Type II Enterprisers 特別第２種電気通信事業者	—	9	10	18	23
International VAN うち 国際ＶＡＮ	-	-	-	10	13
The General Type II Enterprisers 一般第２種電気通信事業者	80	200	338	512	635
Total 計	82	216	361	565	697

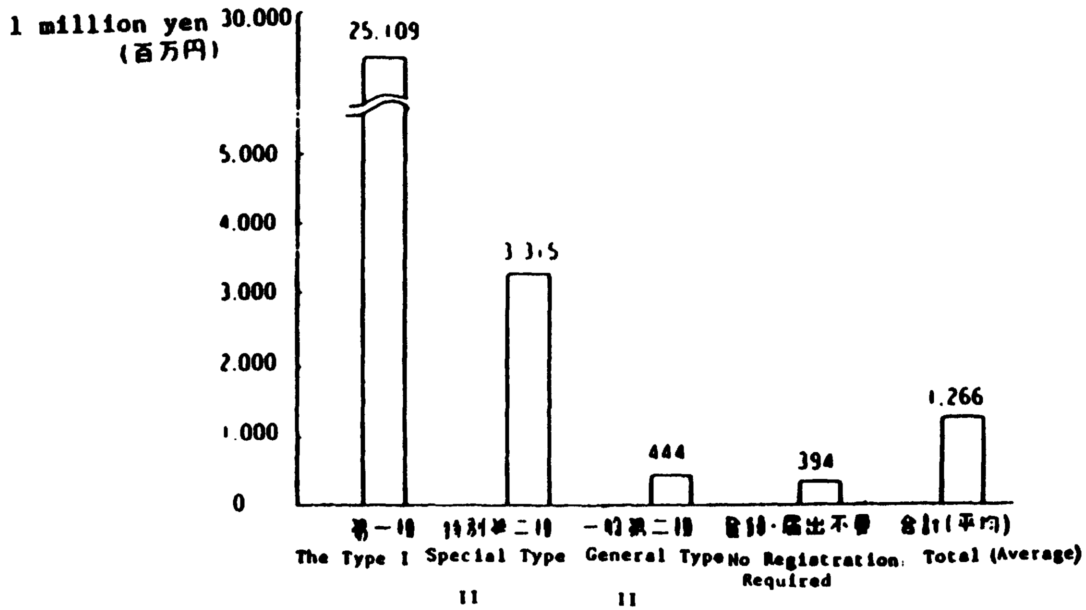
Table 1-2 The Telecommunication Market
表１－２　電気通信情報産業の市場規模見通し

Unit:100 million yen
単位：億円

	1975年	1980年	1985年	1991年	80/75	85/80	91/85
The Type I Enterprisers 第１種電気通信事業	21.574	41.021	53.074	78.512	13.7%	7.3%	10.6%
The Type II Enterprisers 第２種電気通信事業	—	—	5.200	28.266	—	—	32.6%

Figure 1-3 Telecommunication Equipment Investment

図1－5 電気通信事業者区分別設備投資額



investment. This figure suggests the difference between the Special Type II companies and the General Type II companies, in that the Special Type II companies provide a large-scale telecommunication service, while the General Type II companies include the small-scale VAN companies.

4) VAN Market

According to the data released by MPT's data handbook, the total sales of the VAN market amounted to 640 billion yen in 1986, 783 billion yen in 1987, with a moving-average increase ratio of 22.3%. If a forecast is made based on capital increases in VAN companies, an increase ratio in total sales from 1987 to 1989 would be something like 35.7%. This forecast is taken in the MPT's data handbook, and should be severe criticism for its naive technique of regresional models applied to their forecasting.

Figure 1-4 shows the distribution of the VAN companies in terms of the size of sales. Although we observe a gradual shift from smaller companies to larger companies, there are profoundly a vast number of the small and medium-sized companies in Japanese VAN market.

Of Japanese VAN companies, only 37% are those which take VAN service as a principal business, and the rest, namely 63%, take VAN business as a secondary occupation. Table 1-3 shows what these secondary business companies are.

5) The User Market of VAN Service

Japanese users of VAN service are predominantly individuals who are the users of electronic mail service with their own personal computers. The next largest users are those in the wholesale industry and the retail and glossary industries. A more comperhensive picture is seen in Figure 1-5.

1.2 Japan's Telecommunication Policy

1.2.1 Historical Background

1) The Early Start (The Meiji Period)

The Meiji Government put state emphasis on construction of the trunk line of telegraph communication networks in 1869. The centric control of the country led the Meiji Government to invest in communication and to monopolize both telegraph and telephone services. For example, telegraph engineering was the first academic curriculum at the nation's first national university, namely, the University of Tokyo.

Exhibit 6

Figure 1-4 The VAN Companies By Size of Sales

図1－8 VANサービス売上高別企業数（2年前、今年度、2年後）

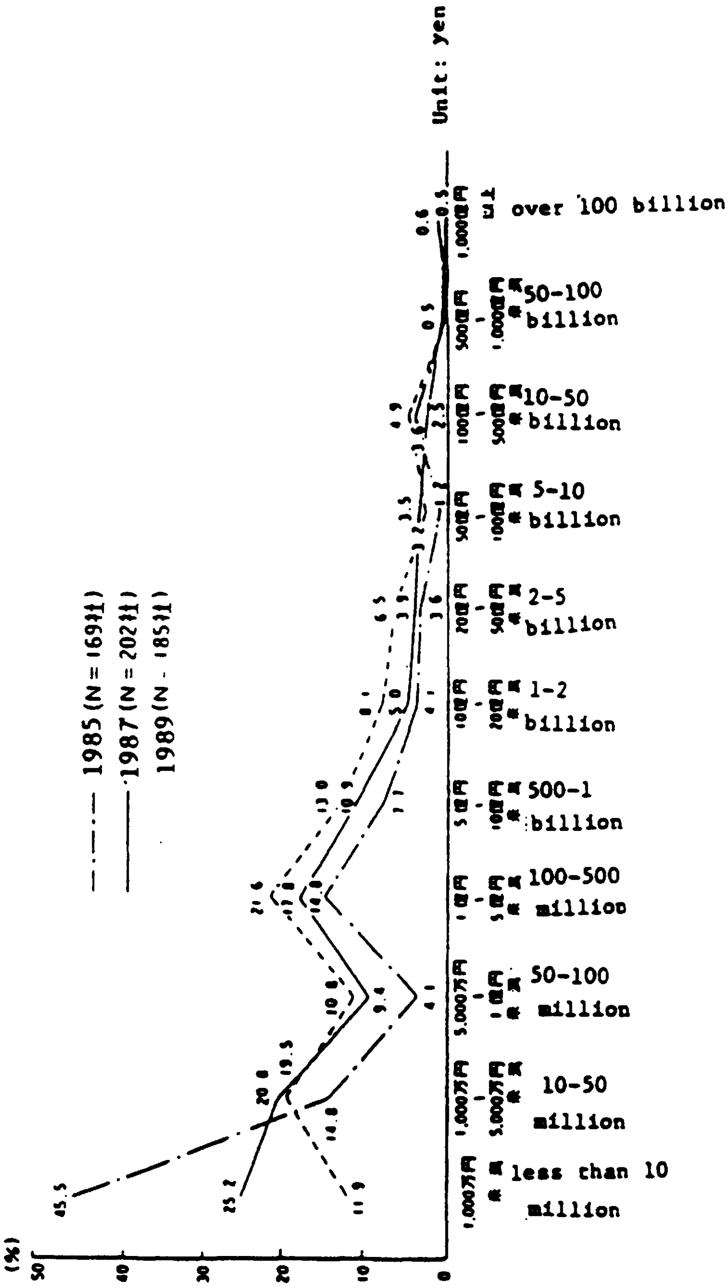


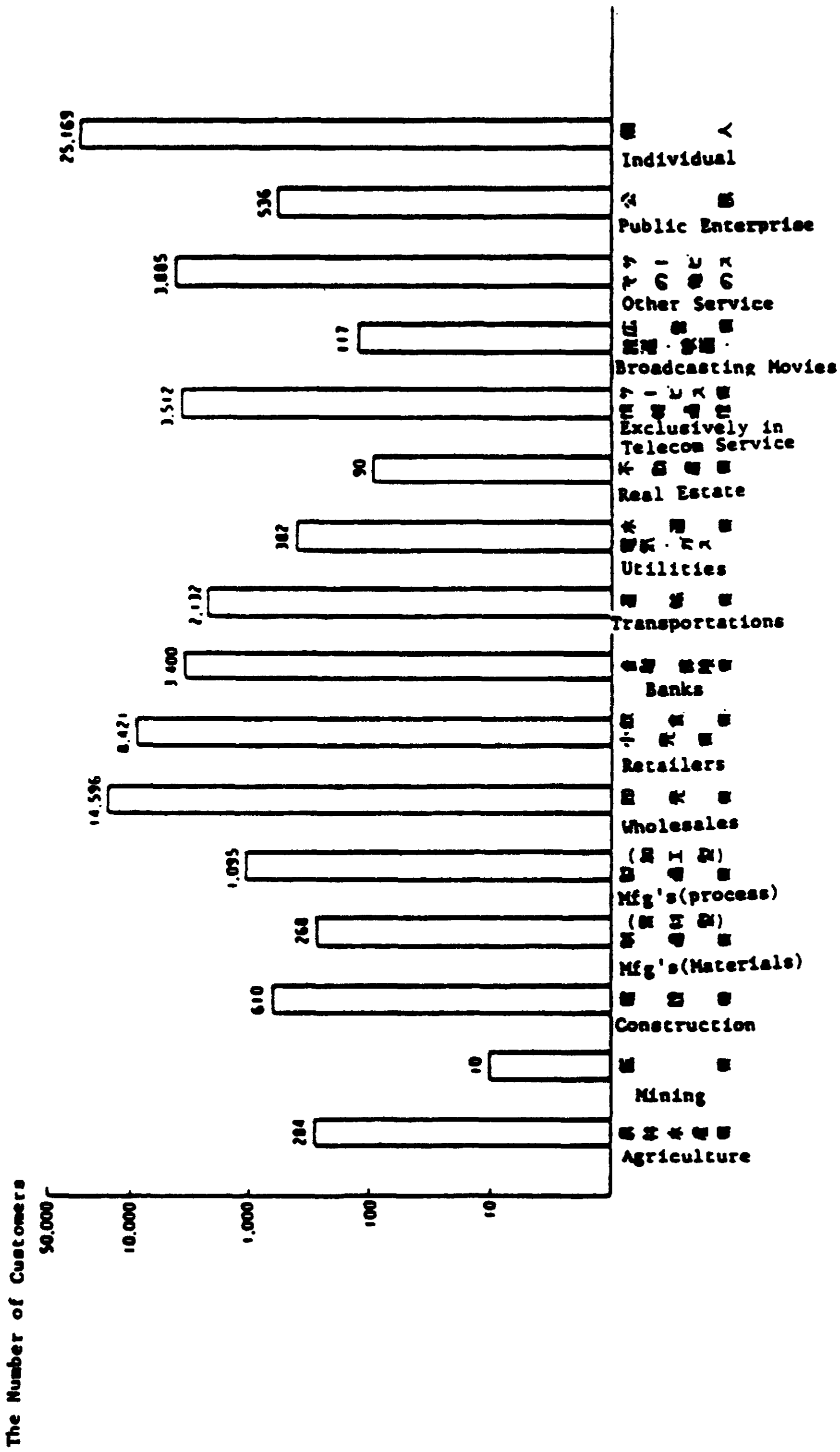
Table 1-3 The Number of Companies Not Exclusively in Telecom Service Industry

表１－６ 電気通信事業者区分に基づく情報通信サービス以外の業務

			農林水産業 Agriculture	鉱業 Mining	建設業 Construction	製造業(素材型) Mfg's(Materials)	製造業(加工型) Mfg's(process)	卸売業 Wholesales	小売業・飲食業 Retailers	金融・保険業 Banks	運輸業 Transportations	電気・ガス・水道業 Utilities	不動産業 Real Estate	放送・映画・広告業 Broadcasting Movies	その他のサービス Other Service	公務他 Public Enterprise	情報通信サービスのみ Exclusively in Telecom Service	合計 Total
Type I Enterprisers	第一種電気通信事業者	企業数	–	–	–	–	–	–	–	–	–	–	–	1	1		6	8
		構成比(%)	–	–	–	–	–	–	–	–	–	–	–	12.5	12.5	–	75.0	100.0
Special Type II Enterprisers	特別第二種電気通信事業者	企業数		–	–	–	2	–	–	–	–	–	–	1	1	–	11	15
		構成比(%)	-	–	–	–	13.3	–	–	–	–	–	–	6.7	6.7	–	73.3	100.0
General Type II Enterprisers	一般第二種電気通信事業者	企業数	6	--	8	6	24	51	52	18	25	7	7	9	80	10	93	250
		構成比(%)	2.4	..	3.2	2.4	9.6	20.4	20.8	7.2	10.0	2.8	2.8	3.6	32.0	4.0	37.2	100.0
Companies with no registration requirement	登録・届出等必要としないデータ通信サービス業者	企業数	4	1	1	3	4	9	8	10	3	3	3	2	24	9	41	86
		構成比(%)	4.7	1.2	1.2	3.6	4.7	10.5	9.3	11.6	3.5	3.5	3.5	2.3	27.9	10.5	47.7	100.0
Total	合計	企業数	10	1	9	9	30	60	60	28	28	10	10	13	106	19	151	359
		構成比(%)	2.8	0.3	2.5	2.5	8.4	16.7	16.7	7.8	7.6	2.8	2.8	3.6	29.5	5.3	42.1	100.0

Figure 1-5 The Number of VAN Customers

図１－１０ ＶＡＮサービスの業種別顧客数



Japan's telephone service was opened only four years later after America's first commercialization of telephone service began in Boston in 1878. However, it was only applied to government use, and public telehone service was firstly installed in 1900. This indicates that telephone communication in Japan was developed in the way of government ownership, without any intention to privatize it.

2) The_Postwar_Reform:_The_Start_of_the_NT&T

In 1943, under the Tojo War Cabinet, the Ministry of Post and Telecommunication and the Ministry of Railroad were merged together in order to integrate land, sea and air transportation and communication in a single administrative unit called the Ministry of Transportation and Telecommunication. However, this manmmoth ministry did not function properly because of its side. After the defeat of war, the Bureau of Telecommunication was separated from this gigantic organization and hence became the Bureau of Post and Telecommunication, which was later elevated to a ministrial level by assuming the postwar name, the Ministry of Post and Telecommunication (the MPT). But, its prewar administrative jurisdiction over air transportation, ship transportation and electric utility service did not come back to the ministry.

As a consequence of social democratization by the GHQ (the General Headquarter of the Allied Forces), workers' strikes occured in every sector of Japanese industries. Among them, workers' strikes by the All Post and Telecommunication Workers' Union was one of the most militant in labor movement. Then, GHQ's policy directive was released to dissolve the MPT into separate organizations for the purpose of weakening workers' political movement within the MPT. In respose to the GHQ's directive, Japanese government proposed to set up two different ministries, the Ministry of Postal Service and the Ministry of Telecommunication, but a single minister would control both ministries. In the mean time, the national railroad service and the salt and tabacco monopoly were separated from the Ministry of Transportation and from the Ministry of Finance, respectively. They both became an independent public corporation.

In the postwar polictical reforms, the creatin of a new ministry was banned because of government budget shortage, so that the proposition of creating the new Ministry of Telecommunicatin faced a serious deadlock. The reorganization issue of the ministry became inevitable when there emerged a serious social problem of telephone shortage and its mulfunctioning. The GHQ was also very worried about mulfunctioning of the telephone exchange system for its political control of Japan. Political debates went on to shift towards the privatization of telephone service as was the case of American AT&T. However, the question remained as to how to mobilize necessary capital money for a such privatization in the midst of economic devastation after the war. Then, an idea of transforming the ministry into a public corporation emerged as a promising future plan. The All Post and Telecommunication Workers' Union aggreed with this public corporation alternative, since the workers thought that it would raise their sallaries if a public corporation was created.

Under the process described above, a law regarding reorganization of the Ministry of Telecommunication was finally passed at the Diet and the Nippon Telegraph & Telephone Corporation (the NT&T, or "Denden-kosha' in Japanese) was established in 1952, and its overseas telegraph and telephone service was taken away to a new private company called the "Kokusai Denshin Denwa, Ltd." (the KDD). The KDD was established as a compromise between a privatization plan of the whole ministry and a public corporation plan.

Because of its wartime predecessor and postwar telephone shortage and mulfunctioning, the NT&T had been basically engineers-led company whose emphasis was placed on technological development in telecommunication. This suggests that engineers had enjoyed stronger political power over non-engineering personnel in the NT&T's decision-making.

3) The Telegraph and Telephone Bonds: A Managerial Innovation

The most serious problem for the newly created NT&T was capital shortage. In order to solve this problem, Japanese government introduced a very wise capital acquisition plan, namely the Telegraph and Telephone Bonds (TTBs). First, in 1953, the government asked city banks and security companies to form an underwriting syndicate to sell the government-guaranteed TTBs. Since telephone demands were so large that anyone who wanted to install telephones must buy the TTBs. Capital money collected by the sales of the TTBs was solely used to finance for the replacement of telephone exchangers and telephone equipment. The TTBs system worked so well, and Japan's telephones, exchangers and equipment were quickly renovated.

4) The Privatization of the NT&T

When Prime Minister Zenko Suzuki launched an administrative reform plan in 1982, he was much concerned with ailing government budgetary deficits. His attempt was to solve budeget deficits without politically unfavorable tax increase. Suzuki's administrative reform plan was continued by the next Prime Minister Yasuhiro Nakasone, and

Nakasone successfully implemented many administrative reforms, including the privatizations of the Salt and Tabacco Sales Monopoly Public Corporation, of the National Railroad, and finally of the NT&T.

However, the NT&T was privatized not because it gave the government a budgetary deficit. In fact, it was one of the most profitable public corporation. NT&T's privatization was taken place for three reasons. First, it was implemented as a package of Nakasone's political slogan of the administrative refomrs of the government-controled public corporations, although his target was on the ailing-by-deficits Japan National Railroad. Second, it was internally motivated within the NT&T itself. Thank to the successful sales of the TTBs, the NT&T achieved complete renovations of Japan's telegraph and telephone system so quickly. This in turn means that the NT&T would not be able to expect fast capital accumulation through the hitherto TTBs in future, so that it has to enter a new profitable business. Unless it changes the status as a public corporation under the government's control, the NT&T cannot open a new business so easily. Then, privatization was only option for the NT&T. Third, the NT&T's privatization was requested by foreign governments, in particular, American federal government's pressure was strong. In 1982, the AT&T and the Department of Justice reached a legal compromise about the anti-trust lawsuit against the AT&T. Two years ago, the British PTT was privatized. So that, foreign pressures were felt to open up Japanese telecommunication market. Then, Japanese government had no choice but privatization of the NT&T so as to open Japanese telecommunication market, but with a careful protective measure. Under the new law of privatization, foreign investment is restricted to a one-third of stock shares for the Type I companies which are common carriers, but completely open for entry into the Type II companies which are engaged in telecommunication service by leasing common carriers from the Type I companies.

1.2.2 The Process of Liberalization

1) Breaking_of_NT&T's_Monopoly

In general, telecommunication is a typical of modern monopoly, because the monopoly in telecommunication meets following three requirements: a) public service---the telecommunication service should be distributed uniformly throughout a country, b) natural monopoly---uniform networks are more economically efficient, base on the scale-of-economy principle, and c) technological standardization---at every point and at every time, a network should be conneted without interfacing problems.

Under these rationales, a law to create a monopoly firm was promulgated in 1952, giving birth to the "Denden-kosha" (the NT&T). Two major missions assigned to the NT&T were the solution of waiting lists of telephone applicants and the implementation of the nation-wide auto-dialing system. Both missions were successfully implemented in 1978 and 1979, respectively.

As technological innovation in the telecommunication area made progress, above three rationales for the state's monopoly gradually lost its legitimacy. First, since market needs became more diversified, the uniformity of telecommunication public service lost its legitimacy. Second, like optical fibers and satellite communication, new communication technologies broke the scale merit of the uniform telecommunication system. Third, the new interface technology does not require technological standardization.

In 1985, three telecommunication laws were enacted to give birth to a free market competition in telecommunication. These are a) The Law of Telecommunication Enterprise, b) The Law of the NT&T, Ltd., and c) The Background Laws for the Law of Telecommunication Enterprise. Figure 1-6 shows the legal configuration of Japan's telecommunication laws.

Since the NT&T has accumulated technological preeminence, technical knowhows, and abovel all the national telephone and microwave networks, the new law on the privatization of the NT&T regulates the scope of privatized NT&T's new business as: a) The NT&T has to perform fair and efficient business, b) The NT&T has to supply a stable and universal telecommuniation service, and c) The NT&T has to undertake R&D and research results should be disseminated to other companies. Other regulations include: d) one third of NT&T's stocks must be held by the government, f) the appoitment of NT&T's executives need MPT's authorization. The NT&T's Law is subject to review till 1990. The most crucial item for 1990 review is whether NT&T be dissolved into the regional companies, like the dissolution of the National Railroad and the AT&T.

2) The Liberalization of Data Communiation

The old Public Telecommunication Law strictly regulated the use of telephone networks and special networks. In particular, the law regarded telephone networks as the most fundamental media in telecommunication, so that its nationa-wide installatin was an urgent policy objective. Any attempt by private parties to lay out a private network or a special-purpose network was then considered as an obstacle to the state's mission to complete the nation-wide telephone networks.

Exhibit 9

Figure 1-6 Japan's Telecommunication Laws

図１－１１ 電気通信法制の仕組み

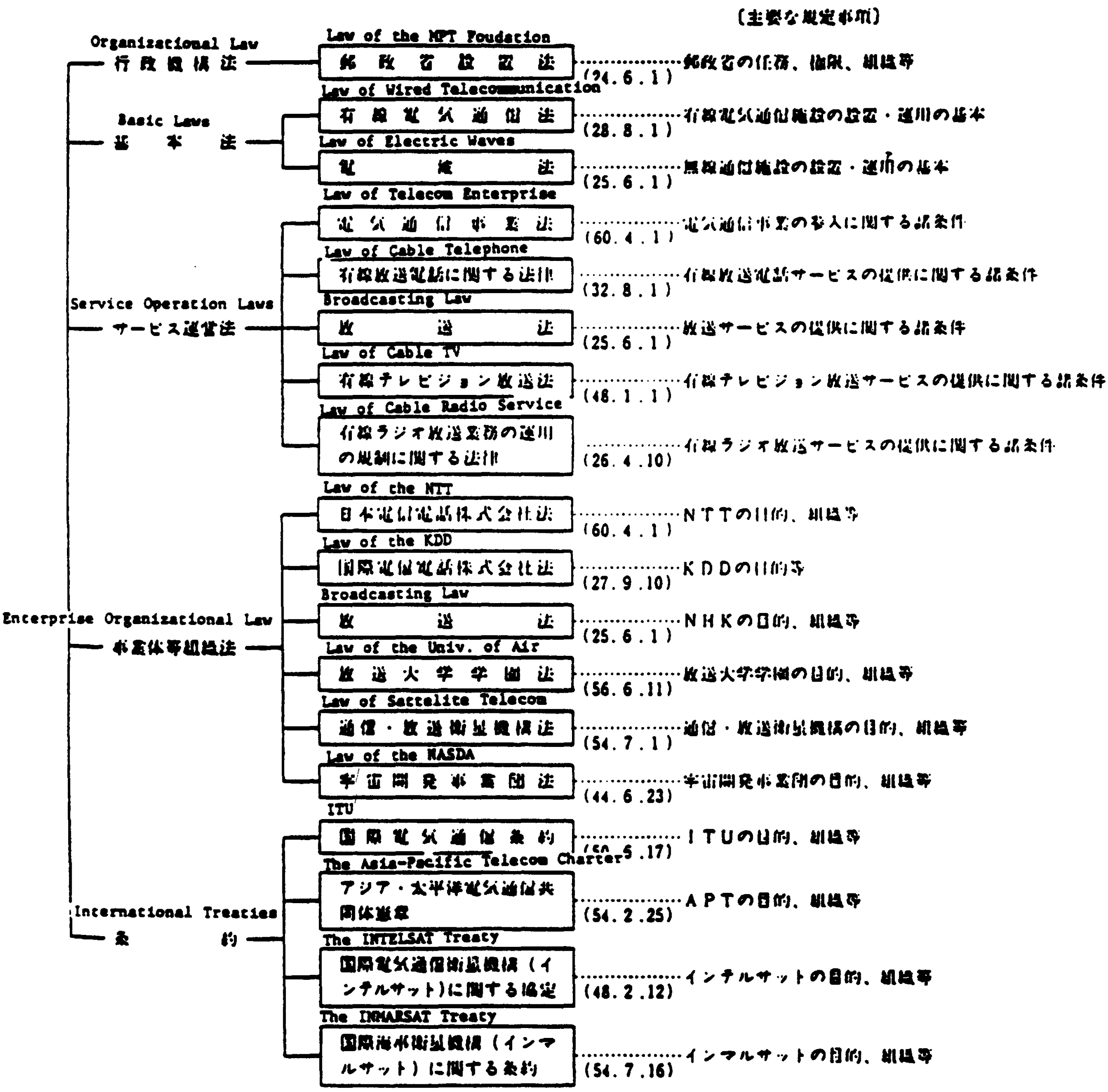


Table 1-4 The Changes of Laws

表1－8 日本のデータ通信の自由化の変遷

Laws	法規制 Regulation	市場の状態 Market
Public Telecom Laws 公衆電気通信法下	Regulated 規制	State's Monopoly 国営独占
The 1971 Revision 1971年改正下	Fundamentally Regulated 原則規制	State's Monopoly 国営独占
The 1982 Revision 1982年改正下	Fundamentally Liberalized 原則自由	Transition from Monopoly to Competition 独占ー競争移行期
The Telecom Enterprise Law 電気通信事業法下	Liberalized 自由化	Market Competition 民間競争

During the late 1950s, computers, which were expensive at that time, were used for data handlings at banks and manufacturing firms. Between branches, some companies started data communicaiton, and in 1964, the Japan National Railroad (the JNR) introduced the computerized seat reservation system. This is one of Japan's first VAN service ever attempted by a non-NT&T company. The JNR had its own communicatin channels for traffic control and safety, so that the seat-reservation system did not infringe on the NT&T's networkds at all. In 1967, the NT&T began a data processing service, but users could not be allowed to link this data line to their own company networks. Then, naturally, as market demands of free data communication increased, a political pressure was mobilized to change the Law of Public Telecommunication in 1971. The revision of 1971 allowd only limited use of data communication, and linkage bewteen different companies was still prohibited.

The second revision of the law came in 1982. In 1978 and 1979, respectively, the state's missions to solve the telephone waiting lists and to implement the nation-wide auto-dialing system were completed, so that, the legitimacy of the state's monopoly of telecommunicatin was lost. Then, by the revised law of 1982, inter-firm networks were legalized, but under the following conditions:

a) only for data processing
b) if not intervene, without data processing, into others's networks.

However, the 1982 revision marked a new era of Japanese telecommunicaiton policies, since it allowed:

a) a VAN business by small and medium-size enterprisers
b) a agent service, without data processing, for the third party's telecommunication use
c) a connection between the common carrier and a private line, if not tripartile connection back to the common carrier, and if accompanying with data processing, and furthermore if not intervene into other parties's lines without data processing.

By the 1982 revised law, Japanese VAN market was officially opened. Three years later, in 1985, three major telecommunication laws came into the fore. Among them, the new Law of Telecommunication Enterprise needs a special attention.

This law classifies telecommunicatin enterprisers into two categories. The first category, desiginated as the Type I Enterprisers, implies the common carriers, while the second category, called as the Type II Enterprisers, means the companies who do not own common carriers, and then by leasing them from the Type I companies, who can provide an enhanced telecommunication service. There are two sub-classifications for the Type II companies, which are: a) the "Special" Type II Enterprisers who give telecommunication serivce to unspecified majority users, or who provide international telecommunication service, and b) the "General" Type II Enterprisers who are those other than the Special Type II Enterprisers. Since the 1987 revision, the Special Type II companies are granted a right to enter an international VAN service, which is a service given to a specific customer, but not to the general unspecified customers.

3) Summary_Matrices

Table 1-4 shows the developmental process by both legal control and market openness. As of 1985, there were 80 companies who participated in the small and medium-size VAN service. As of the end of 1988, there were 658 companies in the Type II category. In 1987, an international VAN was approved, and since then,13 companies have entered into the international VAN marekt.

Table 1-5 shows the typology of companies which are engaged in telecommunication enterprise.

1.2.3 The Uniqueness of Japan's Telecommunication Policy

1) Six_Items_of_Liberalization_Policy

The liberalization of telecommunication policy is not a single entity, but composed of multiple factors. The followng six items seem most important to look at the saliency of the liberalization of telecommunication policies in Japan.

a) the liberty of market entry
b) the liberty of business management
c) the liberty of capital investment in telecommunication business
d) the liberty of installing new telecmmunication means
e) the liberty of network linkage
f) the liberty of supplying telecommunication equipment

a) The_Liberty_of_Market_Entry

With respect to the liberty of market entry, such liberty is fundamentally guaranteed in Japan. There is a ubiquitous word in Japanese as "gensoku-jiyu." Note that "gensoku" implies "fundamentally," and "jiyu" means "liberty" or "freedom." However, this special Japanese

Table 1-5 The Regulations by The Telecom Enterprise Law

表1－9 電気通信事業法による規制

	Type I 第1種	Special Type II 特別第2種	General Type II 一般第2種	Data Processing Enterpriser データ通信事業者*3
Entry Condition 参入条件	License 許可*1	Registration 登録	Report 届出	——
Discontinue of Enterprise 事業の休廃止	License 許可	Report 届出	Report 届出	——
Fee Regulation 料金規制	License 許可	Report 届出	——	——
Business Regulation 提供義務	yes 有*2	——	——	——

＊1 foreign investment regulated
外資規制あり

＊2 Business Regulation of Areas
営業区域内の提供義務（ＮＴＴ法により、ＮＴＴには全国的提供の責務あり）

＊3 Only provides Data Telecommunication, not regulated by the Law of Telecom Enterprise
データ通信のみを提供、電気通信事業法の規律の対象とならない

idiom, "gensoku-jiyu," does not mean complete liberty at all, but the word is always accompanied by another special Japanese word, "kyo-ninka" which literally means either "permission" or "license." In Japan, market entry into telecommunication business is fundamentally free, but applicants need a license from the MPT. In this sense, the entry is conditional, and not absolutely free.

b) The_Liberty_of_Business_Management

For retail sale of telecommunication channels, the NT&T is required to obtain a resale license from the MPT. For wholesale case (i.e., selling a bundle of channels), there are regulations by the MPT and the CCITT since the wholesales of multiple channels give customers an opportunity to install a private network.

c) The_Liberty_of_Capital_Investment

For a domestic investor, there is no limitation as to capital investment into telecommunication business, while, for a foreign investor, a strict regulation is applied.

d) The_Liberty_of_Installing_New_Telecommunication_Means

Under the current Wired Telecommunication Law, the installation of a private notwork is "gensoku-jiyu" (fundamentally free), but under the condition that the MPT would grant a license. This limited liberty is also applied in the United States under the FCC's rules and regulations. In England, regulations are relatively loose since a new network by a VAN company is now permitted.

In Japan, another constraint should not be missed. It is the problem of the right of way. In order to construct a private network, a company has to apply to another ministry, namely the Minstry of Construction, for obtaining the right of way across public properties such as roads and rivers. The stringent regulations by this ministry almost discourage any attempt to install a private network. This is the main reason why only three companies, the Japan Telecom, the Japan Highspeed Telecommunication and the Daini-Denden (which literally means the second NT&T), could enter private long-distant telephone business. They can install private networks without infringing on the Ministry of Construction's right of way, since they use their own land properties such as railroads, express roads and electricity poles.

With respect to wirless networks, they are under a severe control of MPT's Law of Electric Waves since wireless networks require bandwidths. The situation is the same in the case for satellite communication.

e) The Liberty of Network Linkage

Currently, to connect a public network with a private network is regulated in Japan. For example, linking a private voice network with a long distance public telephone lines is banned by the MPT which complies with the CCITT's code. However, a connection between users' terminals and a network of a VAN company is conditionally permitted if an applicant is granted a license from the MTP.

f) The Liberty of Supplying Telecommunication Equipment

Again, for this liberty, the principle of "gensoku-jiyu" is applied. In other words, either domestic suppliers or foreign suppliers have an equal opportunity to enter the euqipment market, but in practice, there are strong ties between NT&T and the so-called NT&T family suppliers. So that, practically speaking, an entry barrier is very high against new comers in this market.

2) The Uniqueness of Japanese Liberalization Policies

The marked difference in telecommunication policies between Japan and the United States is apparent. First, in Japan, liberalization assumes the stability of market order, rather than the enhancement of competition among different parties, while in the United States, competition is a key concept for liberalizing telecommunication market.

In the United States, a dichotomous division is drawn between basic telecommunication and enhanced or value-added telecommunication, whereas, in Japan, demarcation is taken only between the Type I Telecommunication Entreprise and the Type II Telecommunication Enterprise. The rationale for such demarcation by actors in Japan, rather than by the functions of telecommunication, regardless of actors, rests in that, first, if functional demarcation is taken, there would be controversies over the definitions of what basic telecommunication is and what enhanced telecommunication is. As noted earlier, American demarcation was necessary for the FCC to grant a resale license of networks to a second party, other than AT&T.

On the other hand, in Japan, liberalization was initiated by the MPT in the absense of strong market demands, so that the MPT introduced the most desirable scheme of liberalization so as not to loose its political power which was based on the power of "kyo-ninka." MPT's "kyo-ninka" inludes set-ups of users's fees.

In order to keep the rein of MPT's control, a concept of technical standard is necessary. To keep the quality of communication channels, the MPT sets up stringent technical standards to be applied. If an applicant for either the Type I or the Type II category cannot meet such standards, a license is not granted. In the United States, highly technical service has already been operated by private parties, so that, federal control by technical standards cannot be justified.

3) The Problems of Japanese Telecommunication Policies

The unique policy environment in Japan results from the unique behavioral patterns of telecommunication users. As pointed earlier, Japanese users have been accustomed to regulations. This peculiar behavioral pattern made the users dependent on the state's supply of qualified telecommunication networks. In this regard, the concept of supply-push is more prevailing in Japan than the concept of demand-pull.

Currently, Japan's telecommunication policies are primarily concerned with domestic arenas, without full synchronization with international arenas. The real liberalization should be applied to both domestic needs and international ones. So that, current debates at the Uruguay GATT Round should be reflected in polcy formulation at home.

Traditionally, there were two giant telecommunication companies, the NT&T and the KDD, in Japan. Since this oligopolistic market structure had been in effect for many years, policy makers in Japan developed strong propensity to think of telecommunication market in terms of the major actors who provide telecommunication service on a large scale. Such propensity was not altered when the time came for liberalizing the telecommunication law in 1982. Classification of the major actors by Type I and Type II is the case in point. However, it is foreseeable that there will emerge many mini telecommunication companies even in Japan in future. The current classification will then be outdated soon.

We tentatively propose three categorizations as depicted in Table 1-6. These are i) the telecommunication providers, ii) the telecommunication processors, and iii) the telecommuniation users. The second category does not mean the end users, but those who convert telecommunication service into the producers' goods by enhancing original utility provided by the first category.

The Type II Enterprisers under the current liberalization law would not be in the first category, but the processors in the second category, so that state regulations should not be applied to these enterprisers, but be restricted only to the first category. State regulations are justfied if a company attempts to form market monopoly. It is in fact possible that the enterprisers in the first

Exhibit 12

Table 1-6 Telecom Controls & Regulations

通信規制の適用

The Use Pattern of Telecommunication 通信の使用形態		Controls over Telecoms 通信に対する支配力	Regulations 規制
Telecom Providers 通信事業者	The Type I Telecom Enterprisers 第一種通信事業者	Strong 強	Strong 強
	Special (特別) The Type II Telecom Enterprisers 第二種通信事業者 General (一般)		
Telecom Processors 通信利用業者	Information Process Enterprisers 情報処理事業者		
	Data Base Enterprisers データベース業者		
	Banks & Finance 銀行・金融業		
Telecom Users 通信利用者	Companies at Large 一般企業		
	Household Users 住宅用加入者	弱 Weak	弱 Weak

category would run into monopoly in the absense of law enforcement to regulate them. However, such likelifood is small in the case of the enterprisers of the second category. Thus, strict regulations towards the telecommunication processors seem to be, in our opinion, an abuse of legal enforcement.

Under the current WATT-C of the ITU, all entities who are using an international network should be regulated by the ITU. This is also an abuse of regulation enforcement by an international cartel of the PTTs of all countires. If WATT-C is applied, the domestic telecommunication processors are strictly regulated.. If they are regulated, it will be a natural consequence that the end users will also be regulated. This chain reaction of regulations would choke future promotion of telecommunication technology.

In Japan, telecommunication policies are in a transitional state where there emerge several uncompromising contradictions. First, the demarcation between regulatory policies and business promotional policies is unclear. For example, the NT&T is a provider of universal telecommunication service, so that regulatory policies are applied to it. However, since the NT&T was privatized, business promotion policies encourage it to diversify into a franchise business, which would erect new entry barriers against small new comers. Second, the demarcation between telecommunication as the producers' goods and telecommunication as the consumers' goods is also vague. So far, Japanese telecommunication policies have regarded telecommunication as the consumers' goods. However, today, telecommunication is being increasingly used as the producers' goods. Therefore, the hitherto telecommunication policies should be changed to couple with industrial policies in future. Current political confrontations between the MPT and the MITI over territorial jurisdiction is certainly against welfare for all users and future technological development.

Chapter 2 Japan's Telecommunicatin Policy in International Comparison

In this chapter, we will shed light on the uniqunesss and the similarity of Japanese telecommunication policy in an international comparison. Telecommunication policies of different countries differ each other, depending on the unique developmental process and social condition of each country. Generally speaking, from one way to another, each country has strong regulatory policies under the rationale that telecommunication is an entity to universally serve for public welfare. However, with respect to ways and means of making use of regulations, there are many variations. In these non-uniformal ways and means of regulatory policies of different countires, we will try to locate Japanese case.

The first section will be devoted to an international comparison by three areas of telecommunication, namely, a) the entry into common carriers, b) equipment supply, and c) enhanced telecommunication service.

The second section will discuss, in an analytical fashion, the patterns of liberalization for Japanese case and its international counterparts.

2.1 An International Comparison of Policy by Area

2.1.1 The Entry into Common Carriers

1) The Wired Telecommunication

In postwar Japan, the infrastructure of telecommunication service had been developed by the government-owned Nippon Telephone and Telegraph Public Corporation (the "Denden-kosha" in Japanese). Since 1985, the Denden-kosha was privatized with a new name, the NT&T, Ltd. The NT&T is Japan's largest private enterprise and still more or less monopolizes Japan's telecommunication market. According to the recent edition of the Telecommunication White Paper, the number of entries into common carrier (which are classified as the Type II Enterprisers accorging to the new Liberalization Law) has increased to 35 from 13 in a year from 1986 to 1987. However, in terms of market share, NT&T's monopoly is unquestionable. With respect to international telecommunication, there are two entries, but, again, KDD's monopoly has not been shaken at all.

In West Germany, the service provided by the common carrier has been still controled in the hand of the DBP. Even in near future, its complete monopoly will persist. In France, hitherto bad reputation for low quality of telecommunication infrastructure has been considerably improved when the DGT introduced a sophisticated digital network in the 1970s. In future, French telecommunication will be still led by the state's initiative for both promotion and regulation. This is a marked difference from the case of England, where, since 1984, the BT was privatized to allow new entry by the Mercury, Ltd. However, by law, the dupoly by both the BT and the Mercury will be guaranteed till 1990. In this sense, the degree of liberalization in England is less than that of Japan. In Italy, the provider of common carrier is separated from the regulatory entity. The MPT has sole right to regulate telecommunication service, while the STET, a subsidiary of the state's holding company, the IRI, is engaged in providng common carrier. Unique dual approach in Italy is taken in order to welcome foreign investment to modernize Italian telecommunication infrastructure. However, this dual policy seems to have not worked well, and in practice, the monopoly by the state's public corporations is still predominant. In the United States, since 1934, telecommunication service has been regulated by the Telecommunication Law, but natural monopoly by the AT&T was not shattered by regulatory monitoring. Then, the FCC strengthened its regulation aginst the AT&T and finally divided the AT&T into the separate companies in 1984.

Given the above international comparison of telecommunication policies, it seems that two groupings are possible. The first group involes the Unites States, Japan and England, where liberalization has been moving on. Among these countries, the United States has a unique feature in that liberalization policy was initiated by the Anti Trust Law, whereas no other countires have similar legal backgrounds. The second group consits of France, West Germany and Italy, where the state's regulatory power is still strong. Among these strong regulatory countries, Italy is relatively open and less stringent in the state's regulation, so that in terms of the degree of liberalization, Italy would be classified between France and England.

2) The Wireless Telecommunication

There are three categories in the wireless telecommunication, such as a) public broadcasting, b) mobile telecommunication, and c) satellite communication. In all cases, the crucial constraint is the limited availability of frequncy bandwidths. Since wave resources are limited, all countries have strong regulatory controls over the wireless telecommunication.

In Japan, public broadcasting and mobile telecommunication are subject to regulatory controls by the Law of Public Broadcasting and the Law of Electric Waves, respectively. Since the wired telecommunication is subject to the regulations set by a different law, namely the Law of Telecommunication Enterprise, the demarcation between the wireless telecommunication and the wired telecommunication is laid down very clearly.

Unique development of policies towards the wireless telecommunication can be seen in France, where market competition was introduced in 1986 to break the hitherto monopoly by the TDF. Currently, French wireless telecommunication is controled by the CNCL.

With respect to mobile telecommunication, England recently approved, under PTT's control, the entry of private cellular telephone service enterprisers.

Satellite communication is an attractive area of business entry. But, it is restricted by the limited availability of transponders. In Japan, the broadcasting companies show keen interests in entering the business of satellite communication.

2.1.2 Equipment Supply

The supply of equipment is always synchronized with the market condition of common carriers. If the number of common carriers is one in a particular country, market demands for equipment supply are very skewed, so that it is likely that such a common carrier can control suppliers' market by technical specifications or purchasing rules. For example, Japan's NT&T and West Germany's DBP apply stringent technical specifications in order to control the industrial order of equipment suppliers. In such countries, though the suppliers' market is said to be competitive, competition is managed by the demand side, namely the common carriers.

In Japan, since NT&T's monopoly was broken in 1985, the suppliers' market is gradually open to new comers, although there are still a strong cartel-like coalition by the so-called "Denden-family" of equipment suppliers. In England, foreign suppliers can now enter the suppliers' market, while, in France, the nationalized Thomson and CGE control the suppliers' market. In Italy, foreign suppliers are now allowed to enter the suppliers' market for the purpose of modernizing old networks.

2.1.3 Enhanced Telecommunication Service

Entry barriers for the business of telecommunication service are relatively lower than those for entry into common carriers. Each country has its own policy to promote entry into telecommunication service. In the United States, the liberalization of telecommunication service was implemented in the process of relaxing AT&T's natural monopoly. Under FCC's control, telecommunication service embarked on by the subsidiaries of the AT&T. Recently, other new comers entered into the market. This unique approach in the United States considerably differs from approaches taken by other countries.

With respect to the VAN market, there are some variations, from countries to countries. We have already explained the paricularlity of Japanese VAN market. In France, a VAN business is now liberalized, but 80% of French

VAN companies are not new entries but merely the subsidiaries of the DGT. In Italy, the market is open particularly for foreign entry for the purppse of welcoming foreign investment and technical knowhows.

With regard to the resale business of telecommunication, both Japan and the United States enjoy full market openness. European countries show unique policy directions. In England, it was opened, but later the simple resale was restricted since 1984. In West Germany, the most regulatory state, allowed discretionary pricing for resellers, but under the strict control by the DBP.

In the case of the coupling between common carriers and private lines, Japanese policy protects the common carriers by not allowing a connection with a long-distant voice network. West Germany and England restrict most severely the linkage of a private network with common carriers. On the other hand, a connection is open in any form in the United States. In Italy, although a connetion is allowed, but to connect lines between different companies is banned, thereby protecting the state-controled common carriers.

2.2 The Patterns of Liberalization

2.2.1 Analytical Framework

Difference in telecommunication policies among different countries can be better captured not by legal institutions, but by how these legal insititutions are put into practice. Theoretically, government can control telecommunication market in two ways. First, government can create a new market, through either potitive policies or passive policies. The best example of positive polices is Japan's industrial policy. Government can also create a new market through passive policies by minimizing its market intervention. If government chooses to let market principles work with free entries of private parties into a a new market, it is a case of passive policies.

Second, given the fact that, in every country, telecommunication market has been monopolized by the state-owned common carrier, there are two options for government's policies. The first option is approval of monopoly or semi-monopoly. For example, government can exercise strong policy intervention to create managed competition, or managed monopoly. The second option is rejection of monopoly by introducing complete market competition. For either option, government needs strong political power.

Provided that there are two options respectively for the first and second areas of government policies, we have now a two-by-two table as illustrated in Table 2-1.

Exhibit 13

The Patterns of Telecom Policies

Table 2-1 テレコム政策のパターン

Type of Policy 独占の許容 / Type of Market 市場形成の原理	(yes) Monopoly 独占状態 incld. Oligopoly (寡占も含む)	(no) Competition 競争状態
Market Intervention 市場介入型	Managed Monopoly 管理された独占	Managed Competition 管理された競争
Market Mechanism 市場原理主導型	Private Monopoly 民営独占	Free Competition 自由競争

There are four cells in this table, of which each cell means as follows:

a) managed_monopoly:
the monopoly by the state-owned common carriers, or by the state-backed private companeis

b) private_monopoly:
the natural monopoly or monopoly by a privatized common carrier

c) managed_competition:
there are more than two companies, but entries are strictly regulated by government, or entry into a different area by a monopoly company is controled to guarantee free competition

d) free_competition:
no control for new entry

2.2.2 Analysis

Using this two-by-two table, we will review the liberalization policies by different countries. In what follows, we will mainly focus on the wired telecommunication market, the VAN market as a service market and the equipment supply market.

In Japan, as we have noted earlier, the previous state-owned "Denden-kosha" was privatized in 1985. The purpose of privatization was to introduce the principle of market competition. However, even after privatized, the NT&T is still a gigantic company which will exercise natural monopoly. Whether the government can maintain free competitive market depends on how it will regulate NT&T's natural monopoly. With regard to the area of telecomunication service, before the NT&T was privatized, Japanese companies had already developed, internally within their own factories or affiliated groups, technologically sofisticated telecommunication service such as software supply and data processing. So that, in this area, the law of liberalization would accelerate Japanese telecommunication market. However, as we pointed out in Chapter 1, Japanese concept of the VAN business has a unique connotation, not comparable with, say, American counterpart. With respect to the equipment market, since the NT&T demonstrates natural monopoly as a common carrier, the market is still controled by this giantic firm. However, since the market has no regulations, a competitive market will come soon as the service marekt is expanded.

In West Germany, the DBP still monopolizes the common carrier marekt, while the service market is opened under the license system. As for the equipment supply market, free competition is guaranteed, but since there is only one common carrier and the service market is regulated by the government's license, the degree of openness of this market is limited.

In France, no law guarantees monopoly by the DGT, but practically, the DGT monopolizes both the markets of common carrier and telècommunication service. The success of building telecommunication infrastructures by the DGT shows no serious need to liberalize the markets. French style of state ownership is also found in the equipment supply market, since two major suppliers, the Thomson and the CGE, are nationalized.

In Italy, a group of public corporations monopolyze the market of common carriers, whereas the service market is open, even to foreign companies. Since the telecommunication infrastructure has been in a bad shape, Italy tries to improve it with help of foreign technologies. Since the common carrier market is monopolized in Italy, its equipment market is also regulated.

In England, the BT was privatized in 1985, and the Mercury, Ltd., a private company, entered the common carrier market under the state's control. British VAN market is now liberalized, but the simple resale of networks is prohibited. In the equipment supply market, the BT, even after privatization, specifies purchasing prices, but, other than such regulation, the market is widely open to the domestic and foreign suppliers.

In the United States, as mentioned above, policy driven to maintain free market competition is strong, so that AT&T's natural monopoly was broken in 1984. Today, AT&T is permitted to enter into the service market, while in past only its subsidiaries could enter.

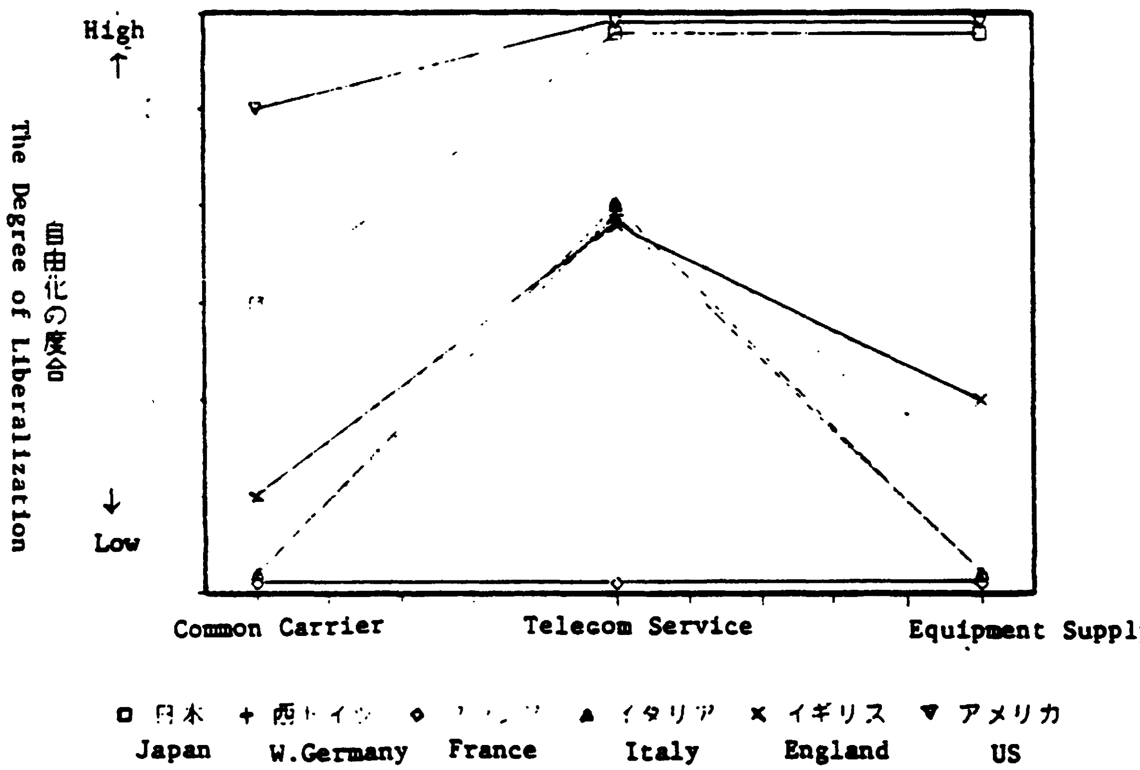
To summarize the above review, an international comparison is neatly shown in Figure 2-1. According to this figure, six countries can be ranked in the following way:

1) The US
2) Japan
3) England
4) Italy, West Germany
5) France

Note that this ranking shows only the degrees of liberalization, and hence it does not imply any value judgement as to the good or bad of liberalization. In some countries, like France, the state's monopoly could function

The Stages of Telecom Policies :An International Comparison

Figure 2-1 各国のテレコム政策
自由化の段階



to speed up the renovation of telecommunication infrastructures with a digital network. If renovation were taken by a private sector in France, it would be more costly, and general users might have to pay higher users' fees.

2.2.3 Japan's Development Process of Liberalization

As shown in Figure 2-2, Japan took several steps towards liberalization. Japan's telecommunication liberalization stemmed from 1971's change of the Law of Public Telecommunicaton. Since 1952, by the Law of the "Denden-kosha" (NT&T), Japan's telephone networks were built to supply qualified telephone service on a nation-wide scale. Later, computers were introduced, since about 1955, by forerunning companies. Then, technological development in semiconductors and equipment led these companies develope their own intramural communication networks. Thus, there emerged a strong market demand to ask for the government's approval of laying out companies' own networks. Such market pressure led the government to relax the NT&T's law to allow such intramural networks. This was the origin of Japan's libelarization process.

To recapitulate, there seem to be two factors which drove the government into liberalization. The first factor is technological development. Since Japanese companies competitively introduced computerized communication networks within their organizations, the enhanced telecommunication market already existed in a latent form. Without such technological quantum leaps in the private sectors, Japan's liberalization would not have come out so soon. The second factor is the uniformalization or, in other words, standardization of telephone networks by the NT&T. Until about the late 1980s, complete diffusion of telephone sets at every household and automatic dialing service, which were two major tragets of the infrastrucrual buildups, were successfully implemented. So that, what would come next as a development of telecommunication in Japan is nothing but liberalization.

2.2.4 Japanese Pattern of Liberalization Steps

As shown in Figure 2-2, Japan's liberalization of telecommunication market came first from the relaxation of the service market. It was 1982, a symbolic year for a drastic change of the postwar development of telecommunication, when private networks were firstly permitted. Only three years later, the NT&T was privatized.

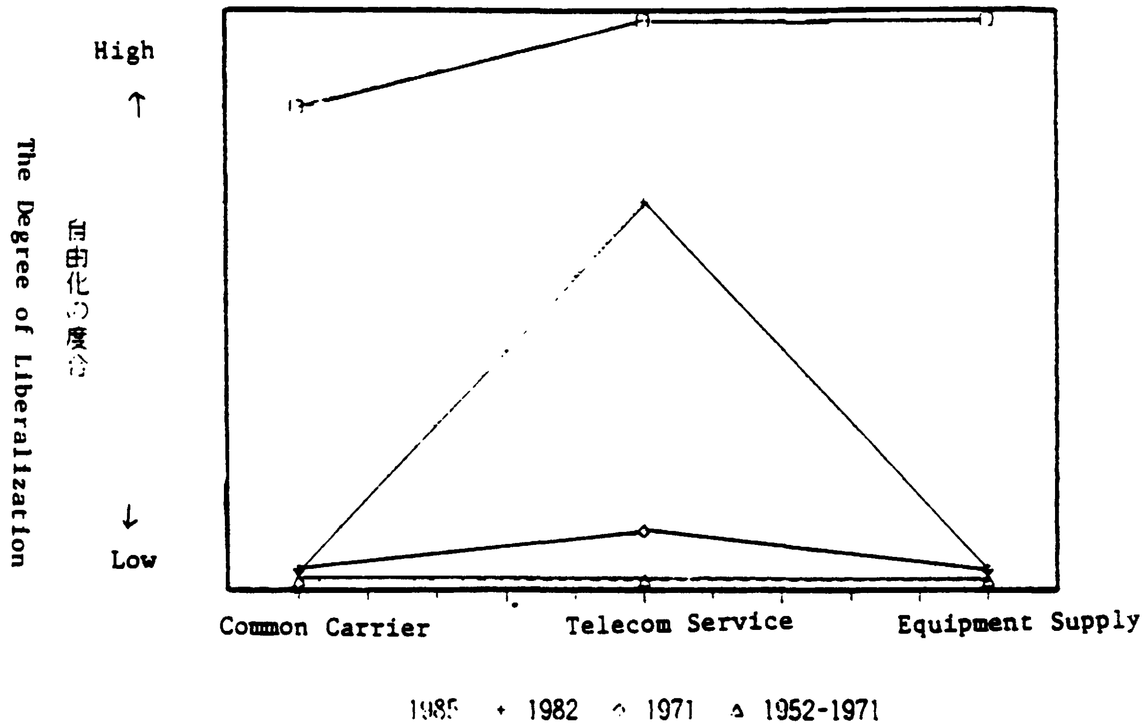
If we compare Figure 2-2 with Figure 2-1, we find some structural similarities, which indicate that, if Japanese

Exhibit 15

The Stages of Japanese Telecom Policies

Figure 2-2 日本のテレコム政策の変遷

自由化の段階



pattern of liberalization is a universal pattern towards complete liberalization of all three telecommunication markets, European countries would take similar steps, namely starting from the liberalization of the service market, going through the liberalization of the equipment supply market, and ending with the liberalizatin of the common carrier market.

The start from the service market is inevitable, since, in this market, there are no stong needs for standardization and, in the mean time, market entry costs are not so burdonsome if compared with the entry into the market of common carriers.

In near future, since all countries would liberalize the service networks first, it will foreseeable that an internatinal agreement is necessary. Currently, in the VAN market, the CCITT advises that an agreement be made on a bilateral basis. Also, there will emerge some conflicts in an international market of equipment supply. Such conflicts will be similar to the current high technology conflicts where competitions among Japan, the United States and Europe are very intense.

In our analysis, we have focused only on the wired telecommunication. But, in future, the importance of wireless telecommunication will become more acute. As the recent political incident of the Motorola's attempted entry into Japanese cellular telephony market indicates, the shift of the common carriers of all countries from wired telecommunication to wireless telecommunication is an inevitable course of development, and this shift will creat a new international conflict.

Chapter 3 The Use Patterns of Telecommunication by Japanese Companies

In Chapter 3, we will summarize how the selected companies have been using telecommunication in their business in Japan.

Our illustrations of telecommunication use by companies are structured with four variables: a) a brief description of business of each company, b) how they are using telecommunication and in which way, c) the future plan of telecommunication use, and finally, d) how they perceive of telecommunication as a competitive weapon.

3.1 The Uniqueness of Japanese Business Environment

3.1.1 Banking Business

Japanese banking business differs from American counterpart in that Japanese banking business allows the nation-wide branch networks under the same bank names, while American banks are basically locally-based, having only a limited number of local branches. As is the case for the casualty insurance industry, Japanese banking service is also subject to the strict control of the Ministry of Finance (the MOF).

Japanese banking system is sometimes referred to as the "Convoy Fleets" which implies that all city banks and local banks are protected to avoid bancrupcy and regulated to escape from excessive competition leading to overlending. For example, the opening of a new branch and the entry of new banks are both regulated.

Another feature of Japanese banking industry is found in its vertical structure having the "Zaibatsu" companies at the top and related manufacturing and trading companies in the periphery. For example, the Mitsubish Bank is a main financial vehicle for the Mitsubishi family companies including the Mitsubishi Heavy Industries, Ltd., the Mitsubishi Motor Company, the Tokyo Marine Casualty Insurance, the Mitsubishi Trading Company, etc. In the mean time, each major city bank has also vertically related to the affiliated local banks.

These unique features of Japanese banking system have many implications of telecommunication networking. First, since each bank shares more or less the same service and same operation, banking networks become similar each other, without much uniqueness. Second, telecommunication networks of banks in Japan tend to be large in size in order to cover all many branches. Third, installation of a private telecommunication network does not give an incentive since all banks are closely related. For example, a client who has a bank account at the Bank "A" can transfer cashes to the different Bank "B."

3.1.2 Teletechtronic Business

Japanese electronic companies which are both a user of telecommunication and a supplier of telecommunication equipment and service are intrinsically independent without a strong government regualtion. They thus can apply any style of telecommunication networks and service unless violating the new Law of Telecommunication Enterprise.

Japanese teletechtronic industry is moving ahead in overseas investment, so that, generally speaking, the companies find every incentive to have its own exclusive telecommunication networks on a global scale. In a sense, these companies are comparable with American private enterprises in assuming telecommunication as a competitive weapon.

3.1.3 Casualty Insurance Business

In the United States, the fire and casualty insurance agencies are individually "application-driven." In other words, the non-life insurance agencies are not operated by the large nation-wide casualty insurance companies. On the other hand, Japanese casualty insurance companies which normally cover also marine and fire insurance have their own sales agencies.

The unique business environment for Japanese casualty insurance industry includes the re-underwriting by the lower-tiered casualty companies and the joint-underwriting by the competitors, thereby attaining a risk-hedge function. In the mean time, Japanese casualty insurance industry is subject to the strict control of the MOF. The introduction of a new insurance plan is not free under the current survailance by the MOF.

The features of re-underwriting and joint-underwriting of Japanese casualty insurance industry creat a large and nation-wide sales agency network in a very integrated form. Thus, there exist ample space in which an electronic network system is adopted in order to facilitate the quality of service and risk-hedge mechanism. However, under the current regulations by the MOF, the linking the auto casualty insurance network with the auto sales network by sharing the same customers' data is prohibited.

3.1.4 Automotive Manufacturing Business

The strength of Japanese automotive companies lies in manufacturing performance as well as in their dealers' networks. It is said, among meny experts of worldwide automotive business, that Japan's unique "Kamban System" or "Just-in-Time System" gives Japanese automotive companies a strong competitive edge. This "zero-inventory" system allows Japanese auto makers to source manufacturing components quickly and most efficeintly without lowering quality.

It might be naturally thought that the "Kamban System" would be easily transferred to an electronically-operated sourcing system, one version of telecommunication network, since the "Kamban System" itself is a large and compliated network. When the GM bought the EDS, it was rumored that the GM would attempt to create, other than the CAD/CAM system, a parts-sourcing network comparable with Japan's "Kamban System."

However, an essence of the "Kamban System" is not merely a sourcing network, but rather a strict quality control devices of purchasing components in a network fashion. Therefore, political power of personnel at the purchasing department is a key to obtain qualified parts from the family-like parts suppliers. The network of these first and lower-tiered suppliers is paternalistically-structured to allow the purchasing department of an assembly company to request highly qualified parts at a sepcific sequence of production lines.

Thus, the "Kamban System" is not a simple network, but a complexity of a social and political web. It is then a fatal mistake if one emulates and replaces this socio-political entity with an electronic network.

On the other hand, Japanese auto makers' sales dealer system is in fact a network which can be consolidated by an electronic network. Quick information gathering about consumers' preference through a computerized dealer system helps an assember shorten manufacturing lead-time. Thus, most Japanese auto companies tend to regard a telecommunication network as a powerful strategic weapon. Automotive companies are very much lead-time conscious in applying a telecommunication.

3.2 The Case Study

3.2.1 The Mitsubishi Bank

1) Company Outlook

Capital 205.8 billion yen

Personnel	14,296
Offices	277 (Japan) 36 (Overseas)

2) Telecommunication Status

a) Priority Area

The first priority is given to security and reliability, since the Mitsubishi Bank has several million customers. The second and third priorities are given to market development and new service development. Because of unique business environment for Japanese banks which were described above, the competitors are using more or less similar telecommunication systems. The trade association of Japanese banks has a special committee to jointy study telecommunication matters.

b) Private Networks

A part of Mitsubishi's head office is implementing a LAN network. Almost all accounting offices of Japanese major companies are linked to Japanese key banks including the Mitsubishi Bank. If a new private network is provided by a third party, the Mitsubishi Bank would also internalize it as a private network. For example, today, most convenient glossary shops have their own internal private networks. If the Mitsubish Bank's network is linked to them, a new private network encompasses a large sevice network, not limiting to a banking service only.

c) The ISDN Network

Theoretically, it would be possible to elevate the current networks basen on personal computers and fax machines to an ISDN. However, the Mitsubishi Bank is not ready to install it, because of cost inbursement incurred for a system change.

d) Network Organization

There is the system development division in charge of developing users' softwares for the users' division in the Mitsubishi Bank. The system development division is currently in charge of the implementation of the Third-Order On-Line System, a comprehensive telecommunication system to link all operations at the Mitsubishi Bank.

3) Telecommunication System

a) Channels and Networks

The Mitsubishi Bank is implementing the CAMS network for automatic cashing service. This network is linked to other banks' CAMS. In 1988, the Mitsubishi Bank developed the ANGEL software which allowed the customers at a hospital, direct mailing companies, financial security companies and sport clubs to connect with the Mitsubishi Bank through their own personal comupters for cashing. It is now considering to implement a new network using an IC cards.

b) Computer Use

There are four IBM 3090's, 4,500 terminals and 4,000 ATMs and CDs. All mainframes are not on lease-based, but purchased. Software development for the Mitsubishi Bank's Third-Order On-Line System (which attempts to computerize every banking service) is jointly undertaken with the Japan IBM and other software houses. However, since different banks are developing their own unique on-line systems, the matching problems among different on-line systems will emerge sooner or later.

c) Overseas Networks

The VENUS-P is currently used. But, it is very inconvenient to use it because the Venus-P is always busy. To link to overseas offices, the SWIFT is also used. For international credit card authorization, the Mitsubishi Bank depends on a Japanese branch of the SITA.

4) General_Use_Environment

There are basically three kinds of business for any banks. The first business is accôunting service, the seond business is international financial service, and the third business is the security and foreign exchange dealing. For these three kinds of business, telecommunication is widely used with unique networks and service applications. Currently, videotex image informatin has not been applied. All written documents are sent via faxes.

In 1965, the Mitsubishi Bank introduced the First-Order On-Line System which intended to mechanize banking management. In 1973, the Second-Order On-Line System was implemented to link all branches through a telecommunication network. In 1987, the Third-Order On-Line System was first introduced, and its ultimate goal was to replace teller service with computerized automatic tellers.

Currently, any attempt of Japanese banks to expand the usage of telecommunication is subject to MOF's control and survailance. For example, a cashing management system used by all Japanese banks resemble a VAN network, but it is prohibited by the MOF to enter a VAN business.

3.2.2 The NEC

1) Company Outlook

Capital	116.6 billion yen
Sales	2,300 billion yen
Personnel	38,000
Offices	109 (Japan) 96 (Overseas)

2) Telecommunication Status

a) Priority Area

Priorities are given to 1) aids for enhancement of productivity, including product design and production control, 2) aids for new product development, and 3) aids for sales management. For example, the LSI design is transmitted through a telecommunication network between NEC's divisions in Japan as well as overseas manufacturing sites. The NEC has its own VAN subsidiary, but it has not reached a profitable level.

b) Private Networks

The NEC is using the 50G wireless networks. However, the quality of these networks are vulnerable by weather condition, so that they are primarily used for voice communication only. Under current regulations by the Ministry of Construction, a private network across public roads is prohibited.

c) The ISDN Network

The NEC is willing to use an ISDN network though it is not sure about how to utilize it. There are merits and demerits in using an ISDN network. The merits are cost reduction since the use of current exclusive lines have to pay a fixed cost while the use of an ISDN line allows a flexible pricing. The demerits are the lack of infrastructure to use such a network.

d) Network Organization

Historically, NEC's general division and technical division were in charge of telephone networks, and the EDP division was in charge of data network. However, five years ago, these two divisions were merged into the office system promotion division. Some outside experts point out that NEC's integuration of divisions would be misleading since the EDP is different from telecommunication in nature.

3) Telecommunication System

a) Channels and Networks

There are 250 PBXs, 18 packet exchangers, 220 multiplexes, 1,000 modems, 4 gateways and so on. There is a VAN resale network from NEC's VAN subsidiary. There are also an inhouse telephone exchange service network and data packeting network.

b) Computer Use

There are numerous mainframes in the NEC. The largest one is an ACOS 1500 at the computer center. There are 250 information processing centers with the NEC-made mainframes.

c) Network Organization

Throughout all branches and the head office, there are the TELNET networks. There are also the data networks using the packet exchangers. As to a VAN network, the NEC is a VAN user connecting its VAN network which is supplied by NEC's own VAN subsidiary. Monthly, 0.8 billion packets are used within the NEC. At average, every 2.5 NEC's employee has one data network. The NEC spends annually 2 billion yen for developing networks and 7 billion yen for maintenance. The use of networks, including both telephone and data networks, costs the NEC for 10 billion yen per year.

d) Overseas Networks

Since there is no regulation in the United States to install a private line, NEC's American subsidiaries are mutually linked together with NEC's exclusive line. However, linking those with NEC's head office in Tokyo is not possible according to MPT's regulation.

Telecommunication between domestic plants and overseas offices and plants is done by voice, fax, data and telex networks. Among American branches, a 1.5M digital network and a GE-MARK II are used. The NEC tries to establish Britain's offices as a network headquarter from which many outgoing and incoming networks are integrated. However, it might infringe on the CCITT proposal that the installation of an exclusive European network is desirable in future, but currently, only public networks are allowed.

4) General_Use_Environment

Under current regulations by the MPT, linking between public networks and private exlusive networks is prohibited. Therefore, it is difficult to connect all NEC's plants and divisions through an exclusive line. Also, current fax lines cannot be differentiated from voice telephone lines, thereby they are subject to the government's regulation on telephone service. The NEC is implementing a 50G Wireless network, but if it is used for a VAN service, it would infringe on the law of the Type I Telecommunication Enterprise.

In spite of these legal constraints, the NEC is moving ahead as both a user of telecommunication and a supplier of equipment. Historically, an exclusive telephone network was implemented at the NEC in 1959, an exclusive data network was in 1970, a packet data network in 1978, and finally, an integrated digital network in 1985.

3.2.3 The Tokyo Marine

1) Company_Outlook

Capital	6,200 billion yen (world's largest)
Sales	1.5-2.0 million contracts
Profits	700 billion yen (world's third largest)

(Note)	Japan's total insurance agencies	330,000
	Japan's total insurance companies	22

2) Telecommunication_Status

a) Priority Area

Priorities are given to 1) aids for sales management, 2) aids for customers' data collectin, 3) aids for new insurance policy development, and 4) aids for productivity enhancement.

b) Private Networks

Currently, there is no need to implement a private network. Current regualtions by the MOF do not prohibit a casualty insurance company to own a private network.

c) The ISDN Network

An ISDN network is very promising to Japanese casualty insurance company. The Tokyo Marine shows a keen interest in using an ISDN network when it is available. However, Tokyo Marine's Kunitachi information center has not been ready to have infrastructure arrangement to install an ISDN network. The Tokyo Marine worries about the vaguness associated with cost and price if an ISDN is implemented.

d) Network Organization

In 1959, Tokyo Marine's first computer was installed. Since then, company reorganizations were repeated from the first statistical survey section in 1953, the statistical survey division in 1964, the system division in 1970, the information system division in 1988, the separate multiple divisions of information management and information system development in 1988. There are two computer centers at the Tokyo Marine, one in Kunitachi (in the outskirt of Tokyo) and one in Senri (near Osaka). The Senri center is a backup center for the Kunitachi center.

3) Telecommunication_System

a) Channels and Networks

There is no private network in operation at the Tokyo Marine. To link other companies like banks, trading companies and other casualty companies, the public NT&T's channels are used. For an inhouse exclusive network, the Tokyo Marine has a private line. Since there are so many insurance agencies, it would be difficult to install terminals at every agency office. Currently, some of them are using their own personal computers to link Tokyo Marine's main branch offices.

b) Computer Use

IMB's mainframes are used at the Kunitachi center on a lease basis. Development costs of softwares amount approximately to 1 billion yen for a three year span. Annual costs to lease computers and to maintain networks are about 20 billion yen. However, such costs occupy only a small margin of Tokyo Marine's total sales.

c) Network Organization

There are two channels connecting the Kunitachi center, the Tokyo head office, the Senri center and the Osaka branch office. There are also two channels diagonally connecting these four nodes. From these main nodes, there are numerous outgoing lines and incoming lines to link major local branches and key affiliated insurance agencies.

d) Overseas Networks

There are only telephone and fax lines connecting with 34 different countries. When re-underwriting with foreign casualty insurance companies are undertaken, the Tokyo Marine uses electronic mail and telex communication devices.

4) General_Use_Environment

Networks are self-closed within the Tokyo Marine itself. By linking bank's networks, the Tokyo Marine transfer bills to banks. Data are exchanged with other casualty companies. Currently, a network is being developed to link to sucurity companies. Historically, the First-Order On-Line System started at the Tokyo Marine in 1973 in order to consolidate auto insurance management. The Second-

Order On-Line System began in 1982 to expand the use of telecommunication within this company. Today's most updated system at the Tokyo Marine is called the ETS (the Excellent Tokyo Marine System), which includes customers' individual information, capital operation, general accounting purposes and management consolidation.

3.2.4 The Toyota Motors

1) Company_Outlook

Capital	132.2 billion yen
Sales	6,024.9 billion yen
Personnel	64,000
Production	3.64 million cars in 1987
Sales Dealers	314

2) Telecommunication_Status

a) Priority Area

At Toyota, telecommunication is regarded as a means to enhance manufacturing productivity. In particular, it is used to shorten manufacturing lead-time, namely a time span from market analysis to a final product. Currently, production cycle has been extensively shorten from previous 4-year cycle with aids of telecommunication.

b) Private Networks

Within Toyota's plants, there are internal private networks. However, if they are extended to outside, they would be subject to regulations of the law of Type I Telecommunication Enterprise.

c) The ISDN Network

It would be possible to use an ISDN network in future. However, today, its merits have not been fully felt. Also, an application of an ISDN network requires a strong infrastructure, and the Toyota Motors is not ready yet to implement it.

d) Network Organization

At present, there are two parallel organizations in charge of telecommunication service at Toyota, namely the first information division and the second information division. The former is responsible for operating an EDP system, and the latter is for intramural communication.

3) Telecommunication_System

a) Channels and Networks

Internally, a digital network is being operated. To link plants and offices in North America, an IBS network is applied. For a packet network, Toyota uses NT&T's DDX-P. The VENUS-P is used for communicating with overseas branches. For data communication, Dentsu's MARK-III is applied. There are totally about 3,500 terminals in use. Toyota's communication protocols are developed within the company.

b) Computer Use

IBM's, UNISYS' and FACOM's mainframes are used for engineering purposes, while IBM's computers are solely used for non-engineering purposes. Softwares are patched for Toyota's own use by the company's software engineers.

c) Network Organization

For linking a triangle network to Nagoya, Tokyo and Toyoda offices, a 6 mega high speed network is installed. Overseas networks are all connected through the Tokyo head office.

d) Overseas Networks

Connection with overseas subsidiaries is undertaken with the company's exlusive networks. For overseas agencies and dealers, a MARk III network is applied.

4) General_Use_Environment

All networks are being operated on an on-line basis. This permits that market orders could change only 4 days before production is completed. The "Kamban System" does not use telecommunication. For technical information, Tokyota is using a SMS data base. Tokyota completed to install Toyota's own network called the CNTS-net in April 1988. This system allows to shorten manufacturing lead-time considerably.

3.3 Summary Table

The above discussion is summarized in Table 3-1.

Chapter 4 Corporate Strategy and The Use Patterns of Telecommunication: A Typology

In Chapter 4, based on our analysis of the case study in Chapter 3, we will introduce two dichotomous frameworks by which the salient features of telecomunication use by companies are better extracted. These frameworks are: the ready-made type and the order-made type. The ready-made type implies that comapnies are using telecommunication as it is without further modification to meet their business needs. On the other hand, the order-made type means that companies are making efforts to improve telecommunication in order to better fit their business needs.

The patterns of the use of telecommunication by companies are divercifed, depending on the nature of business they are engaged in. However, very recently, companies tend to regard telecommunication as a central nerve, not just a peripheral supporting means for corporate decision making. Telecommunication has been deeply entrenched within the so-called corporate integration.

An important device of companies' central nerve, whether for corporate integration or for just daily supporting operations, is a network. The subsequent part of this paper will thus focus on the characteristic of how companies are using networks for market strategy. Here, we define market strategy in such a loose way as coporate stance vis-a-vis a particular market in which a company can fill with services and goods.

4.1 Analytical Framework

4.1.1 Typology

In terms of whether companies can provide the ready-made goods or services or the order-made ones, corporate stance can be classified into two; a) the ready-made type, and b) the order-made type.

(a) The Ready-Made Type

Companies having a corporate stance of the ready-made type supply goods and services in mass quanity. These companies are so-called "supply push" oriented. The merit of this corporate stance can receive merits of scale-economy, while the demerit rests in that they cannot completely satisfy individual needs of customers.

(b) The Order-Made Type

Corporate stance of this type means that companies provide goods and services to meet the customers' particular needs. Companies of this type are "market-pull" oriented. They can earn value-added profits, while they are constrained in a sense that organizational expansion or large scale-merits are impossible because large-scale procution of the order-made products are very costly.

4.1.2 Features of Telecommunication Use for Production

Production system is basically a feedback operation, having the following steps: product development, product design, production, inventory control, sales, and back to product development again. This feedback process is ubiquitous in manufacturing industries, but is also applicable to other non-manufacturing industries such as banks and insurance companies.

Telecommunication is used at evey node of the production feedback loop. But, the use of telecommunication varies depending on whether corporate strategic stance is order-made oriented or ready-made oriented. In other words, the use is differentiated by the uniqueness of which node of production feedback is most applied by telecommunication.

(a) Companies of the ready-made type absorb in market needs from general mass unidentified customers. Future product development is based on their own market assessment at present time, thereby creating a time lag between market needs and production. Product orders from retailers and customers are then input into inventory and production. If inventory is full, products are released from inventory stocks, and if inventory is small, such information is transferred to procution. Telecommunication can integrate this inventory-production interaction cycle.

(b) On the other hand, particular market needs are input in the case of the order-made oriented companies. Then, based on these specialized market needs, product design and development begin. In this case, the relation between market needs and procution is rather real-time-based without unnecessary time lags. Customers' orders are directly input into product development, thereby the use of telecommunication is heavilily concerned with two nodes of the feedback process,. namely product development and product design.

To summarize the above discussion, the market difference between the ready-made type and the order-made type is represented by the existence of time lags. The ready-made type has a rather conservative corporate stance having a strong feedback consciousness to look at a'prior market need. The order-made type, on the other hand, has a real-time corporate decision-making to directly input market needs into development, design and production.

4.2 Grouping of Company Cases by Typology

Based on our dichotomous typology of corporate stance, we grouped all company cases, not only Japanese companies but also European and American counterparts.

We found that there are 9 cases for the ready-made type, 3 cases for the order-made type, and 4 cases for the mixed type, which stand between the order-made type and the ready-made type. Note that we did not group company cases not just by their types of business activities, but by the corporate stances to use telecommunication. That is to say, the order-made type implies only corporate stance in using telecommunication, and does not means only those comanies whose primary business areas are ordered production. We found that Britain's GEC could not be categorized in either type, since the GEC is not a single company but rather a conglomerate using telecommunication as a device to integrated compartmentalized member companies under the same name of the GEC.

4.2.1 Compapies of the Ready-Made Type

In Japanese case, the NEC and the Toyota Motors fall in this category. In foreign cases, the Daimer Benz, the Fiat Motors, Hewlett Packard, the Levi Straus, the McKesson and the VISA are in this category. Here, we will discuss only Japanese case.

1) The NEC

The NEC produces and sells telecommunication equipment, computer, electronic equipment and devices and general consumer electronic appliances. For all products, the NEC produces in mass quantities. The priority of telecommunication use at the NEC is placed on product design and developmnet, production control, enhancement of productivity, new product development by different divisions, management system, and worker training and education by satellites.

NEC's telecommunication is operated in two ways: the double-layered star-shaped telephone networks (TELNET) and the double-layered fish net-shaped packet exchange system for local networks (DATANET). In 1985, a new high speed digital network began to operate for integrating telephone networks and data networks. Also, the NEC has entered into a VAN business by providing various service through the C&C VAN service networks.

2) The Toyota Motors

Toyota is one of the world largest auto manufacturers. Its production is a typical of mass production based on market research to input customers' needs. Product development depends on its own assessment of market for immediate future. The priority of telecommunication use is place on the reduction of the so-called "lead-time" between product design and production, the shortening of development cycles, and the accurate collection of sales information.

Toyota's production is undertaken based on the famous "Kamban System" which is not a computerized telecommunication of parts control, but a manual batch inventory control. It has, however, on-line networks particularly for order input control and product control. Therefore, the basic nature of Toyota's use of telecommunication is for inventory control per se. If shortage of inventory stocks is forecasted, production is accelerated to fill in such shortage.

For quick response to order inputs, Toyota created the TNS (Toyota Network System) to link up with 314 dealers in a a star-shaped network which is an on-line data communication network. The basic philosophy of the use of telecommunication at Toyota is the realization of single integration of all business operations at every point of organization.

4.2.2 Companies of the Order-Made Type

In Japanese case, only the Tokyo Marine falls in this category. In foreign cases, the European Ford and the Nixdorf are also in this calss.

1) The Tokyo Marine

Casual ty insurance itself is an order-made product. The Tokyo Marine has been reforming the use of telecommunication from hitherto enphasis on computer control for different insurance plans and sales to sophisticated data management for each customer by inputting specific customers' needs.

The priority of telecommunication use at the Tokyc Marine is placed on sales promotion, gathering of customers' individual data, new product development, and productivity enhancement by a single integrated accounting system. Tokyo Marine's ETS (the Excellent Tokyo Marine System) is deemed to integrate different telecommunication uses for its business management.

Centered at the Kunitachi (in th outskirt of Tokyo) Data Center, Tokyo Marine's telecommunication networks are formed in a pattern of fish net-shaped for batch controls. However, there are sub-networks of star-shaped at each sub-data centers and major branch offices for covering sales agents.

4.2.3 Comapanies of the Mixed Type

In Japanese case, the Mitsubishi Bank falls in this category, while in foreign cases, the Banque Nationale de Paris, the Barclays Bank and Commerzbank are in this category.

1) The Mitsubishi Bank

In Japan, excessive competition among major banks leads to the adoption of the so-called "electronic banking" in order to reduce operating costs and increase management productivity. Some banks adopt the cash/account management system (CAMS) for directly linking them to individual customers for indepth services. In the mean time, banks are increasing entering in an agent servive to substitute for customer companies' intramural accounting and saving functions. This service is called as the "firm banking." They are also considering to give the so-called "home banking" by directly reaching individual customers through personal telecommunication networks. The Mitsubishi Bank is one of Japanese banks which are vigorously expanding banking service in these areas.

The Mitsubishi Bank places the priority areas of their use of telecommunication on the attainment of security and safety in handling financial business, diversification of business, and expansion of both new banking merkets and new sales products. It is now reschuffling the hitherto use of telecommunication into the so-call "The Third On-Line Implementation," a today's catchword for every major banks in Japan for future comprehensive electronization of all banking sevices through networking of all customers, regardless of companies or individual customers.

The Mitsubshi Bank has already implemented on-line connections with all branches and affiliated financial institutions. Currently, the Mitsubishi Bank is trying to develop compartmentalized application software packages for wider ranges of computer application to be used for new product development in a flexible manner.

4.2.4 Summary Tables

Table 4-1 Summary Table for Japanese Case

Company Name	Nationality	Business	Branches	Management Principles	Business Strategies	Organization	Features of Telecom Use
Mitsubishi Bank	Japan	Banking	277 (domestic) 36 (overseas)	Implementation of on-line networks, . . reliability, direct service for customers	1) Safety, Security 2) New Market Development, New Product Development, 3) Enhancement of Service		Simple, Mass quantity, High Speed Processing, On-line overseas networks, 2 layered hard and soft systems
NEC	Japan	Computer, etc.	109 (domestic) 96 (overseas) 113 (affiliated subsidiaries)		1) Increase of Productivity, 2) New Product Development, 3) Development of Management System, 4) Intramural Training by Satellite ---C&C Concepe, NEC's VAN		VAN provider for internal use Earns profits by sales of VAN-equipment
Tokyo Marine	Japan	Casualty Insurance	34 countries	Customers-based service Quick response to casualties, fires, etc	1) Market Development (Customers' Data System) 2) Product Development, 3)Productivity Increase (Single Accounting System), 4) Training, 5) Safety and Security (Crisis Response System)	330,000 agencies (independent)	2 feedback loop backup system
Toyota Motors	Japan	Auto Mfg.	378 (domestic dealers) 20 countries	"Kanban System" Shortening of lead-time	1) Productivity Increase (Shortening of Lead-Time), 2) New Product Development (Shortening of Product Development Cycle) 3) New Market Development		

Name of Countries	Type of Networks	Shape	Configulations of Networks	Use Patterns	Channels
Mitsubishi Bank	The Third-Order On-Line System	Star	Domestic, Overseas System, separated from Lower Subsystems	On-line processing	exclusive lines (high speed digital), public lines, VENUS-P, SWIFT
NEC	Telenet .... Datenet .... Digital Integrated Networks	Star F Net	.Telephone networks Data networks (Packets) ...Integration of Telephone and Data Lines		exclusive lines, public lines IBS, VENUS-P, DDX-P
Tokyo Marine	The Second-Order On-Line System.. .... Overseas Networks	F.Net	.. Kunitachi, Senri decentralized computers(40 units) .. Telephone plus fax		exclusive lines, public lines
Toyota Motors	TNS................ Domestic Networks .. Overseas Networks ..	Star	.On-line connection between dealers and head offices .. .Telephone plus data .. Data (MARK III) plus fax	Car Order/Delivery System	exclusive lines public lines internal private lines IBS

Nam. of Companies	Computers	Cost(yen)	Telecom Service	Maintenance	Motivation	Future Plan	ISDN
Mitsubishi Bank	IBM		Cash Management, Saving/Lending Service	Flex system by system decomposition, not lease, total purchase		The Fourth-Order On-Line System Bank-POS, IC cards	no infrastructure, no standardization, uncertain merits, high costs
NEC		2billion (development),7 billion (maintenance), 10 billion (networks)	Datenet VAN	By Office System Productivity Center for telephone and data lines, separately	for Prodctivity, Development and Design Efficiency Cost Reduction	Overseas LSI Design (CAD/CAM)	no infrastructure, uncertain merits
Tokyo Marine	IBM	1 billion (operation) 10 billion(development)	Casualty Insurance Networks	By Information System Center By outside companies for software development	For enhancement of productivity	ETS linking all agencies establish security dealing offices	useful for outside connection (but, today, uncertain merits)
Toyota Motors				By Computer Divisons for Management and Engineering Systems, separately	To meet managment needs	CAD/CAM (not fully implemented, today, parts suppliers networks	no infrastructure, uncertain merits, not necessary at present

Table 4-1 Companies of the Ready-Made Type

表4－1 レディーメイド型企業

Name 企業名	Business 業種	Type of Product 製品	Type of Network ネットワークの形態		Network System システム	Note その他
ダイムラー・ベンツ Daimler Benz	自動車 Atuos	耐久消費財 Consumer Durable	星 Star	サブネットの統合 Integration of Sub-Network	受注－生産－配車－会計の統合 Integration of orders, production, distrib, accounting, etc.	海外5900拠点 5900 overseas sites
フィアット Fiat	自動車 Autos	耐久消費財 Consumer Durable		センターの統合 Integration of Data Centers	特約店との接続 Linking dealers by networks	
ヒューレット・パッカード Hewlett Packard	電算機 Computer	耐久消費財 Consumer Durable	星網 Star F.NBt	ROUTS PSN	注文管理システム order control system	
リーバイ・ストラウス Levi Strauss	アパレル Apparel	非耐久消費財 Consumer non-durable	星 Star	本社－小売り店・流通センター Head Office-retailer-distribution center networks	カタログ・注文エントリー catalogue order entry system	公衆回線 using public nets
マッキーソン McKesson	薬品 Medicines	非耐久消費財 Consumer non-durable	星 Star	本社－小売り店・流通センター Head Office-ratailer-distrib.center networks	カタログ・自動注文エントリー catalogue auto-order entry system	公衆回線 public nets 双方向 dual directions
NEC	電算機 Computer	耐久消費財 Consumer Durable	星網 Star F. net	電話＆データ Telephone & Data nets	デジタル統合網 integrated digital network	C＆C VAN
プジョー Peugeot	自動車 Autos	耐久消費財 Consumer Durable	星 Star	サブネットの統合（三極中心） Integration of subnetworks 3 poles in star	特約店・下請け接続 linking to dealers and subsidiaries	
トヨタ Toyota	自動車 Autos	耐久消費財 Consumer Durable	星 Star	TNS	車両受発注システム order/distribution system	かんばん方式 Kamban System is not at site.
ビザ VISA	カード Credit cards	金融サービス Financial Service	星 Star	ホスト＊2 2 host computer-networks	オンライン信用供与・バッチ決済 On-line credit system & batch-processing	公衆電話網に依存 using public net

Exhibit 18

表４－２　オーダーメイド型企業

Table 4-2 Companies of the Order-Made Type

企業名 Name	業種 Business	製品 Product Type	ネットワークの形態 Type of Network		システム Telecom System	その他 Note
欧州フォード European Ford	自動車 Automobile	耐久消費財 Consumer Durable		core-net ＋ CAD/CAM net	設計のローカル化 Localization of Product Design	PSTNに依存 PSTN-dependent
ニックスドルフ Nixdorf	電算機 Computers	耐久消費財 Consumer Durable		分散型ＩＰＣ Decentralized IPC	注文管理・開発 分散一統合化 Order Control, Product Development integration by decentralization	
東京海上 Tokyo Marine	損害保険 Casualty Insurance	金融サービス Financial Service	網 Fish Net	分散処理コンピューター Decentralized Data Processing	顧客単位の対応 Customer's-oriented	

表４－３　混合型企業

Table 4-3 Companies of the Mixed-Type

企業名 Name	業種 Business	製品 Product Type	ネットワークの形態 Type of Network		システム Telecom System	その他 Note
パリ国立銀行 La Banque Nationale de Paris	銀行 Banking	金融サービス Financial Service	網 F.Net& 星 Star	ＣＴＩの分業 combined CTI （全国*3＋地方*4） 3 national, 4 local	ＧＡＢ ＲＴＣ	未オンライン Not On-Line
バークレイ銀行 Barclays Bank	銀行 Banking	金融サービス Financial Service		ＢＩＮＳ	通常・ＡＴＭ ATM for normal use in-branch端末 Terminals	
コメルツ・バンク Commerzbank	銀行 Banking	金融サービス Financial Service	星 Star 網 F.Net	２階層ネット＋外輪ネット Two-layered Network plus Periphery Net	支店に顧客データ ＣＯＢＩＴＳ Customers' Data at branches	オンライン？ On-Line? unknown
三菱銀行 Mitsubishi Bank	銀行 Banking	金融サービス Financial Service	星 Star	第３次オンライン The Third-Order On-Line System	ＡＴＭ・ＣＡＭＳ ホームバンキング Home Banking	オンライン On-Line

To summarize the above grouping of telecommunication uses by corporate stance, Table 4-1 is attached for the ready-made type, Table 4-2 for the order-made type, and Table 4-3 for the mixed type. These tables enable easy comparison among differnt companies.

4.3 Features of Corporate Stance by Different Networks

In this section, we will try to extract the salient features of networks for each corporate stance.

4.3.1 The Networks for the Ready-Made Type

Mass production of ready-made products can be further classified in the following way. In the cases of the auto companies and the credit card companies, mass production or mass sales are undertaken based on small varieties of commodities. In the case of the electric equipment industry, a medium size of product differentiation is observed. Lastly, in the case of the non-consumer product areas such as medicines, a vast quantity of products aim at mass sales.

However, in all the cases, a priority of telecommunication is placed on inventory control, rather than on production itself. This is largely due to the fact that products are not directly sold by producers but sales are performed by a great number of retailers and thier affiliated dealers. So that, a feedback loop starting with order inputs and ending at output supply through inventory stocks necessiates an intense use of telecommunication networks to attain high efficiency and quick market response.

Companies of this type are using exclusively a network of star-shaped. The reason behind is rather simple. They have to maximize efficiency of complicated processes of order inputs at a start point and of distribution of outputs at an ending point, so that the central control of information is indispensable. In the mean time, they have to supply unitary products for every retailer or dealer, requirng the central control of qulity control with a star-shaped network.

There are two unique cases in this kind of corporate stance, namely, the MacKesson and the Levis Straus. Both companies are using an automatic catalogue order system to compensate for the weakness of the ready-made products. In other words, they try to use telecommunication networks to maximally absorb order information from individual customers. In particular, the MacKesson is trying to develop two-way communication channnels for inputting orders by taking an advantage of the order-made type. On the other

OECD