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Beyond liberalization

From the network of networks to the system of systems

Eli M. Noam

Telecommunications are moving from the traditional monopoly, by way of the intermediate stage of a 'network of networks', to the stage of a 'system of systems' in which users are served by systems integrators that access each other. This environment will not be the 'end of history' as far as regulation is concerned, and government is not likely to disappear from this area. It would be naive to expect less regulatory tasks. Liberalization will not mean libertarianism. Opening telecommunications to competition, painful as it is, will prove to be politically and conceptually the easy part. Dealing with the consequences will be the next and more difficult challenge.

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This is the first in a series of three articles by the author to appear in *Telecommunications Policy* on the theme 'Beyond liberalization'. An earlier and partial version of this article appeared in *Regulation* magazine. The forthcoming articles are 'Beyond liberalization: reforming universal service' and 'Beyond liberalization: the impending doom of common carriage?'

Suppose the telecommunications infrastructure keeps evolving towards institutional diversification and technological upgrade. What then? At present the focus of attention is on restrictions – technological, regulatory, political and financial. Yet in the developed world the day is approaching, historically speaking, when many of these bottlenecks will be overcome – when entry by various service providers is wide open; fibre is widespread; radio-based carriers fill in the white spots in the map of telecommunications ubiquity; and global carriers operate beyond their home territory. In such an environment, what market structure can we expect? And what regulatory environment need we erect? It is time therefore to ask a fundamental question for future telecommunications policy: *After competition, what?*

The conventional scenario for the evolution of telecommunications, offered by traditional state monopoly carriers around the world as their vision of the future, was the *integrated single superpipe*, merging all communications infrastructure into a single conduit controlled by themselves and interconnected internationally with similar territorially exclusive superpipes. This scenario of integration took no account of the simultaneous organizational centrifugalism that was taking place, first in the USA and now increasingly in other countries. Instead of consolidating, the network environment kept diversifying. Take as an example local transmission, the segment widely considered to be a natural monopoly's natural monopoly. Yet today we can identify a wide variety of potential and credible participants for rival local transmission based on their entrepreneurial dynamism, and on economies of scope rather than on those of scale:[1] fibre-based metropolitan area networks; cable television providers; radio-based cellular carriers; electric utilities; long-distance companies extending their distribution plant; and other local exchange companies crossing territorial borders and invading each others' turf. Similar lists can be made for other physical segments of the network, whether they are in domestic, long-distance, international, mobile or switching.

The emergence of new networks is not simply a matter of technology

[1]For a view in support of economies of scale, see Peter Huber, *The Geodesic Network II*, The Geodesic Company, Washington, DC, 1992.

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or politics, but of the dynamics of group formation. As the system expands, political dynamics lead to redistribution and expansion. This provides increasing incentives for some users to exit from a sharing coalition, and to an eventual 'tipping' of the network from a stable single entity to a system of separate sub-coalitions.[2]

This view of success undermining its own foundations is basically Schumpeterian. From the monopoly's perspective it is deeply pessimistic, because it implies that the harder their efforts and the greater their success, the closer the end to their special status is at hand.

The role of systems integration

Yet liberalization of physical entry is not the end of the story, only its beginning. Competition begets diversity; diversity begets complexity; and complexity leads to efforts at simplification. Thus the challenge is how the actual user of telecommunications will handle an environment that is so different from the technologists' model of the single superpipe. How can the numerous network pieces be integrated into a usable whole? There are several ways to do so.

Users' self-integration. At a very basic level, this is today's system for US users, who arrange for their own long-distance carrier and equipment. Large users often put together networks on their own, by leasing lines, buying equipment such as PBXs and LANs, and managing it. Self-integration gets complicated very quickly as the number of carriers, services, prices and equipment options multiplies. A related technique has the user's terminal equipment incorporate some built-in intelligence which can make the right choices among carriers and services on a real-time basis.

Carriers' integration by expansion. Carriers could enter horizontally into new geographic markets or vertically into new services – by expansion, merger or acquisition. 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. This has led to a variant, namely joint ventures among carriers, where several companies specializing in different market segments link up with each other through institutionalized cooperation.

Integration by systems integrators. Perhaps the most promising way of putting together the various bits and pieces of networks and services is for a new category of 'systems integrators' to emerge who provide the end user with access to a variety of services, in a one-stop fashion. They relieve customers from the responsibility of integration for which expertise is required, and yet are not captive to recover major investments as carriers are. These specialized integrators, whose predecessors are known as outsourcers or managed data services providers, might typically assemble packages of various types of services, equipment, etc, and customize these packages to the specific requirements of their customers. They could operate a least-cost-routing system, switching users around from carrier to carrier, depending on the best deal available for a given time and route. Likely to emerge are domestic and international markets in transmission capacity, in which contracts in

[2]Eli Noam, 'Network tipping and the tragedy of the common network: a theory for the formation and breakdown of public telecommunications systems', *Communications and Strategies*, No 1, 1er Trimestre 1991, pp 43–72.

capacity are traded, with both consisting of future options and a spot market operating in real time.

The characteristic of 'pure' systems integrators – for there will 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 them to the customer on a one-stop basis. They resemble, in part, today's resellers, but they do much more. They relieve customers from the responsibility of integration for which expertise is required. To these customers, the identity of the underlying carriers and their technology might be unknown and transparent as transmission becomes a commodity.

Who will be the telecommunications systems integrators? They are likely to be a diverse lot. Some might be today's resellers and value-added providers, computer systems providers, defence contractors seeking diversification, and corporate networks with excess capacity. Others would obviously be carriers themselves, such as local exchange companies, long-distance and international telephone firms, cable television operators and metropolitan area networks. Their integrator function, however, is very different from their carrier function, as will be discussed below. All are likely to compete and to collaborate vigorously with each other.

Governments can also be system integrators, either directly by operating their own network systems, or indirectly by supporting new types of non-governmental integrated applications. The Internet is an example. A public Corporation for Network Applications could be the vehicle to encourage such efforts.

Today, systems integrators already exist to some extent for large customers and customer groups. But tomorrow systems integrators may put together individualized networks for personal use, or *personal* networks. These 'PNs' would offer individually tailored 'virtual' and physical network arrangements that serve individualized communications needs and provide access to frequent personal and business contacts, data sources, e-mail, user groups, transaction programs, video and audio publishers, data processing and storage, bulletin boards and personal information screening. A systems integrator is also likely to provide residential users with a *tele-mailbox* – a customer's telecommunications node at or near their premises – into which various communications flows terminate.

As these integrator-provided networks develop, they access and interconnect into each other and form a complex interconnected whole sprawling across carriers, service providers and national frontiers. In the process the telecommunications environment evolves from the 'network of networks', in which carriers interconnect, to a 'system of systems', in which systems integrators link up with each other. The Internet is an early example.

This evolution has begun in the USA. The Rochester Telephone Co, a medium-sized independent telephone company, has proposed to separate itself into a carrier (R-Net) offering transmission to all, including its competitors, as well as a services operator (R-Com) which would offer the actual service to customers. Rochester couches this proposal in the language of 'wholesale' and 'retail'. But clearly, R-Com will offer packages that contain much more than R-Net's services. Inevitably it will become a systems integrator.

Regulation

Where does such an arrangement of customized networks managed by systems integrators leave government regulation? How does it deal with real virtuality?

Regulation had been essential to the old system, partly to protect against monopoly, partly to protect the monopoly itself. In the transition to competition, what was left of regulation was seen as temporary, shrinking reciprocally with the growth of competition. In time, it would diminish to nothing. Yet can one expect the 'system of systems' to be totally self-regulating?

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 major insight as a thinker.[3] Its importance goes way beyond economics. 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. Yet the more complex and advanced an economy becomes, the more difficult it is to guide it centrally. Complexity is neither a necessary nor a sufficient condition for justifying centralized control.

On the other hand, there is also the opposite and simplistic view that more advanced technology, merely by creating new options, makes all regulation unnecessary. But consider new chemical products 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 or market failures.

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. To assure various policy objectives, such as the free flow of information across the economy and society and technological innovation, regulators and courts instituted a variety of regulatory policies, such as universal service with rate subsidies, common carriage, interconnection rules, quality standards and limited carrier liability. But in a system of system integrators, what forms of such regulation, if any, are still necessary?

In traditional telecommunications, regulation by government existed partly to affect 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. In return, the dominant carrier, whether private or governmental, received protection from competition by other providers. 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 towards carriers. They can protect users against carriers' underperformance and power, and get them the best deal. This would largely resolve traditional

[3]Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, 2 vols, ed Edwin Cannan, Methuen, London, 1904.

problems of price, quality, privacy and market power. 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 control declines drastically.

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

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. With competing carriers, an internal redistribution is not sustainable once other carriers without redistributive burdens target the subsidizing users 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 inversely 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.

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 arbitrageurs in demand elasticity. This is also likely to increase their attractiveness to customers in comparison to 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 carrier, would end up bearing a greater cost share. Also, systems integrators, absent some support mechanism, would de-average prices for their customers and charge, for example, rural customers a price that reflects the greater cost of serving them.

Yet this need not spell the end of support schemes. If, for various reasons of policy or politics, one wants to subsidize some categories of service or users, it is still possible to do so, only in different ways. One alternative mechanism might be a communications sales or value-added tax. The moneys raised might go to a 'universal service fund' which would be used to support certain services or categories of users. Benefited users could receive, for example, a 'virtual voucher' that could be redeemed at the various competing carriers, and which would make them, too, interesting to the new carriers. Such a system would replace the present hidden tax system and would make it accountable.

Interconnection and financial viability

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 normally granted by incumbent firms. That is the lesson of decades of US experience. Regulatory requirements such as open network architecture, comparably efficient interconnection or collocation were part of the evolution towards competition, and towards an increasing unbundling of hardware and software segments. In effect, these provisions regulated in order to deregulate.

One problem here is technical interconnectivity. In a system of systems, integrators may well pick different standards and protocols, either for reasons of sub-optimization or for strategic–competitive reasons. This can be exacerbated by vertical links. If they are part of equipment manufacturers, their standards may try to further their equipment vending strategies. And where the systems integrators are controlled by monopolistic carriers, standards may be set to provide advantages in integrator competition. Will market forces be sufficient for a convergence? Not always. 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. In some instances the former would become too great, and interoperability may have to be instituted as a default standard, just as it is for other economic arrangements such as in the law of commercial transactions.

Assuring physical interconnectivity will be hard enough. But still harder will be financial interconnectivity. The first problem is that in a competitive environment systems integrators need to 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 the bulk of cost in a capital-intensive industry such as telecommunications networks is fixed, and would not get compensated in such an arrangement. In a world of transmission as a commodity, carriers would not break even.

Interconnection rights accelerate this development. An initial investment is less likely if a loss were entirely borne by the first carrier, while the benefits would have to be shared with other entrants who would be able to interconnect and thus immediately gain access to the critical mass created by the first carrier. The implication is that in an environment of multiple networks which can interconnect, less start-up investment would be undertaken. It pays to be second. A situation of market failure exists. The long-term result would be either a disinvestment in networks, the re-establishment of monopoly or oligopolistic pricing. Because none of these scenarios is desirable, they would lead back to various regulatory schemes, and even to a direct outside subsidy for the early stage of a new network service.

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.[4] The implication is that common carriage, as the product of common law judgments later codified by statutes, was an economically efficient institution. Among its purposes were reduction of market power, protection of an essential service, protection of free flow in goods and information, promotion of basic infrastructure, reduction in transaction cost, and limited liability.

The blows to traditional common carriage do not come from new rival telecommunications carriers, 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. The other challenge to common carriage is the systems integrators we have discussed. 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 because, among several other reasons, it cannot use differentiated pricing due to its non-discrimination obligation, it cannot prevent arbitrage and it cannot pick its customers. As a result a systems integrator may provide services more cheaply, even though it uses 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. And that is, indeed, what is already starting to happen.

What are the implications? The system of systems might have the technical capacity for a large number of voices, yet it may still result in a narrower spectrum of information if systems integrators have gatekeeper powers. 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 sub-networks 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.

New problems

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.

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

[4]See eg Richard A. Posner, *Economic Analysis of Law*, 3rd edn, Little, Brown, Boston, MA, 1986; and Guido Calabresi, 'Some throughts on risk distribution and the law of torts', *Yale Law Journal*, Vol 70, No 499, 1961.

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 favour large-scale firms. Generally, it is hard to imagine that the nature and shape of scale economies are similar for each layer of the OSI hierarchy of communications services, from basic transmission up to computer-based applications. Thus integrator power is unlikely.

A more threatening potential for the exercise of power by a systems integrator would be if it controlled a tele-mailbox described above – the termination point for a variety of communications links to the user. To prevent this from happening, the operators to tele-mailboxes would have to grant equal access and interconnection to other communications providers. In other words, the tele-mailbox would have to be an open platform.

Another issue of integrator power would be their hold over customers. For example, they might mislead unsophisticated users about performance characteristics and prices. Such issues of consumer protection can be dealt with by consumer protection or public service agencies.

Carrier power

Carriers functioning as systems integrators could favour their own segments of service or equipment. Furthermore, their advantages include established customer relations and the foundation of a major transmission element. However, this base is 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.

On the other hand, traditional carriers have some advantages. These include the coordination of planning, advance information, established goodwill, and reduced transaction costs for operations under one corporate roof. Carriers which strengthen these advantages might therefore establish themselves as competitors in systems integration. Yet what about 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.

Where monopoly power persists in any transmission segment, end-to-end competitiveness would have to be assured by the imposition of non-discriminatory access to these segments. But with such standby safeguards available, there should be no problem of having carriers operate as system integrators.

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 behind the USA and Japan in the evolution of networks. The traditional monopoly carrier is usually firmly entrenched,

and operating in all stages of communications. In consequence, systems integrators cannot truly compete against governmental or semi-official public telecommunications operators (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 gatekeeper powers over entry into their own home markets. Thus the PTO of an important European country could restrict the ability of a US systems integrator to offer global services, while at the same time entering a liberalized environment in the USA.

Of course, other countries' PTOs can play the same game, and partly 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. 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.

Conclusion

Telecommunications are moving from the traditional monopoly, by way of a 'network of networks', to a 'system of systems' in which users are served by systems integrators that access each other. This environment will not be the 'end of history' as far as regulation is concerned, and the government is not likely to disappear from this area. It would be naive to expect less regulatory tasks. Liberalization does not mean libertarianism.

In the 1980s telecommunications policy was centred on open entry. This was correct then and now. But in the 1990s second-generation issues involving the integration of the various partial networks and systems will be at the forefront. This means dealing with the impact of the systems integrators that will emerge, as this article has argued, as the central elements of the future telecommunication structure. Their influence will eliminate the need for many regulatory actions, but will keep some and add others. What will be left includes responsibility for:

- reform of universal service;
- interoperability;
- physical interconnection and access;
- free flow of information content;
- prevention of oligopolistic behaviour;
- network investments where market failure exists;
- international coordination.

None of the developments anticipated in this article will happen overnight, though some are already manifest. But policy wisdom meets the prepared. Opening telecommunications to competition, painful as it has been, will prove to be politically and conceptually the easy part. Dealing with the consequences will be the next and more difficult challenge.