

Chapter 24

THE NEXT FUTURE OF TELECOMMUNICATIONS: FROM THE NETWORK OF NETWORKS TO THE SYSTEM OF SYSTEMS

Eli M. Noam

Director, Columbia Institute for Tele-Information (CITI)

Graduate School of Business

Columbia University

1.0 INTRODUCTION

As telecommunications are moving inexorably towards competition, deregulation, and fiber optics, several fundamental questions for telecommunications policy are rarely asked: *After competition, what? After deregulation, what? After broadbanding, what?* In the U.S. the day is not far off, historically speaking, when entry is wide open; when fiber is widespread in most stages of most networks, when radio-based carriers fill in the white spots in the map of telecommunications ubiquity; and when international carriers operate domestically. In such an environment, what market structure can we expect? And what regulatory environment need we erect?

The conventional vision for the evolution of telecommunications offered by traditional state monopoly carriers around the world was the *integrated and singular superpipe*, merging all communications links into a single conduit controlled by themselves, and interconnected internationally with similarly exclusive national superpipes. This scenario of technological integration took no account of the simultaneous organizational centrifugalism that was taking place, first in the U.S. and now increasingly in other countries. Instead of consolidating, the network environment kept diversifying.

Originally, telecommunications was synonymous with a monopoly telephone provider, and ^{that} is where most of the world is still today. In the U.S., during the 1960s, cable television emerged as an effective, low cost, and high capacity communication wire that today passes almost 90% of homes. In the 1970s, alternative narrowband networks began to interconnect into the telephone network. At first, new long-distance private line providers emerged, then switched carriers, mobile carriers, and rival local companies. Take for example local transmission, the segment widely considered to be a natural monopoly's natural monopoly. Today there are several other potential and

credible contestants for rival local transmission: fiber-based metropolitan area networks; cable television providers; radio-based and cellular carriers; electric utilities; building-based, shared-tenant services; and various local exchange companies crossing franchise lines. Similar lists can be made for other segments of the network, whether they are in domestic long-distance, international, mobile, or switching.

These physical network elements become linked with each other through various interconnection arrangements and form what I described a few years ago as the "network of networks". In time, it will be impossible to define what the "public network" is.

2.0 THE ROLE OF SYSTEMS INTEGRATION

Yet this is not the end of the story. Competition begets diversity; diversity begets complexity; and complexity leads to efforts at simplification. The actual user of telecommunications will attempt to simplify the balkanized environment that is so totally different and so much more complex than the technologists' model of the single superpipe. Yet, how can the numerous transmission, software, and equipment pieces be integrated into a usable whole? There are several ways to do so.

2.1 Model 1: Integration by End-Users

User's Do-it-yourself Integration: This is basically today's system for American residential users. They arrange for their own long distance company and terminal equipment, and maintain separate billing and service arrangements. Large users, too, often put together networks on their own, by leasing lines, and buying and operating equipment, etc. My own university, Columbia, employs 45 people in the process. Self-integration gets complicated very quickly as the number of carriers, services, prices, and equipment options multiplies. When even Citicorp chooses not to do it anymore by itself, how could Aunt Minnie?

Terminal-based Integration: Under such a system, a user's terminal equipment incorporates some built-in intelligence which can make the right choices among carriers on a real-time basis. The PBXs of large corporate users usually have a so-called "least cost routing" option. This concept has been extended to the residential market by Japan's DDI long-distance competitor, which has persuaded millions of Japanese to buy special terminals that can automatically pick the cheapest carrier for any given call. DDI, not surprisingly, is ^{often} usually the cheapest carrier. On the whole, customer-premises integration, even if done through intelligent devices, still suffers from the associated transaction cost and from the ultimate bottleneck, namely our own human limitations to handle complexity.

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2.2 Model 2: Carrier-Based Integration

Expansion of Carriers into End-to-end Carriers: This could be done by their entering horizontally into new geographic markets or vertically into new services — by expansion, merger, or acquisition. The approach is reminiscent of the old Bell System's battle-cry "the System [i.e., AT&T] is the Solution". Realistically, it is hard to imagine today any company that is big and varied enough to offer all types of facilities and services, and to do it well, locally, domestically, internationally, across services, in telecommunications, computers, enhanced services, and equipment.

Joint Ventures among Carriers: Companies specializing in different market segments could link up with each other through joint ventures or institutionalized cooperation, such as in expansion of the traditional international cartel regime of national monopolies. This is a likely development and its problems will be discussed further below.

2.3 Model 3: Integration by Systems Integrators.

Perhaps the most promising and innovative scenario for the integration of the bits and pieces of networks is systems integration. A new class of "systems integrators" is emerging. Their role is to provide the end-user (corporate, governmental, affinity groups) with access to a variety of services, in a one-stop fashion. These specialized integrators, also known as outsourcers or managed data services providers, assemble packages of services, tariffs, and hardware, customizing these packages to the special needs of their customers. To these customers, the identity of the underlying carriers and their technology might be unknown and transparent as transmission becomes a commodity. Systems integrators might typically put together local, long distance, mobile services, VANs, equipment, etc. They could operate a least-cost-routing system, switching users around as capacity becomes available. They can function as capacity brokers, buying and selling capacity as it becomes available. Likely to emerge is an international market in capacity, consisting of a futures capacity market and a spot market operating in real time.

Systems integrators have always existed. Examples are:

- General contractors in construction projects,
- Travel packagers,
- Computer service firms, and
- Insurance agents.

The characteristic of "pure" systems integration — for there will obviously be various hybrids — is that they do not own or operate the various sub-production activities but rather select optimal elements in terms of price and performance, package them together, manage the bundles, and offer it to the customer on a one-stop basis. They relieve customers from the

responsibility of integration for which expertise is required, and yet are not captive to the need to recover major infrastructure investments as carriers are.

Who will be the systems integrators? They are likely to be a variety of participants:

- Local exchange carriers,
- Cable television companies,
- Long-distance carriers,
- International carriers,
- Telecommunications resellers,
- Computer systems providers,
- Value-added providers,
- Office automation firms,
- LAN providers,
- Defense contractors seeking diversification,
- Corporate networks with excess capacity, and
- Non-profit groups,

The latter category of system integrators are connecting groups offering social or educational services. An example in the United States is the National Research Education Network (NREN) that links research users in an integrated system operating on leased carrier facilities. Furthermore, one might extend this approach and charter and fund a *Corporation for Public Networking* that would function similarly to the existing Corporation for Public Broadcasting. CPN could provide seed money for non-profit system integrations that would be proposed by various non-profit affinity groups, and would be technically managed by commercial firms which bid for operator contracts. Various levels of government could also use their large presence as users of systems integration services (e.g., the huge Federal FTS-2000 network) to advance new applications that could spread to non-governmental systems.

Today, systems integrators exist for large customers. They have also begun to be active in establishing group networks, establishing internetworked "tele-communities" that will be discussed further below. When it comes to small users, Mom and Pop need not apply, but tomorrow things may be quite different. The additional step would be for systems integrators to emerge that put together individualized networks for personal use, or *personal* networks. Before dismissing the notion of PNs as extravagant, consider that only a dozen years ago nobody expected personal computers on everybody's lap, either.

What does a personal network mean? It means an individually tailored network arrangement that fits an individual's communications needs. It does not mean a separate physical system, but mostly a "virtual" system, with bandwidth-on-demand, provided by a whole range of providers and multiple carriers, and packaged together to provide easy access to some of the following:

- volume calling plans,
- frequently called parties (MCI offers a Friends and Family customization),
- workplace (transforming the nature of the organization),
- frequent business contacts, domestic and international,
- data sources,
- transaction programs,
- video, audio, and text publishers,
- telemetry services such as alarm services,
- data processing,
- bulletin boards,
- access numbers moving with user (700 numbers),
- personal free-phone (800) for selected incoming calls,
- personal access charge calls (900) for certain incoming calls (such as by telemarketing's credit on the phone bill),
- personal FX. (local number calling) regardless of distance,
- abbreviated dialing, including by name,
- personal data storage, and
- personal information screening.

One of the most important services which a systems integrator is likely to provide to residential users will be a *tele-mailbox* into which various communications flows terminate.

As these personal, group, and inter-organizational networks develop, they access and interconnect into each other, and form a complex interconnected whole, sprawling across carriers, service providers, and national frontiers. The telecommunications environment evolves from the "network of networks" in which carriers interconnect, to the "system of systems" in which systems integrators link up.

3.0 REGULATION

Where does such an arrangement of customized networks managed by systems integrators leave government regulation? In the recent past, policy debates centered on the opening of telecommunications, broadcasting, and cable television markets. Is competition sustainable? Is it advisable? Who gains? Who loses?

Regulation had been essential to the old system, partly to protect users from the monopoly, partly to protect the monopoly itself. In the transition to competition, what was left of regulation was seen as temporary, shrinking reciprocally with the growth of competition. In time, it would diminish to nothing.

At that point, what would happen? Advocates of competition were always a bit vague on that question, like old Bolsheviks who were not sure,

even as they were storming the Winter Palace, what communism might actually look like one day. And you see what happened.

Can one expect the "system of systems" to be totally self-regulating, with no role for government? Does liberalization imply libertarianism?

The notion of an invisible hand mechanism, the idea that out of numerous decentralized sub-optimizing actions there would emerge, without any central direction, some overall and beneficial equilibrium, is perhaps Adam Smith's (1904) major insight as a philosopher.¹ Its importance goes way beyond economics.¹ Can electronic communications function in such a fashion, optimally arranging themselves in the absence of an overall plan or direction?

The mere notion is almost incomprehensible to telecommunications traditionalists. They argue that the more complex the technology and the network become, the more necessary it is to plan it in some centralized fashion. This type of argument was countered by the Austrian economist von Hayek (1942) half a century ago, when he pointed out that, to the contrary, the more complex and advanced an economy becomes, the less it is possible to guide it centrally. Recent collapses in Eastern European economies seem to prove von Hayek right. Complexity is neither a necessary nor sufficient condition for justifying centralized control.

On the other hand, there is the also the opposite belief, equally simplistic, that more advanced technology, *per se*, makes regulation unnecessary. But consider, as counter-examples, chemical manufacturing, or nuclear power generation — complex technologies that are tightly regulated. Or airlines, whose actual operations are strictly controlled, even as their prices may be deregulated. Technology does not abolish negative externalities, though the means of dealing with them may change. Thus, we need to look at the question in greater detail.

Why do we have regulation in telecommunications? To some it is merely an exercise in capture and rent-seeking by powerful interest groups. To others, it is based on underlying public policy goals, including restriction of market power. There is truth in both views, and they are not mutually exclusive. Thus, despite the misuse to which regulation is subjected, it has also definite public policy goals, including:

- universal coverage under affordable rates,
- free flow of information,
- restriction of market power and monopoly pricing,
- effectiveness of business transactions,

1. It has been observed for the evolution of species, as well as for the functioning of bee and ant colonies, for population migration, for organizational hierarchies, and many others. See Nozick (1974, pp.20-21).

- support of high technology,
- interconnectivity in society,
- interconnectivity of equipment,
- high technical quality of service,
- privacy and security of communications, and
- revenues for government.

To assure these goals, legislators, regulators, and courts instituted a variety of policies, such as rate subsidies, universal service obligation, common carriage, interconnection rules, access charges, quality standards, and limited liability for carriers. But in a system of system integrators, what forms of such regulation, if any, are still necessary? And what new ones, if any, may be required?

In telecommunications, regulation by government existed partly to effect the balance of power between huge monopoly suppliers on the one hand, and small and technically ignorant users on the other hand. It inserted the political and administrative process to alter unconstrained market outcomes which might negatively affect consumers and competitors. In return, the dominant carriers received protection from competition. Even where competition emerged with rival carriers emerging, customers still had no expertise in dealing with a complex set of services and products. In a system of systems, on the other hand, the imbalance changes drastically. Now, systems integrators, competing with each other for customers, act as these users' agents toward carriers. They can protect users against carriers' under-performance and power, and get them the best deal. This should resolve many traditional problems of price, quality, market power, security, even privacy. Business communications should be more effective than ever. Technological innovation is likely to be accelerated by knowledgeable buyers and marketers of services. Thus, assuming that users have a choice among systems integrators and that systems integrators have a choice among non-colluding suppliers of underlying services, the need for government intervention declines drastically. Direct regulation could often be transformed into standby alertness.

On the other hand, not all traditional policy goals are fully resolved in a system of systems. Let us turn to them now.

Universal Service/Affordable Rates: The emerging systems of systems will exert competitive pressures on cost and therefore on many prices, thus making telecommunications more affordable to some. But, it will be impossible to maintain the traditional redistributive system of generating subsidies and transferring them internally within the same carrier from one category of users to another category. Several things will disrupt this arrangement. In a network of competing carriers, an internal redistribution is not sustainable once other carriers without redistributive burdens target the users whose price is above cost as the most likely customers. Furthermore, residential users may

end up paying a proportionally higher share than large users, because cost shares in the substantial joint costs may end up allocated inverse to demand elasticity — the Ramsey pricing rule — and large users have more options and hence greater elasticity. Thus, the trend which at present is described as a "rebalancing" of prices towards cost would go much further than that, burdening the inelastic customers. Nor can one expect to continue to rely on a system of access charges to provide the source of subsidies, since these charges imply access into "the" network, which will be a meaningless concept where alternative transmission is easily available.

Yet this need not spell the end of support schemes. If one wants to support some categories of service or users such as the rural population or the poor — either for reasons of social and regional policy, or for the positive externalities their participation offers to others who can reach them — it is still possible to do so, only in different ways. For example, one could draw on general government revenue or on specialized communications charges such as a communications value-added tax (a step-wise sales tax neutral with respect to the extent of integration, the nature of the carrier, and geographic location). The monies raised might go to a "universal service fund" which would be used to support certain network providers or categories of users. This charge would replace the present opaque system and would make it transparent and accountable. Other models might also be possible; underlying this is uncoupling the question of optimal industry structure from that of optimal social policy.

Systems integrators, by aggregating the demand of many small customers, can provide them with a higher demand elasticity with respect to carriers, and thereby generate low prices and low shares in fixed costs. Systems integrators thus serve, in effect, as arbitragers in demand elasticity. This is also likely to increase their attractiveness to customers over staying as customers of carriers, and this accelerates the move to systems integration. On the other hand, those customers not able to obtain systems integrator service, perhaps because they are only reached by a monopoly carriers, would end up bearing a greater cost share. Also, systems integrators, absent some support mechanism, would deaverage prices for their customers, and charge, for example, rural customers a price that reflects the greater cost in serving them.

The advantage of systems integrators is that they pay to competing carriers a price based only on the latter's short-term marginal costs and can pass this low cost on to their customers. Yet a significant part of cost in a capital intensive industry such as telecommunications networks is fixed, and would not get compensated in such an arrangement. The long-term result might be either a gradual disinvestment in networks, or the reestablishment of monopoly, or price cartels and oligopolistic pricing. None of these scenarios would be desirable and they will prove to be a challenge to future regulators.

The Free Flow of Information: In the traditional network environment, the granting of access and non-discriminatory content-neutrality is required of the general "public" networks by law, common carriage regulation, and even common law. But common carriage requirements do not apply to systems integrators. They can institute restrictions on their systems, and exclude certain types of information, subjects, speakers, or destinations.

One of the central observations of the "law and economics" school of thought has been the fundamental economic efficiency of the common law.² The implication is that common carriage, as the product of common law judges later codified by statutes, was an economically efficient institution. Among its purposes was reduction of market power; protection of an essential service; protection of free flow in goods and information; promotion of basic infrastructure; reduction in transactions costs; and limited liability.

Yet, the institution of common carriage, historically the foundation of the way telecommunications are delivered, will not survive in a system of systems. To clarify: "common carriers" (the misnomer used to refer to telephone companies) will continue to exist, but the status under which they operate — offering service on a non-discriminatory basis, neutral as to use and user — will not.

The blows to traditional common carriage do not come from rival telecommunications carriers such as MCI, but from two new directions. The first is the increasing overlap between the common carrier system and well-developed mass media private contract carriers such as cable television networks, which in a remarkably short period have wired the nation with a second and powerful network system, and which are on the verge of entering point-to-point, switched, and mobile telecommunications services. The other challenge to common carriage are systems integrators. As mentioned, common carriage does not apply to systems integrators.

In head-to-head competition between a common carrier and a private contract carrier or systems integrator, the former is at an inherent disadvantage:

1. A common carrier cannot use differentiated pricing due to its non-discrimination obligation and because it cannot prevent arbitrage. Non-common carriers' rivals can offer services to some customers at a low enough price to induce them to sign up, and use their contribution to revenues to underprice a common carrier for low-elasticity customers.

2. A common carrier must serve a contract carrier or systems integrator, but not vice-versa. There is no reciprocity. Competitors can use

2. See e.g., Posner, (1986); Calabrese (1961).

valuable parts of a common carriers operations, but need not share their own unique features.

3. A common carrier cannot pick customers.
4. A common carrier cannot manage the competition among its customers and benefit from it.
5. In putting together a service package, the systems integrator can pick-and-choose among the lowest-priced component providers, while the common carrier is likely to offer only its own.
6. Competition for transmission and other services will lower the price for systems integrators to marginal cost, which is likely to be lower than the average cost for both common and contract carriers of providing it.

As a result, a systems integrator may provide services more cheaply, even though they use the carriers' underlying transmission facilities!

It is unlikely that the common carriers will simply sit by in such a situation. They will operate their own systems integrators, and they will move to contract carriage themselves, such as price-differentiation of customers, partly based on the argument of "meeting competition." And that is, indeed, what is already starting to happen. The "deaveraging" of prices would become standard, and negotiated rates would spread to many non-commodity services.

This kind of erosion of common carriage is unavoidable in the long term. The only way to prevent it might be to force systems integrators to become common carriers, but this would have to be inevitably extended to most private networks, contract carriers, media, and enhanced service providers. This seems neither doable nor desirable.

Where alternatives are stark, the possibility of a mixed system suggests itself. But what can that be? There are several possibilities for a hybrid system. But none of them is likely to stem the long-term dynamics of a shrinking in common carriage, both across carriers and industries, and within mixed firms. In the long term, common carriage will not survive, even if the former common carriers will.

What are the implications? The system of systems might have the capacity for a large number of voices, yet it would still result in a narrower spectrum of information, because systems integrators and carriers would not want to be identified with certain types of uses and users. Take for example birth control information by a hotline of an abortion clinic. Faced with negative publicity and pressure, service providers with discretion in the choice of customer may drop the service as a business decision. It is of course likely that "alternative" carriers and systems integrators will emerge to serve such

uses. Yet this solves only part of the problem. The need for the various systems to access each other, and for information to travel over numerous interconnected carriers, means that the restrictiveness of any one of the participants would require everyone else to institute content and usage tests before they can hand over or accept traffic, or they must agree to the most restrictive principles. Information travels across numerous subnetworks until it reaches its destination, and nobody can tell one bit apart from another bit. If each of these networks and systems integrators sets its own rules about which information is carried and which is not, information would not flow easily. The reason for common carriage generally, whether in transportation or communication, is to foster publicly available infrastructure and reduce transaction costs. As such, it is similar to other societal arrangements to encourage economic transactions, by devices such as legal tender status for currency, negotiable instruments in commercial transactions, and limited liability for corporations. Thus, even if common carriage erodes, its neutrality principles still remain important for economic efficiency and free speech, and will have to be protected in other ways, for example by establishing content-neutrality for transmission across carriers.

Interconnection and Compatibility: The economic rationale behind 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. As various discrete networks grow, they must interoperate in terms of technical standards, protocols, and boundaries. Yet interconnectivity is not willingly granted by incumbent firms. That is the lesson of decades of American experience. Regulatory requirements such as open network architecture, comparably efficient interconnection, or collocation were part of the evolution towards competition. In effect, these provisions regulated in order to deregulate.

Many of these interconnection requirements are likely to be temporary, to be superseded in a competitive system by contractual arrangements. Yet optimal interconnectivity and interoperability would not always be self-generating. For example, a systems integrator may pick different technical standards and protocols, either for reasons of sub-optimization, as part of competitive strategy, or due to vertical links into equipment manufacturing and carriage. In the past, while manufacturers competed, including in standards, carriers cooperated (being territorial monopolists) to maintain technical compatibility. In a system of systems, economic theory suggests that it is impossible to say in advance whether a convergence to compatible standards will take place. Where it does not occur one must weigh the cost of incompatibility against the benefits of flexibility. Similarly, there can be a problem if quality standards vary across interconnected networks, with some providing low quality that negatively

affects others, or others setting excessive requirements for interconnecting into them. Setting floors on quality would also protect against costs-cutting largely based on a reduction of the operational work force.

4.0 NEW PROBLEMS?

What new type of problems might be associated with 'systems integrators'?

Integrator Power? If there are strong economies of scale and scope in systems integration, only a few large firms would survive. In theory, integrators with market power might sell only a full range of services to the end user, charge monopolistic prices, force a carrier to enter into exclusive arrangements, or control access to the "tele-mailbox." These are fairly standard problems of vertical extension of market power in one stage of production into other stages. Without such underlying market power no market distortion would be sustainable. Such problems, if real, could be dealt with through regular antitrust enforcement and consumer protection.

But in any event, is market power in systems integration likely? Sources of market power might be the ability of a large systems integrator to get advantageous rates from carriers or to set aside proportionately less spare and redundant capacity by averaging out demand spikes across its more numerous customers. On the other hand, any customized service operation requires close attention to and contact with customers, and this factor does not favor large-scale firms. Generally, it is hard to imagine that the nature and shape of economies of scale are similar for each layer of the hierarchy of communications services, from basic transmission up to computer-based applications.

A more threatening potential for the exercise of power by a systems integrator would be if it controlled the tele-mailbox described above — the termination point for a variety of communications links to the user. As our earlier discussion pointed out, it is likely that the systems integrators would operate these tele-mailboxes and their connecting links to the user. It would be a natural extension of LAN systems. Such control would give them the opportunity to prevent the communications carriers or systems integrators to reach the user. In other words, they would be able to create a new bottleneck! Indeed, they would be able to extend this control upstream into other parts of the communications network system. To prevent this from happening, the operators of tele-mailboxes would have to grant equal access and interconnection to other communications providers. In other words, the tele-mailbox would have to be a common carrier, though the carriers terminating into it need not be.

Another issue of integrator power could be their hold over customers. For example, they might mislead unsophisticated users about performance

characteristics and prices. And they might lock them into contracts or equipment from which it would be expensive to withdraw, thus reducing the potential for exit by dissatisfied customers. These issues of consumer protection can be dealt with, like others, by general consumer protection agencies or specialized public consumer departments. In addition, small users might be effectively represented vis-a-vis a systems integrator by some aggregators, such as a union, a church, or a building association.

Thus, integrator power, while theoretically possible, it is not likely.

Carrier Power: The key question for the role of traditional carriers in systems integration is the nature of market power which they might exercise. Competitive systems integration requires competitiveness in each important stage.

Carriers functioning as systems integrators could favor their own segments of service or equipment. Furthermore, their advantages include advance information, established customer relations and goodwill, brand identity, reduced transaction costs under one corporate roof, and the foundation of a major transmission element. ~~① — contained into one~~ by ~~per se~~

Do they also have advantages of size? We have to distinguish between economies of scale in systems integration, and in the underlying transmission elements. The latter would benefit independent systems integrators, too, as long as they could obtain capacity on the same terms as the carrier's integrator service. However, these advantages are also a burden. In a competitive environment, it is more likely that independent integrators will have a competitive advantage over established companies who promote their own services over lower-priced independent offerors. To be truly competitive as a systems integrator, a traditional carrier's systems integration operation must be willing to compete against its own carrier and in effect become independent. While this might be conceivable, it might require significant rethinking. Such re-thinking has recently begun in the U.S. telephone industry. The Rochester Telephone Co. has proposed to separate itself into a carrier (R-Net) open to all, and a services operator (R-Com); Ameritech proposed to separate its carrier from its switching functions, subject to several conditions.

Looking at the reverse side of a vertical relationship, couldn't a carrier provide preferential service to its own systems integrators? In a competitive environment in a commodity service it is not economically rational to limit one's sales to one's own outlets. And where market power exists in the carrier's service segment, regulators are likely to assure non-discriminatory service. It will be easier for new firms to enter in a system of systems integrators if they do not have to build an end-to-end network, but simply resell or broker the production of others, or if they can have others market their own production. Thus, a system integrator system should enhance competitive entry for carriers.

The competitive advantage of the established reputation of traditional carriers should not be overestimated. All of them are geographically specialized while their customers are internationally minded. They have only limited experience in advanced value added services. And they may have only a limited track record in advanced computer equipment and applications that would increasingly be an integral part of a systems package. One must resist the temptation to think in narrow telecommunications terms when it comes to integration. Traditional carriers may have the edge in the lower three layers in the OSI hierarchy. But as communications include more and more upper level elements, they are more often than not in uncharted waters. A customer might well prefer a computer firm to a telecom carrier, reasoning that it is easier to migrate down rather than up in the OSI hierarchy. This might be the reason why computer-based firms are serious players in the systems integration business, for example Digital, IBM, or EDS. Digital, for example, replaced Sprint as the systems integrator for Citicorp's global network. Other systems integrators are high technology firms such as GE, or defense contractors with a desire for civilian diversification, and with experience in large-scale turnkey projects. For example, Martin Marietta was a bidder for the U.S. federal government's huge FTS-2000 network project.

Thus, it does not seem likely that a carrier would be dominant in systems integration; but if extension of market power is real, other protections could be instituted. Again, there will be much need for creative rethinking of new policy approaches.

International Asymmetry: The system of systems works as long as it is competitive in each of its stages, or as long as regulation establishes non-discrimination. However, in an international setting neither of these conditions is likely to be met. Most countries lag the U.S. and Japan in the evolution of networks. The traditional monopoly carrier is almost always firmly entrenched, and operating in all stages of communications. In consequence, systems integrators cannot truly compete against these governmental or semi-official Public Telecommunications Organizations (PTOs) in systems integration, except in market niches. This might be considered to be an internal issue for these countries, except that it has a global anti-competitive impact. This is because some of these PTOs are aggressively pursuing international systems integration themselves, while at the same time holding gate-keeper powers over entry into their own home markets. Thus, the PTO of an important European country could restrict the effectiveness of an American systems integrator to offer global services, while at the same time entering the more liberalized environment in America. It could also operate to benefit the interests of allied equipment manufacturers.

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Of course, other countries' PTOs can play the same game, and as a result a new trend of international carrier collaboration has emerged in which major PTOs enter into joint ventures of systems integration. Potentially at

least, these alliances of dominant national carriers could create international cartels, and barriers to competitive entry of other systems integrators, whether in their home countries or internationally. It has the anti-competitive potential of "whip-sawing" in which a one-sided liberalization across frontiers permits the remaining monopolist to fully appropriate the previously shared monopoly profits. To prevent this it is essential to press internationally for non-discriminatory access, lease, and interconnection arrangements that are neutral as to the nature or the nationality of the systems integrator. The U.S., being the largest and most interesting market for systems integrators, can exercise leadership in pressing for such reciprocity.

5.0 WHERE DOES THIS LEAVE STATE REGULATION?

In the United States, the traditional State regulatory role in telecommunications was for near-distance, wireline, low ISO-layers, single carrier type of communications. But communications are moving to distance-insensitive, multi-path, upper-layers, multi-carrier system. True, the 1934 *Communications Act* does not change, and states win a few battles in the courts. But sooner or later, the reality of the new telecommunications environment will catch up. States should therefore be ready to define what their role should be.

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The openness of the evolving network system will not stop at the national frontiers. Telecommunications will transcend the territorial concept, and the notion of each country having full territorial control over electronic communications will become anachronistic. Communications are becoming distance-insensitive. Systems integrators will reroute and arbitrage traffic in the most cost effective ways. This undermines attempts to administratively set rules for prices and service conditions. No country can be an island anymore. It will be difficult in such a global environment to develop a United States policy to make it stick internationally, and domestically.

Recalling the list of regulatory tasks, which are best suited for the states? Raising revenue for a revised system of subsidies would be best done nationally (or with a national floor) to avoid inefficient routing or diversion of traffic in order to circumvent a state-specific tax. On the other hand, the revenue collected nationally could be distributed through state universal service funds in accordance with their priorities, and States could add their own redistributive mechanisms.

Similarly, common carriage principles should be national, or else we will create a balkanized flow of information. Interconnection should also be set by national rules, though some regional variation would be tolerable, except for technical standards. The dealing with market power of domestic systems integrators and carriers is best accomplished by federal anti-trust

agencies and equal access rules. On international issues, a purely Federal role seems natural.

A state role is most critical in the area of consumer protection, where consumers may need help in dealing with systems integrators who misrepresent performance, charge incorrectly, or are difficult to dislodge because of the nature of their contract with users. In this area, State regulators and consumer advocates need to engage in a new generation of problem-identification and resolution. It is likely that many of the protection functions will migrate from specialized utility commissions that regulate large utilities to more broad-based consumer protection agencies applying general principles of business fraud, etc. An example are the providers of alternative coin telephone service or "900" services. In both cases abuses occurred which required consumer protection efforts beyond utility regulation.

The problem is not merely fraud. For example, my own university, Columbia, runs its own private telephone system. It resells services to customers (students and faculty), setting rates often higher than the public network's bulk rates. It dictates the kind of services available. It chooses the kind of equipment that can be interconnected — exactly four kinds of terminals, one color only. (Does this sound familiar?). And forget about answering machines or other specialized terminal equipment. Columbia could refuse service to a radical political group. It could censor the messages in electronic mailboxes.

Columbia does not exercise all of its powers; but while its self-restraint is laudable, it is no substitute for the checks and balances of a competitive or regulatory system. Petty monopolies can emerge, largely unencumbered by the protection built into the public network, at least in the past, by law, custom, regulation, and competitive pressures. Thus a set of new consumer protection questions is upon us, requiring new approaches.

6.0 CONCLUSION

The purpose of this analysis is to point out that the introduction of vigorous competition will not be the "end of history" as far as regulation is concerned, and that government is not likely to disappear from this area. In the 1980s, telecommunications policy was centered on open entry. This was correct then and now. But in the 1990s second-generation, or issues involving the integration of the various partial networks and services, will be at the forefront. A new type of service provider is emerging — systems integrators — which will change the nature of industry structure and consequently the nature of regulation.

None of these developments anticipated in this article will happen overnight, though some are already manifest. But this should not lead us to ignore and avoid understanding them. Opening telecommunications

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competition will prove to have been the easy part. Dealing with the consequences, and protecting traditional policy goals in the new environment with new tools will be the next and more difficult challenge.

REFERENCES

- Calabresi, Guido (1961) "Some Thoughts on Risk Distribution and the Law of Torts," *Yale Law Journal*, Vol. 70, pp.499-.
- Nozick, Robert (1974) *Anarchy, State, and Utopia* (New York: Basic Books).
- Posner, Richard A. (1986) *Economic Analysis of Law* (3d edition) (Boston: Little, Brown, and Company).
- Smith, Adam (1904) *An Inquiry into the Nature and Causes of The Wealth of Nations*. 2 vols. Edwin Cannan (ed.) (London: Methusen & Co., Ltd.).
- Von Hayek, Friedrich (1942) *The Road to Serfdom* (Chicago: University of Chicago Press).