Chapter 16

The struggle for control within the telecommunications networks

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My topic centers on the question: Who will control the networks of the future? If we look at who provides telecommunications network services in the United States today, we see that as a result of divestiture we have interexchange carriers and local exchange carriers, but, increasingly, the large corporation is becoming an operator of networks and a provider of network services, stimulated as long ago as 1959 by the *Above 890* decision and by the Specialized Common Carrier decision. Large corporations have been building networks that separate from the carriers the transmission of large amounts of traffic.

What is meant by a large corporate network? Perhaps the largest private network, not really a corporate one, is the federal government network, the 'FTS' or Federal Telecommunications Systems. Started in 1962, it is one of the oldest private networks.

General Motors is currently completing a network that will link all of its many companies and locations and support 250,000 telephones. That makes it considerably larger than many of the 1400 independent telephone companies. Boeing in Washington has a private network with some 70,000 stations and several switches that are central office class. Indeed, many universities have converted to a central office class switch.

Why do we care about the large corporate users and why is it important to focus on this trend of their building networks? First, large users account for a substantial fraction of carrier traffic in revenues. In some areas, 25 or 30 percent of the revenues of the local operating company are accounted for by 1 or 2 percent of the businesses. As they leave the network by building their own systems, the carriers, especially the local exchange carriers, could be seriously threatened.

Second, large users are learning to wield political power, which will change the politics of regulation. In recent years, we have witnessed the

International Communications Association, an organization of 600 large corporate users, form a public policy committee to intervene in state regulatory cases; and the Ad Hoc Telecommunications Committee, also an organization with large manufacturers with private networks, now intervenes in regulatory proceedings. Hence we have additional stakeholders and players in the regulatory process.

Most large networks continue to use transmission facilities supplied by the carriers, but in the future the value added to a network and the profits will be derived from the control of the network, not in the simple carriage of bits. Having this kind of control over a network presents a major change in the way telecommunications service is provided.

There are several reasons why private networks have developed. Perhaps the principal one is the tariff policy. For many years the fixed costs of non-traffic sensitive plants, particularly the local loop from the telephone central office to the customers' parents, have been traditionally recovered not through a fixed charge but through a usage sensitive tax on long-distance service. That tax, paid originally through separations and settlements, is now paid more explicitly through access charges - the carrier common line charges. The tax means that if you are a large user of long distance you will pay an amount much higher than the actual cost of the local access facility.

If you could build an alternative facility or design a network in which you do not have to pay the tax, you will have ample financial incentive to do so. For many years, private lines, which provide service at a fixed price, independent of volume, served as a way to avoid the usage sensitive tax.

To make use of a private line for more than connection between two points, you had to add switching. And so we saw the growth of large networks like FTS or the GM network, in which switching, owned by customers, combined with private lines leased from carriers to provide a switched network service at substantial savings.

A second reason for the growth of private networks has been the perceived unresponsiveness of the carriers. Shortly after divestiture, the lag time to get facilities from the carriers grew, in some cases to 12 and even 24 months. If you built your own network, with your own switching and even your own transmission, the process was under your control and hence you could maneuver more quickly.

In a data-dominated world, rather than merely a voice world, new kinds of capabilities have been needed by users. They want to build their own integrated digital network and have multiple services, what we might call an 'isdn,' but in lower case to distinguish it from the upper

case ISDN represented by the worldwide carrier plan for integrated services digital network. The advantage of building such a private network is that it provides the ability to control one's own destiny. The original motivation for the FTS was that during the Cuban Missile Crisis, telephone calling to Florida grew to such enormous proportions that government calls could not get through. President Kennedy decided that the government needed its own network that could control the allocation of resources so priority calls could get through.

The ability to control the network, to allocate resources, to develop new services, to change, to do something as simple as reassign a telephone number to someone who has moved his or her office – that kind of control is part of what corporations have been buying in order to build their own private networks. Such integrated and advanced services are perhaps best characterized by a quote from Thomas O'Toole, Director of Corporate Digital Networks for Westinghouse. In an article describing the Westinghouse network he said, 'The definition of the Westinghouse Network is very similar to the definition of upper case ISDN. We are providing the Westinghouse users an ISDN type of service because that is what they require. This network supports crucial business applications and we simply could not wait for ISDN to come along and fulfill the need.' Users would like to have one entity responsible for the network end to end. In a divested environment, it is not possible to find a carrier who can be responsible end to end; you can do it yourself. That, too, has been a motivation for taking control and building large user networks.

Consider the theory of markets and hierarchies developed by economist Oliver Williamson. He noted that in trying to understand what circumstances will prompt people to procure services in an open market rather than to take them into their own organization and produce them in a vertically integrated way, we must take into account the amount of uncertainty in the marketplace and the degree to which specific kinds of investments have to be made. As certainly as divestiture has become a part of the telecommunications industry, so the amount of uncertainty has grown enormously.

In looking at the kinds of investments users want, we find that custom networks are ones that provide specific services necessary to the strategic objectives of their business - the airlines with their reservation systems, American Hospital Supply with its order entry system, the securities firms with their stock trading systems. As the investments become larger, and the uncertainty remains correspondingly large, the tendency, according to Williamson, is to bring the operations inhouse,

rather than trying to procure them from the market. From this we conclude that an important trend of the next decade is likely to be large users trying to take control of the networks.

I mentioned that the value added in networks is in control. From one perspective, if you were a seller of services, transmission or switching, providing the user with the control he wants may be a way to sell him the bare transmission and the switching services. If you provide better network management, you will sell the switch that provides it, and the hardware sale goes along with the selling of the control capacity.

The process of control, however, has many elements. For one, it is the management of the network, which means managing the network's configuration and solving problems if something goes wrong. Another part is service definition control, that is, a kind of control that enables one to recombine elements to define new services. As a network becomes more like a large computer, users want to be able to program it and write software for it, thereby changing the kind of functionality that the network provides. Users also want cost control, and buying fixed-price lease lines, switching assets, or transmission assets has been a way of isolating them from the uncertainties of tariff policy. At the same time, control is not uniquely identified with ownership.

Control has three dimensions to it. One dimension is that of ownership of switching resources. You can buy your own private branch exchange or you can buy switching resources by the call, as you do with the public switched network. Alternatively you can contract for switching resources, as with Centrex, and pay a fixed price without usage measure.

Another dimension is transmission. You can own transmission resources by putting in a microwave system, your own fiber optics. You can lease them at a fixed price, contract them for unlimited usage, or buy them by the call, with package switch and circuit switch services.

The third dimension of control may be thought of as depth. What is particularly important is that carriers have recognized that control is something the end user wants. In the past, the only way to gain control was to buy the equipment. For example, you could buy the terminal that tells the switch what phone number you want assigned to which office. What the carriers are doing now is providing end users with terminals that sit on the end users' telecommunications manager's desk, allowing him or her to program the central office switch to rearrange telephone handsets, to provide overflow-calling or call-forwarding services, or what have you. In other words, while retaining responsibility for operational control and performance and problem management, they have given account control and configuration control to the end user.

Control, then, is not necessarily inherent in the ownership of the facilities.

In examining emerging competition in the network, we have to consider the perspective of equipment vendors, local exchange carriers, and interexchange carriers: How do they want to supply the end user with control; how do they want to view what is supplied by the other players in this structurally separated business? The equipment vendor's view of how the network should look is that the vendor's equipment will sit on the customers' premises, the private branch exchange. All control of the network will be supplied by customer-owned and equipment-vendor-supplied switches. Local exchange carriers and interexchange carriers will be reduced to providing pipes (transparent bit pipes that interconnect the switches). All of it is controlled by equipment on the customers' premises, which makes the user completely responsible for network management with tools provided by the vendors.

The local exchange carrier, by contrast, would like to see the control provided by the central office switch that sits within the local exchange carriers' network. The premise's equipment is reduced to the provision of handsets, with all of the network management residing in the central office switch. But again, the interexchange carrier is reduced to providing the bit pipe, so all of the value added is being supplied by the local exchange carrier.

The interexchange carrier would like to reduce the local exchange carrier to the provider of a bit pipe with no intelligence. The interexchange carrier wants to manage the network from the center, with common channel signaling and software defined network service. Perhaps there would be a PBX at the customer's premises, but a minimally functional one, with most of the network management in the centralized network rather than in the end equipment – or perhaps even supplying Centrex from the interexchange carrier's point of presence. We have seen over the last several years that AT&T has reprogrammed its Class 4 offices so they are capable of providing Centrex services.

What all this means is that three perspectives contend with each other in shaping ideas of how to organize a network. In every case, each of three players is trying to be the one who captures the market for control of the customer's network. That provides the point of contact for the customer for performance resource allocation and configuration management, and often in switching. The strategies of the players in the current environment are to maximize their opportunities to realize each of these scenarios.

For example, for the interexchange carrier, they need to hinder the ability of the LECs to do that. They can try to do so by resisting their efforts to enlarge the scope of services they can provide, such as by developing T-1 links and other links between the interexchange carrier and the customer's premises. This encourages bypass in order to adjust tariffs, as with the Megacom tariff of AT&T, which makes it attractive to bypass the LECs and gain additional flexibility in customized services to offer end users. For example, AT&T had been in a dispute over wanting to offer a specialized service to DuPont where they would put a custom multiplexer in their premises. They were constrained from doing so because under current rules they are required to announce and publicize all of the interfaces by which they interface with customers. The product they want to buy is from NET Corporation, and NET is not interested in having the interfaces of the product made public. Hence, AT&T wants to be out from under such disclosure requirements so they can engage in more customized service provisions.

From a regulatory perspective, the regional Bell operating companies have perhaps the most difficult situation. In order to make a network management work for them, they must be able to at least resell the long-distance services provided by interexchange carriers, if not actually become long-distance facility base carriers, so they have the authority to do least-cost routing on behalf of the customer to manage its network. They also want to gain control over the network's switch vendors. But to reprogram the switch to provide new services, the Bell operating companies have to go to AT&T or Northern Telecom who supply the switch and hence be dependent on them. The Bell operating companies clearly do not want to be dependent, particularly on AT&T, and so their current strategy is to design what they call the Intelligent Network II, which is a generic device that executes call processing primitives, collects the number dialed, connects two lines, and interacts through a signaling channel to a computer called a service control point. This computer, the service control point, has all of the logic for accomplishing a particular service. For instance, if you want a service that routes after three rings to your secretary's number or a voice mail system, the instructions to do that are in the service control point. The switch simply reports to the service control point computer that three rings have gone by and the service control point implements the appropriate logic.

The important part is that the service control point takes the control function of the switching system and extracts it to a place where the

operating company has more access to it, can write software more easily, and can develop services more rapidly. Interestingly enough, under Open Network Architecture, the same access may become available to the end user, and so we may see the end user programming a computer that controls the switch. The carrier switch to provide the same services and the value added of that computer and the programs that support it – which are not at all insignificant – then go to competitive suppliers and not necessarily to the Bell operating companies.

Indeed, an example of this is Digital Equipment Corporation, which proposed what they call the computer integrated telephony concept. The idea is that the integration of voice and data services do not have to be carried over the same pipe. I can carry my data over my local area network and my telephone service over a pair of telephone wires. What is important is that I facilitate functional integration by being able to communicate between my data-processing system and the telephone switch; so I can have an incoming telephone number key into my data-processing system and tell me whose customer record to bring up on the screen; or I can have my rolodex on my screen invoke the telephone switch to dial a certain number. Digital Equipment's concept is that a standard interface, what they call the CIT or computer integrated telephony interface, would be defined by switch manufacturers and carriers, and all parties in the data-processing industry would have the ability to access, through that interface, telephone switching resources whether public or private.

What all this leads to is the notion that the control of networks is becoming separated from the physical facilities of switching and transmission, and the diversity and the competitive area is in control. That is where the new services need to be innovated and developed more rapidly.

What are the implications for future regulatory policy? In his book *The Geodesic Network*, Peter Huber argued that transmission costs are becoming higher than switching costs, or rather that switching costs are dropping more rapidly. As a result, the correct design of a network is not a star, which is the configuration when you want to economize on switching, but a geodesic network in which you use much more switching at many more different points.

There are problems with that argument, not the least of which is that with the decline in fiber optics cost, transmission costs today may be declining faster than switching costs. Second, and perhaps more important, switching and transmission costs are declining more rapidly

than the costs of software and of management. Therefore, economies of scale lie in pure transmission – at least in the production of switches.

The software that controls switching holds great promise for effecting enormous economies of scale. In developing a standardized generic switch having a specific set of built-in primitives, one might spend perhaps a billion dollars. Moreover, putting together combinations of primitives to form new services is a highly differentiated business. It is one where being small, responsive to customers, and having strategic heterogeneity are essential. We may well envision a situation in which numerous players provide software and control, and a much smaller number of players provide switching and transmission.

Where control is going to reside, whether on the customer's premises or on the carrier's premises, is harder to determine. There is certainly a trend toward centralization of control. Even in private networks, the telecom manager of the corporation tries to concentrate in one location at corporate headquarters all of the software that manages the whole network. In the same sense, AT&T and the regional operating companies are trying to bring into one service control point the software that controls all of their switches. The tendency is to centralize in order to avoid having to update software at every location. You can only do it at one place. If you have to do maintenance on that software, it is where the programmers are. Nevertheless, once software has been built, it is certainly easy to replicate and distribute.

From all this we see that future competition in the networking business extends far beyond the familiar competition between carriers. It is also between carriers and large end users. The competitive battleground has switched from competition over who will provide the simple transmission part of networking services to competition for signaling and control. Yet the signaling and control business is highly differentiated, highly uncertain; the kinds of services that people will want and what the markets for them will be are not very well known. Rate-of-return regulation is based on the premise that one is selling a standardized service with economy of scale, and therefore one must be prevented from pricing the service at monopoly prices.

This assumption breaks down totally for a new service that involves risky innovation. The risk is not that the innovation will be priced too high, but that it might be priced too low and lose money, and the loss will be laid off on other ratepayers. A question that deserves careful consideration is how to set up a situation where carriers have proper incentives to take risks that will be borne by the appropriate parties – by

users of new services or shareholders of the carriers - not necessarily by consumers of existing services?

Do the present rules provide a level playing field in this battle for control? At present the regional operating companies are very much disadvantaged by information restrictions and by software restrictions. AT&T as well is disadvantaged by the restrictions on what they can do in information services. The entry of new players creates new problems of coordination. I referred earlier to the fact that many corporations are setting up their own integrated services digital networks that do not correspond to any international standard. It is quite possible that the existence of those networks will derail the creation of a standardized ISDN. Why buy one if you already have one? It is likely that we will end up not with a single international or even national network, where everyone can communicate by using standardized protocols, but with a cacophony, as in the computer business of private systems connected at great cost on the margin, one with each other, and the overall level of conductivity is greatly reduced.

As to who will support the standards for interconnection, the strongest force for standardization is currently the operating companies, precisely because they do not engage in manufacturing. It is in their interest to have the manufacturers standardize the equipment so they can buy it on commodity terms instead of being locked into a single supplier. If we allow them into the manufacturing business, the incentive for standardization may greatly diminish. As a consequence, this will lead to an acceleration of a trend already happening in which large users have incompatible network standards. This separation of control from transport and switching creates opportunities and risks for users and carriers. It is certainly one that we should pay close attention to in looking at the future of telecommunications.