

The Historic Evolution of the Network System : Past Change, Present Impact, and Future Policy

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Introduction

According to J.K. Galbraith, "the great advantage of being in the same world as the United States is that it reveals to other countries the pleasures and horrors that will afflict them only a few years hence".¹ And while such generalization must be taken with caution, some of the broad trends of recent American trends in the areas of telecommunications are relevant to circumstances as they evolve elsewhere.

Because several of the changes in telecommunications policy originated in the United States under a conservative political regime, they are often viewed as the product of particularly American business interests, wrapped in a Chicago economic ideology. But more recently, several other industrialized countries have begun to adopt similar policies, or at least to discuss changes that previously seemed unthinkable. This raises the question whether the changes go deeper than the nature of the respective governments in power, and whether they reflect a more fundamental change. This paper argues that the changes in policy are indeed part of broad transition in which the traditional network is transformed by a multiplicity of centrifugal forces into a loosely interconnected federation of sub-networks. It then describes the impact of the past five years in the United States, to provide an empirical foundation, and then leads to a discussion of future policy priorities.

Part I : The Past - The Dynamics of Network Transformation

For several decades two opposing forces have been at work, transforming the traditional world of telecommunications. One force is technological in nature, is unifying and integrative. ISDN, the integrated super pipe, and broadband networks

¹ Galbraith -- Interview with Francis Cairncross, The Observer, 22 November 1970

are examples. The second force is social and economic in nature, and is fragmenting, is diversifying, and tends to split things apart. The growth of extensive private networks and distributed network intelligence are examples of this force.

Telecommunications are only one instance of the wide-spread ascendancy, in recent years, of centrifugalism in previously shared arrangements. Wherever you look, people are breaking up all kinds of networks of interaction and forming new ones.

In telecommunications, we are rapidly moving from the one large monolithic network towards a decentralized and segmented federation of public, private and semi-public networks. In effect, a network of networks -- domestic and multi-national, hardware and software, specialized and general, private and public. It's a very untidy affair, and it makes people nervous who like things well-organized and compartmentalized. I like to use the term the pluralistic network to describe the new environment. It is the latest stage in the development of communications networks. Without going into historical detail, the stages of network evolution in telephony are as follows :

1. The cost-sharing network.

Expansion of the network, at this stage, is based on the logic of spreading fixed costs across many participants, and increasing the value of telephone interconnectivity. This period of telephony, in the United States, lasted through late 1940's.

2. The redistributory network.

At the next stage, the network grows politically through transfers from some users to others, particularly to newcomers to the network. This period lasted into the early 1970s, when it began to change slowly.

3. The pluralistic network.

In the current phase, the uniformity of the network is breaking apart because the interests of its numerous participants cannot be reconciled anymore, and a federation of sub-networks is emerging.

It is important to understand that these trends have a certain logical progression. At first the network expands because it makes economic and technical sense. Later, because it makes political sense. But as the network provider succeeds in providing full service to every household, it also undermines the foundation of its exclusivity.

In time, the cost sharing arrangement becomes increasingly counterproductive to the early users, because its democratization imposes an increasingly higher cost share on them. At some point, it can become more attractive to leave the existing club and form a new one. It is true that such users would have to spread the fixed costs of the new network among fewer participants, but they would have much less of a redistributory burden to bear. The ability to communicate with those remaining in the old association would not be lost if there exists an interconnection between the two networks. If such interconnection were priced at cost (i.e. low) the new network users may be considerably ahead economically, since they can avoid the redistributory burden without a loss of communications reach. The only factor then remaining is whether the cost of the new network is attractive to its members.

There are several broad trends that contribute to new network coalitions becoming an increasingly realistic proposition :

1. The Saturation of Basic Service

For a long time, the primary policy goal was to establish a network that would reach every household; this also benefited the supplying industry. The achievement of universal renovation is a fairly recent phenomenon. In Germany, penetration in 1960 was 12%; in 1980, 75%. In France, it was 6% in 1967, and even less in the provinces.

Having been successful in spreading telephony, the supplying industry becomes a victim of its own success in saturating the market. In France, almost 5% of the GNP went into telecommunications investments in 1978. Today it's less than half of that for basic voice telephone service. It can pursue several strategies : Thus, the domestic basic market does not grow anymore, but contracts.

Option 1 : Upgrade

This means an accelerated supply push rather than demand pull. It means move into videotext, ISDN, IBN, and cable television as ways to provide the industry with procurements

Option 2 : Export Offensives

Increased attention to international activities can substitute for the shrinking basic domestic market. However, many of the more interesting markets in industrial and industrializing countries are protected by their governments who use the network as a way to promote a domestic electronic industry. The result are trade frictions around the world, and eventually partial opening of national markets in order to achieve reciprocity.

Option 3 : Targeting Users as Equipment Buyers.

Perhaps most importantly in the long run, manufacturers turn to the large users as a market for equipment. In the United States, whereas in 1975 virtually all of capital equipment in telecommunications was invested by the carriers, in 1986 it was only 2/3. About \$15 billion were invested by non-carriers, mostly large users. Such equipment includes PBXs, multiplexers, concentrators, network management equipment, satellite and microwave facilities, etc.

Users have increasingly assumed control over the network segments closest to them; first, over equipment on their premises; second, over the wiring segments in office and residential buildings. It was natural, as the next step, that they began to share in a full array of telecommunications services within their building.

The implication is that the equipment industry, in the past a protector of the old order, is increasingly part of the process of creating alternatives to the traditional shared network.

2. Reductions in Equipment Costs and Increases in Productivity

A second factor leading to greater sub-networking is that the underlying economics of transport and switching have shifted considerably downward. A unit of communications has become much cheaper, both to transmit and to switch.

Switch prices came down in price per line from \$230 in 1983 to \$144 in 1988. Manpower requirements declined considerably.

Similarly, the price per meter of fiber has come down from \$7 in 1977 to 23 cents in 1988 while its transmission capacity has increased enormously; LEDs dropped from \$2000 a few years to \$30 today. In 3 to 5 years fiber will be cheaper to install than copper.

Thus, the cost curve drops down as a whole. It becomes more affordable to start an alternative arrangement as the economic incentives to share in one large public club decline.

3. Increases in User Size

The trend of information-intensive large users has been to grow rapidly, as part of the move to a services-based information economy. As the traffic volume of large users goes up, it takes fewer users to travel down the cost curve and benefit from economies of scale.

4. Upward Drift of Cost Curve of Old Network

Costs and efficiencies of networks are not simply a question of engineering, but also of market structure. The existing network, operating as an exclusive

arrangement, tends to drift upwards in terms of cost. This can be exacerbated by regulatory arrangements that lead to wrong incentives, such as to overcapitalization (Averch-Johnson effect).

The implications are that a new network, unencumbered by the accumulated high-cost attributes of the old one, could operate on a lower cost curve even in the absence of technical progress.

5. Specialization

As the information flow requirements of large users become still larger, they are also becoming increasingly specialized.

Equipment offered by numerous vendors permit many configurations to accommodate the requirements and procedures of organizations. It is no longer as necessary to forgo benefits of specialization in order to benefit from cost sharing. Furthermore, some users aggressively employ a differentiation of telecommunications services as a business strategy to provide an advantage in their customers' eyes, and they affirmatively seek a customized rather than general communications solution.

The New Network Coalitions

These incentives to network separatism and group formation can lead, where they are permitted to do so legally, to alternative sharing arrangements of alternative network associations. It is a process that might be called "the tragedy of the common network", because it is not the failing of the traditional system, but rather its very success which undermines it. The success of communalism creates the forces for particularism.

New coalitions of users are thus emerging. People who have been part of the old coalition -- the public network -- are packing up and leaving, and establishing new affiliations.

Examples are large private intraorganization networks, shared tenant services, local area networks, wide area networks, and other specialized services.

These groupings of users need not be territorial. The idea of telecommunications as consisting of interconnected national systems is likely to be transcended in many instances, and specialized transnational networks will emerge. This becomes possible with the drop in cost of international circuits.

In the future it is likely that specialized global networks will emerge for a variety of groups that communicate with each other intensely. Their relation to each other is functional rather than territorial, and they can create global clustering of economically interrelated activities much in the way that in the past related activities clustered physically near each other.

Obviously, most entities would participate in several networks, and the pluralist network does not mean separate transmission links for each subnetwork at every point. It will often make sense to transport the traffic of several low volume users part of the way on the general network until the point where there is enough aggregate traffic to branch off. The economics of sharing are not abolished. But they must prove to be superior rather than being imposed by a legal requirement.

PART II : The Present - The Impact of Change : The United States

The dynamics of change described in the first part of this paper have been most pronounced in the United States. The most dramatic policy action in the US was the dismemberment of its telecom near-monopoly AT&T. It is useful to look at the impact of the transformation in the US, because many changes in the network structure, in the US as well as in Europe, are resisted on the grounds of negative side-effects.

Thus the Divestiture of AT&T in 1984 was accompanied by grave criticism, by serious and less serious observers. Generally, the negative assessments involved concerns :

- 1) that residential rates would skyrocket as the long-distance subsidy was removed;
- 2) that universal service could no longer survive;
- 3) that service quality would decline precipitously;
- 4) that productivity would suffer due to the loss of the efficiencies of the centralized Bell system;
- 5) that research and development would decline without monopoly profits to feed it;
- 6) that long distance competition was not a realistic proposition;
- 7) that the equipment market would remain unchanged with AT&T and its allies in the BOCs dictating the pace of change as well as prices;
- 8) that AT&T would prosper while the local exchange companies would wither
- 9) that employment in the telecommunications industry would suffer.

What has been the reality ? By now, we have had almost five years of time to look at actual events. The next section will take a look at empirical figures. Several caveats are very important :

- 1) Each of the several subtopics would deserve a full-length study.
- 2) Some of the data is for New York State, and may not be representative.
- 3) Perhaps most importantly : in many cases one cannot infer a causal connection between divestiture and certain positive developments. In some cases, they could have occurred despite divestiture; in others they could have been higher without it. The conclusion of the analysis is not to credit

divestiture, but rather to demonstrate that the sky did not fall in, and that adjustments in the system prevented most of the fears from becoming reality.

1. Residential Subscribers

One of the most immediate concerns was the likely effect of the AT&T divestiture on residential subscribers. Anticipated figures of 300% rate increases were frequently suggested by experts, and repeated as near-facts by the press. The reality of the past four years has been different. Both in percentages or absolute numbers, the figures are far less dramatic. Nationwide, local rates in real terms increased at the annual rate of 6.9% ; but interstate long distance rates declined by 7.8%.²

In absolute terms, local residential rates, for a nationwide average, increased during 1980-86 by about \$4.30, half of it after divestiture.³

In New York State, basic measured service subscription rose in four years by 46%; but in absolute terms this was a \$2.61 increase in an average monthly phone bill. New York Telephone reports that the average monthly household bill, holding the basket constant, increased by only 80 cents from 1983 to 1986. According to the FCC, overall telephone rates (long distance and local) for the United States as a whole rose since 1984 by about 15%, but that was barely above the rate of inflation (CPI) of 14.1%, and did not include savings from lower equipment costs. The Consumer Federation of America, one of the most vocal opponents of divestiture, finds an overall decrease of 2% below inflation in the 5 years 1984-1988, with increases mostly in the beginning,⁴ and conversely, another study calculates an actual reduction in average consumer bills of \$5.06, or 11.7% adjusting for inflation. For business users, the savings was calculated as 12.3%.⁵ In between, and probably most detailed, are the figures by the government's Bureau of Labor Statistics, which show overall rates to have risen in the first 2 years, and

² Crandall, Robert W., 1988, Fragmentation of the Telephone Network: Implications for the Policymaker, Washington, DC: Brookings Institution.

³ Noll, Roger G., and Susan Riely, 1988, "The Laboratory of the States: Local Service Prices Before and After Divestiture", Palo Alto, CA: Center for Economic Policy Research.

⁴ Mark Cooper, "The Telecommunications Needs of Older, Low Income and General Consumers in the Post-Divestiture Era", American Association of Retired Persons and the Consumers Federation of America, Washington, D.C., Oct. 1987.

⁵ Louis Perl, NERA, "Welfare Consequences of Competition in Telecommunications", 1988.

then flattened out, so that the overall impact for the five years 1984-1988 is a reduction of about 2% below inflation.⁶

Furthermore, many of the local rate increases reflected filings for the period immediately after divestiture. For all states, FCC figures indicate local rate hikes approved by state carriers declined from \$3.87 bil. in 1984; to \$1.15 bil in 1985 and \$.29 bil. in 1986; and to negative \$.46 bil. in 1987 (of which one fourth was accounted for by New York). According to the FCC, in 1987/8, total rates in real terms declined by about 4%, with local rates falling behind inflation.⁷

According to recent figures by CCMI/McGraw Hill, business telecommunications costs, including toll, WATS and private line use, using 1984 as a base of 100, stood at 76.9 in the third quarter of 1988.⁸

It must be stressed, of course, that the statistical average disguises losers, i.e. those users who consume relatively more local and less long-distance calls than average.

Rates did not rise as much as initially feared, in part because costs could be contained. Among the reasons were lower interest rates and taxes. But other factors were higher productivity, lower staffing, and lower equipment prices.

2. Universal Service/Telephone Penetration

The prediction of steep rate increases did not take into account the working of the political-regulatory system where a strong commitment to social concerns has protected local service rates. Furthermore, social safety nets in the form of budget or "life-line" service for the needy were introduced.

Subsidized rates for the economically disadvantaged were approved in many states. In New York, for example, "Lifeline" service of \$1/month for basic dial tone was instituted in 1987 by the Public Service Commission. In addition, the FCC access fee was waived and usage was discounted by about 10% in two different options. Installation fees for those who did not yet have telephones were reduced to \$2/month over a year. No deposit is necessary. An estimated 1.5 million users are eligible for the program with eligibility being determined by membership in one of several social support programs. (It should be noted that

⁶ John Burgess, "Dismantling of Bell System Yields Results Despite Pain", Washington Post, Dec. 24, 1988, p. 41.

⁷ FCC, July 5, 1988, Telephone Rates update.

⁸ New York State Telephone Association, Inc., Newsletter, Nov. 1988.

many social programs include an allowance for a telephone ; thus, net cost to the user may be still lower than the above figures.)

Partly because of lifeline and other protections overall telephone penetration did not decline after divestiture, but actually increased, from 91.4% in November 1983 to 92.7% in March 1988 (FCC, 1988).⁹ For the middle class, (\$30,000/yr household income) penetration was 98% and higher.¹⁰ For the poor (e.g., income of \$5,000 - 7,500), it rose from 82.7% to 84.0%. (The official poverty line for a household of 4 was \$11,012 in 1987). For poor Blacks (\$5,000 - 7,500), telephone penetration was lower, but it too, rose, from 74.7 to 76.1%. For Hispanics at the same income level, it rose from 71.1 to 71.7%.

Nor do rural telephone subscribers seem to have been pushed off the network. In typical farm states such as Iowa and Kansas, telephone penetration (95.1 and 95.2%) is higher than the national average. (FCC, 1988.) On average, 95% of all farms have telephones, according to the Rural Electrification Administration. Telephone rates for rural areas are often (but not always) lower than in urban areas, because flat rate service is cheaper for small exchanges, because of various subsidy mechanisms, and because of lower overheads.

3. Service Quality

Another expected result of the divestiture was a decline in service quality. However, service quality of local service (in New York State) on the whole, appears to have held steady, partly due to regulatory vigilance. In New York State, both medium-sized and large users reported greater satisfaction with their service than before (from 83% and 65% in 1984 to 92% and 95% in 1986 through 1988 for medium and large customers) (NY Tel Survey).¹¹ For all customers, a "comfort" index of 18 objective service variables held roughly steady at about 88 out of 100 from 1984 to 1988 (NY Tel Survey). Similarly, customer complaints to the PSC were not increasing. (In recent months, however, the quality measures in the outer Boroughs of New York City have deteriorated, though they are now on the rebound.) Several other indices show a slight service decline in the first 2-3 years after divestiture, with subsequent improvements that brought quality back to the pre-existing levels. It is important to note that the maintenance of service quality did not happen by itself, but rather was the result of substantial regulatory involvement.

⁹ FCC, Common Carrier Bureau, Industry Analysis Division, "Telephone Subscribership in the U.S.", Washington, D.C., 1988.

¹⁰ J. Fuhr, Jr., "Telephone Subsidization in Rural Areas", Chester, PA, 1987.

¹¹ New York State Public Service Commission, from data collected by New York Telephone, 1988.

For long-distance service, it is harder to get quality measures. Here, the rapid transition to fiber-based transmission seems to improve performance.

4. Productivity

Labor productivity has risen in the first 3 years since the divestiture by almost 40%, according to the Communications Workers of America.¹² At New York Telephone, the number of employees declined steadily, while according to the company wages rose for the remaining employees ahead of inflation.¹³

Overall, the expenses per NYT access line, including the reduced taxes, declined from about \$53 to about \$44, i.e. almost 17%, despite inflation of 14%. Revenues per line, at the same time, increased for NYT since 1984 from about \$82 to \$88, leading overall to a very comfortable rate of return of 13.6%, higher than for the Business Week Top 1,000.¹⁴ From 1984 to 1988, AT&T reduced its annual overhead expense by \$6 bil. In December of 1988, it wrote down \$6.7 bil. in aging long-distance equipment, under pressure of competition.

5. Research and Development

There was also a great fear about a technological decline, because Bell Labs' R&D would be curtailed by profit-minded management. Actually, the opposite occurred. One study found that total R&D employment rose from 24,100 in 1981 to 33,500 in 1985. (AT&T and the regionals' joint R&D firm, Bellcore, combined.)¹⁵ (Noll, 1987) By 1988, the regional companies were adding their own laboratories, and total R&D employment rose to an estimated 35,600. However, in comparison to many industries, overall RBOC R&D was still quite low.¹⁶

6. Long Distance Competition

AT&T's long-distance rates were reduced by 40-45% in real terms since the divestiture until 1988 (However, the end-user line charge has partly offset this saving.) The company was fairly successful in protecting its position, though its

¹² Communications Workers of America, Information Industry Report, Vol.1, No. 2, Dec. 1987.

¹³ New York State Public Service Commission, Communications Division, 1988. (Data provided by New York Telephone.)

¹⁴ Consumer Federation of America, "Divestiture Plus Four: Take the money and Run", Washington, D.C., Dec. 1987.

¹⁵ Noll, A. Michael, 1987, "The Effects of Divestiture on Telecommunications Research", Journal of Communications, Vol. 37 no. 1, pp. 73-80.

¹⁶ R. Harris, "The Implications of Divestiture and Regulatory Policies for Research, Development and Innovation in the U.S. Telecommunications Industry", Berkeley, 1987.

market share had no place to go but down. Of inter-LATA long-distance service, it reports its 1988 first quarter share as about 70%, down from 85% in 1985.¹⁷ As a percentage of all users, however, AT&T's share is higher because it has more small subscribers. (If short-haul interexchange service is included in the market definition (i.e. including the local exchange companies regional (intra-LATA) service, AT&T share is about 60%). AT&T's market share declined each year by about 2%, even though, at present, not all households are yet connected to "equal access" exchanges that permit easy choice among carriers. AT&T's volume increased at an annual rate of 7.6%, but that of its competitors by almost 40%.¹⁸ The number of competitors increased from 42 in 1982 to 451 in 1987.¹⁹ Of these, most are only resellers. Even if AT&T's market share is still quite high, its prices had to come down substantially. MCI, the strongest of AT&T's rivals, by 1988, was a healthy and profitable (second quarter profits for 1988 : \$73 million) \$5 billion company with an ever-increasing line of services. It was sufficiently healthy and confident to buy back IBM's share in the company.

To keep up with innovation and offer a state-of-the-art network, AT&T had to write off \$6.7 bil in December of 1988, an indication of the existing competitive pressures.

7. Equipment Prices

The US market for central office (i.e., local exchange) equipment was characterized in the past by a fairly closed shop, except for the independent telcos. The vast Bell system and all of its customers -- comprising 80% of the total market -- were foreclosed to other suppliers by its ties to AT&T's manufacturing subsidiary, Western Electric.

Although most analysts expected the BOCs to cling to AT&T as their equipment supplier after divestiture, in fact they embraced a wide variety of non-AT&T equipment quite rapidly.

Procurement of network equipment by local telephone companies is governed by their obligation to state regulators to pay the lowest possible prices. They are under pressure to keep rates low due to the loss of subsidies from long-distance service. The ability to compare cost trends for the 22 companies also forces them

¹⁷ AT&T, Data from FCC, Common Carrier Bureau, Industry Analysis Division, "AT&T's Share of the Interstate Switched Market : First Quarter 1988", Washington, D.C., 1988.

¹⁸ Data from FCC, Common Carrier Bureau, Industry Analysis Division, "AT&T's Share of the Interstate Switched Market : Fourth Quarter, 1987", Washington, D.C., 1987.

¹⁹ FCC News, February 2, 1988, page 15.

to seek low-cost equipment. The "gold plating" (over-capitalization) of the past is unlikely to persist in today's environment. Because of the divestiture, the BOCs no longer have any incentive to increase Western Electric's profits, since none of those profits are returned to the BOCs.

Equipment prices fell as the BOCs and end users gained the freedom to go shopping at many other suppliers. AT&T's national market share, e.g. for central office switches, dropped from 70% in 1983 to 46% in 1986, with Northern Telecom reaching 40%. Very significantly, central exchange equipment costs declined steadily, from \$230 per digital line in large exchanges in 1983 to an estimated \$144 in 1988.²⁰

The flip side of this development is that US firms lost enormously in terms of markets. Imports increased from \$1.6 billion in 1983 to over \$3.5 billion in 1987,²¹ while exports inched from \$.8 billion to \$1.0 billion. In central office switches, the foreign-based companies' share greatly increased.²² The number of foreign equipment grew, in particular from Asian suppliers; in 1987, only 43% new equipment licenses (Part 68 Registrations) went to US firms (including licensees of foreign firms), while 48% went to the Far East firms.²³ All these tendencies created an unanticipated problem for U.S. foreign trade which is likely to be a major political issue in international telecommunications for U.S. policy makers.

Technical network standards are coordinated for the BOCs by Bell Communications Research (Bellcore). Neither the executive branch, the FCC, nor the state commissions have shown a desire to set standards beyond those already in place. This may change, or become a problem in the future.

8. Health of the Industry

When the AT&T divestiture was announced, US critics, and with them many foreign observers, interpreted this event as a victory for AT&T, which had shed, it was widely believed, the sluggish and regulated parts of its business and gained the rights to the world of the future, the new information technology. This interpretation disregarded the long fight that AT&T had waged to preserve its end-to-end vertical integration, which was the cornerstone of its corporate philosophy. So far, the experience has been sobering for AT&T in the equipment

²⁰ NY PSC as reported by New York Telephone.

²¹ Communications Workers of America, Information Industry Report, Vol.1, No. 2, Dec. 1987.

²² U.S. Department of Commerce, NTIA Trade Report Staff, "NTIA Trade Report: Assessing the Effects of Changing the AT&T Antitrust Consent Decree", Washington, D.C., 1987.

²³ W. Von Alven, FCC, Washington, D.C., 1988.

field, in particular in computers. The Bell companies, in contrast, have been doing well, as mentioned, averaging rates of return of 13.6%, well above the average for the top US corporations and doing so with lower risk.

It is important not to confuse the health of AT&T with that of the rest of American telecommunications. A glance at the trade press with its constant announcements of new services, products, ventures and market entrants shows great vitality. Indeed, it is precisely the dynamism of this process that will undermine the economic/legal rationale for the divestiture, namely to separate the competitive and monopolistic sectors of telecommunications.

9. Employment

The number of employees at AT&T and its successor companies indeed fell, from 971,000 in 1984 to 837,000 in 1987, a drop of over 130,000. Most of the reductions were in manufacturing, and are part of the more general decline of US-based electronics manufacturing. Overall telecommunications employment seems to have picked up again after 1986. According to the Communications Workers of America, (Nov. 1988), "While employment in the telecommunications industry declined steadily from 1981 through 1986, that trend appears to have turned around in 1987 and employment growth has continued in the first half of 1988. In fact, total industry employment has recouped most of the losses suffered during the past three years, having nearly reached the employment level of 1985 but still 16.5 percent below the 1981 peak." (CWA, Nov. 1988)

If equipment is defined more broadly to include also computers, smart office equipment, etc., the number of jobs has increased.

Employment in the network itself dropped; New York Tel, e.g., lowered its staff from 60,000 to 50,000. This is partly attributable to the lower manpower requirements of digital equipment. According to CWA's President Morton Bahr, Nynex as a whole did not lay-off employees, but proceeded through attrition and early retirements. The company increased the staffs of its subsidiaries to 16,000 within a short period. Many of these jobs, however, are marketing and similar activities, and frequently not unionized. Additionally, many of the new types of networks, whether offered by private or public carriers, generated hundreds of new jobs.

For both the sector telecommunications network and equipment, the Bureau of Labor Statistics predicts employment increases of 2% annually. Even if these figures seem somewhat over-optimistic, they suggest that no great drop is in store in this growth sector. This is not, after all, the steel or the ship-building industry.

A Tentative Conclusion

Based on this admittedly partial evidence, one may conclude that the last five years of telecommunications development in the US have not been as bad as many anticipated, and as many earnestly persist in believing. The system proved itself capable of adjusting to major and rapid change, even while in the midst of unprecedented transformation. Some of the negative fall-out was moderated by regulatory actions. In other cases, offsetting economic adjustments took place.

As a consequence, there has been no upheaval. The worst fears were not realized. Thus, the divestiture of five years ago -- and the adjustments to it -- should cease to obsessively preoccupy the policy agenda, and make room for the new issues that are central to a pluralistic network structure, and which require much thought and attention. These will be discussed in the following.

Part III : The Future - The Next Policy Agenda

Having clarified the direction of change in the network system, where does this leave future telecommunications policy? It would be naive to expect less regulatory tasks. Many disputes become less intramural and more regulatory in nature. I would like to discuss seven main regulatory tasks which network pluralism suggests for the near future. Of course, there will be significant national and regional variations within the broad trends. They are :

1 Protection of Interconnection and Access

The tension between the integrative and pluralistic forces is most pronounced on the front where they intersect: the rules of interconnection of the multiple hardware and software sub-networks and their access into the integrated whole. In coming years policy makers must structure ways in which network interconnection is granted, defined, policed, priced, and harmonized.

The rules of access of the network participants to each other are key. If you leave control over interconnection to the strong, they will squeeze the weak. Power over interconnection led to the disputes between AT&T and MCI, and to the subsequent divestiture.

Open interconnection and access can be viewed as an extension of traditional common carrier principles, extended to the subparts of the network. It is critical to have rules of the road that all members of the network family can live with. These rules of interconnection now are being debated in the US at the state and federal level under the rubric of Open Network Architecture, or ONA. ONA is a framework, established in the FCC's Third Computer Inquiry, for opening the core

of the public network by disaggregating switching into its component functions permitting separate access, interconnection, substitution and competition for each of them. ONA is addressed also at the state level. For example, New York state is now taking steps to begin implementation here. In Europe, the Open Network Provision goes in a similar, though more modest direction.

2. Protection of a Balance Between Standardization and Diversity

Some degree of technical standardization is necessary for disparate systems to interconnect. As the number of networks, and their sophistication increase, the need for standards is even greater. However, the recent rapid progress in networks is probably attributable to the experimentation and diversity that have characterized its recent growth. There is need for a system in which uniformity and diversity coexist, as is true for much of the economic system of this country. The advantages of uniformity derive from greater industry and service stability, and increased compatibility and portability between different hardware and software. Its primary disadvantages involve reduced freedom to innovate and experiment, and the loss of flexibility to adapt to changing or local conditions. What is needed is a process to weigh and balance the various needs, and a hierarchy of uniformity.

3. The Role of Telecommunications Policy as Economic Development Policy

Traditional industrial countries have a long-term problem of economic health. Newly industrializing countries are ceaselessly active in making economic inroads, using telecommunications as a strategic tool. Given their economic advantages in manufacturing, the only way to keep up with them is to stay ahead in information content, process intelligence, and innovation. Better ways to use telecommunications policy as part of broader industrial development must therefore be conceived.

4. Regulatory Treatment of Telephone Carriers in Their Capacity as Mass Media

As telephone companies offer the pathways for interactive and mass announcement services, they move close to becoming mass media. Telephone network will soon have video capabilities. These changes have also raised challenges to the Common Carrier principle. In the common law tradition, carriers and other businesses affected with the public interest have had an obligation to provide service to all indiscriminately. They provided transport or transmission function, with no influence or responsibility over the content of transmissions.

5. The Prevention of Oligopolistic Behavior and of Cyclical Instability

The pluralistic network is less efficient in minimizing resources, and there is likely to be excess capacity. There is nothing unusual about this, for almost every industry has excess productive capacity, and the competitive effect is usually beneficial for customers. In the telecommunications field, with its low marginal costs, competition will cause periodic price instability. One of the functions of future regulation will therefore be to moderate the worst effects of price volatility and at the same time prevent industry efforts at collusion.

6. Protecting the Viability of the Core Network and Establishment of New Mechanisms of Redistribution

The pluralistic network will make it increasingly difficult to maintain the traditional system of internal transfers from one class of users to another.

This does not spell the end of transfers as such. There is still ample reason and opportunity to subsidize some categories of service for reasons of social policy or regional development, or for the positive benefits that new subscribers provide to existing users. Revenues for that subsidy should be raised and distributed in the normal way of taxation and budget allocation.

Another mechanism to support desired subsidies could come from direct assessments towards a "universal service fund" by network providers and users who do not themselves fulfill a social service role such as offering rural telephony or low-traffic telephones.

At both the federal and state level, experimentation goes on with "lifeline" programs to insure access by the poor. The philosophy behind this is not to subsidize everyone to the maximum possible, but rather to provide a social safety net so that the network evolution will not push the poor off the network.

7. Establishment of Global Arrangements to Match the Global Scope of Networks

The openness of the network will not stop at the national frontiers. In the long run, telecommunications will transcend the territorial concept, and the notion of each country having full territorial control over electronic communications will become archaic in the same way that national control over the spoken (and later the written) word became outmoded in Western society.

For satellite transmission, in particular, the marginal cost with respect to distance is close to zero. Fiber-optic links have also lower distance-sensitive costs. The implications are that communication flows can be routed in indirect ways to exit previous shared arrangements, or in order to join new and more congenial ones. Arbitrage becomes easily possible, and with it the incentive for a country to

liberalize its regulatory regime to become a communications "haven". This undermines attempts to administratively set rules for prices and service conditions.

No country can be truly an island anymore. The more interrelated countries and economic activities are, the less likely are there stable solutions to separate policies. And where instabilities exist in one country, they affect the entire system. It becomes increasingly difficult to control all of the elements in such a complex matrix of interrelations.

In the future it is likely that specialized global networks will emerge for a variety of groups that communicate with each other intensely. Their relation to each other will be functional rather than territorial, and they will create global clustering of economically interrelated activities much in the way that in the past related activities clustered physically near each other.

The challenge to regulatory policy is how to frame rules in such a complex environment, how to coordinate them with other countries (whose outlook is often quite divergent, particularly if they have not reached the pluralistic stage of network evolution) and to how to make them stick.

Conclusion

These issues will, no doubt, lead to significant regulatory controversies, and occupy policy makers in the US and elsewhere for a long time. None of the tasks is beyond our grasp in terms of complexity or political feasibility. But they require us to end the nostalgia for the simplicity of the golden age, and to imagine a very different network environment.

It suggests that we look forward, and do not plan, like generals, for the last war. Unfortunately, telecommunications policy makers tend to be reactive rather than pro-active. Nor does the industry show much evidence that it knows where it is going. It would be good if many policy participants would be able to provide some intellectual leadership that goes beyond ritualistic incantations of competition or economies of scale. There are significant issues in the telecommunications environment whose analysis cannot be pressed into those particular molds. What we need to do is to expand our vision, and deal with inevitable evolution. If we understand the forces at work, we can be more tolerant to each others' struggles of change.