Telecommunications Services:
Industry Directions and Regulatory Implications

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Over the next 15 years, the telecommunications services industry will achieve dramatic growth in both new services and revenues – with significant implications for nations, businesses, and individuals around the globe.

Arthur D. Little studies in Europe, Asia, and the Americas reveal that the industry will expand at rates averaging more than 5 percent per year, compared to 4 percent per year over the past ten years, and that regional growth rates will be as high as 7-8 percent (in Europe, Asia, and Africa). Furthermore, the industry will play a much more dynamic role in local and world economies, in part because of the enormous restructuring now under way throughout the world – in which public sector monopolies are being transformed into deregulated, competitive enterprises – and in part because of the opportunities made available by new technologies.

Although these changes will dramatically affect the way we lead our lives, they have received astonishingly little attention. Neither governments nor corporations have taken significant steps to prepare for them. In this article we take a look at where the industry stands today and where it's going in terms of technology services, and regulation.

Emerging From the Stone Age

The telecommunications industry today may be thought of as just emerging from the Stone Age, and the telephone network as analogous to a blunt stone ax. The latter has been with us for so long that we are inured to its basic limitations:

• The network allows you to call a place, not the person you want to reach, who may or may not happen to be at the place you call. Mobile telecommunications services have proven so popular because they attempt to address this fundamental limitation – but at a considerable price and (so far) with poor quality.

• The network allows you only to talk (and, with fax capability, to write); it cannot support the substantial visual component that is essential to effective communication.

• The network is the processing bottleneck in business computing; the speed of processors has improved more rapidly than that of available telecommunications services.

Service providers are attempting to hone this blunt instrument with various customer calling features, such as call waiting, call forwarding, and voice messaging, and with overlay data services. However, to use these features, people must learn a whole new algebra in which the symbols vary from one country to another and appear to lack any logic.

The industry is now poised to overcome these limitations. Within the next 10 to 15 years, it will move from the Stone Age into the Middle Ages and on to the Industrial Revolution, conveying significant benefits:

• Ubiquitous, reasonably priced broadband communications supporting the universal availability of voice, data, and image-based services

• Truly personal communications based on inexpensive, lightweight mobile handsets, individually programmed to deliver tailored services that meet subscribers' needs – wherever they are

• Business communications in which the network and the processors with which it interconnects will be evenly matched in terms of power

Underlying these changes are some exciting technologies.

The Enabling Technologies

The key technologies that will drive the transformation are:

• Fiber optics

• New switching and networking protocols and systems software

• Microcellular wireless and low-orbit satellite technologies

Underpinning these key technologies are digital switching and transmission technologies, which have become base technologies in that they are now fairly generally available. They are all competition-friendly technologies. (For further discussion of technologies, see the article by Phil O'Donovan in this issue of *Prism*.)

Fiber optics. National and regional telecommunications corporations („telcos") will begin installing „fiber to the curb" (a little short of „fiber to the home") within the next few years, as passive optical systems become

cheaper than metal loop. We predict that sometime around 1995 (varying from one telco to another), the decision will be made to deploy fiber fully. That is to say, from that date on, all refurbishment and new plant will be by fiber. By 2010, 60 percent of the loop between the service providers and the curb in Europe and North America will be fiber. To achieve this conversion, no special financing is needed; telcos merely need to continue to invest at current levels in maintaining and expanding their cable loops.

The fiber installed to the curb will be extended into the home when the cost of electro-optic components comes down sufficiently to allow widespread networking of broadband services supported by fiber optic connections directly into the home.

New services made possible by all this fiber will generate new revenues that, in turn, justify an increased rate of installation. One new service that could be carried, of course, is television. Many telephone companies in the United States and Europe see such fiber optic connections as the means to compete with existing cable TV systems in the future. Conversely, cable television providers are now beginning to offer telephone service, particularly in the United Kingdom, where the regulator has encouraged this service offering in order to create competition in local exchange telephone service. Similarly, the New York Public Service Commission recently required New York Telephone to offer interconnection at its switches to the fiber optic local distribution network of Teleport Communications, Inc.

Significantly, fiber to the home, unlike the old metal loop, need not be hard-wired to a single local switch. Instead, it could allow residential subscribers to access many remote switching service providers over a single local cable network, with the connection between individual subscriber and switch being established by software (Exhibit 1). For example, a subscriber in Boston, who currently receives all his or her telephone service through New England Telephone, could choose to connect directly to a mobile or wireless access provider without passing through New England Telephone's switch.

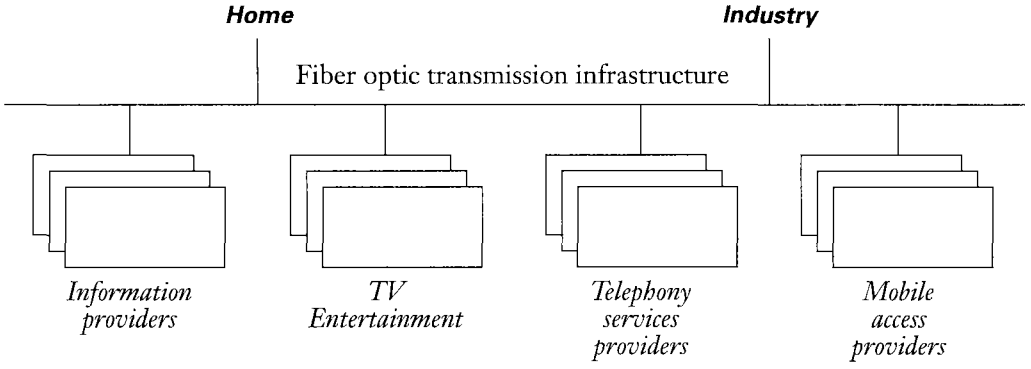
This system would be far more flexible than the current „equal access" facility, which generally allows subscribers to choose only their long distance providers, and only by way of the telco, which controls the switch and provides the dial tone. Fiber loops would allow subscribers to make this choice directly and also to choose among competitive suppliers of residential „dial tone." Similarly, the fiber installed for telephony will be TV-capable and could be configured to allow access to a large number of entertainment providers, reducing the barriers to entry in that business.

A complete fiber infrastructure engineered to support multiple service providers would permit the transmission system to resemble a highway system supporting many different types of business and pleasure traffic, rather than resembling, as it does now, a railway network where the owner of the tracks also owns the freight and passenger wagons. This kind of open, competition-friendly infrastructure is essential to the development of the service industries.

Switching and networking protocols and software. A number of new technologies can add significant functionality to the network. SONET (synchronous optical network) in the United States and SDH (synchronous digital hierarchy) in Europe are the basis of the new synchronous networks that will be put in place later in the 1990s. These networks offer a substantially higher level of network management and bandwidth allocation capabilities than today's plesiochronous networks. SDH enables telcos to reconfigure the network dynamically and add or remove circuits and subscribers without having to reconfigure the physical network.

Exhibit 1

Open, Competition-Friendly Infrastructure



Asynchronous transfer mode (ATM) is the basis of highly flexible broadband network services. ATM supports very-high-speed data communications on a „connectionless" basis – i.e., without requiring a prearranged dedicated access line. Signalling System 7 (SS-7) facilitates the implementation of intelligent network services. SS-7 enables information about the call to travel independently of the call itself.

These technologies take advantage of the enormous capacity of fiber. Once they are in place, adding another subscriber is just like adding another vehicle to a motorway. At present, adding a subscriber may involve creating a new physical circuit – adding a new lane to the motorway.

Microcellular wireless and low-orbit satellite technology. In parallel with these advances in fixed network communications, the race is on to develop truly personal worldwide mobile communications networks (Exhibit 2). These are likely to be based on cellular technology using small cells (anything from tens of meters to hundreds of meters, compared to several kilometers and upwards today) and higher frequencies (around 1.9 GHz**,** compared to 800-900 MHz today). Smaller cells permit the system to reuse frequencies more often and to use much smaller handsets, since each handset will be closer to a base-station and therefore will need less power than in larger cells. The net effect is that many more subscribers can be added to the system.

Exhibit 2

Personal Communications Networks

Feature	***Today's cellular mobile***	***PCN***
Cell size	*Several kilometers +*	*Hundreds of meters +/-*
Frequency	*800-900 MHz*	*Around 1.9 GHz*
Handset weight	*Pounds*	*Ounces*
Programmability	*No*	*Yes*
Pricing	*Premium*	*Basic*
Quality	*Poor*	*High*

The new PCS (personal communications service) handset will be smaller and lighter than an empty wallet. It will contain a removable smart-card individually programmed with the subscriber's service requirements (e.g., refuse all calls during working hours except calls from selected numbers) and also programmed to handle billing and charging automatically (e.g., containing a set amount of prepaid stored value).

Clearly, PCS technology will place enormous demands on computer-based tracking systems and hand-over protocols. However, the influx of many more subscribers will reduce per-user costs. PCS costs, in today's money, are expected to be nearer the costs of today's fixed communications than today's high-cost mobile services. In addition, the use of low-orbit satellites will permit truly worldwide mobile communications – whether the caller is in downtown Manhattan or on a desert island. (For further discussion of mobile communications, see the article by Clifford Bean and Malcolm Ross in this issue of *Prism.)*

The Services and Their Impact

The general trend will be to use mobile technologies for simple person-to-person voice communications and fixed communications networks for broadband, image-based communications. The latter might include, for example, videotelephony, such as the ability to connect your video camera to show your grandparents in a distant land around your new home. It will certainly facilitate entertainment distribution (e.g., dial-a-video from your specialist entertainment supplier, who will have a range of programs recorded on optical discs and whose programming will be published in a directory similar to today's telephone directory).

Similarly videoconferencing will form a natural extension of videotelephony, far less awkward and expensive than it is today. A range of video-based business applications can be envisaged.

Of course these services will raise or reawaken a host of public policy issues in areas such as privacy, security, pornography, and others, which are beyond the scope of this article. (For further discussion see the article by John Magee in this issue of *Prism.)* Legal, regulatory and politically motivated decisions can have a significant influence on the rate of deployment of new services, as the current controversies in the United States about the

appropriateness of caller identification services demonstrate. Which „rights“ should prevail: the caller's right to privacy, or the right of the person being called to know who is calling and from where? Such issues may be resolved differently in different countries, states, and local regions. Network operators and service providers must develop business strategies and tactics to cope with these diverse local conditions.

Intelligent networking features will shift from today's call waiting, call forwarding, and similar services to the personal numbers of tomorrow. We predict that by 2010 a majority of the population will be using some sort of intelligent personal numbering service that ensures that calls from particular individuals follow the called party as he or she travels or are routed to voice messaging services when he or she chooses to be unavailable to a particular caller. These services will be supplied competitively, with the basis of competition for the suppliers being innovation rather than price. Some 40 percent of American households are willing to pay $60 a year today for the call waiting facility – almost half the subscription cost of a second line. In buying this service, they also do their telco a favor by eliminating a good portion of costly (to the telco) busy signals. The subscription revenues alone amount to some $2.5 billion a year in the United States. The increased usage generates about as much additional revenue, and all at minimal incremental cost.

If 40 percent of households will pay $60 per year for the optional call waiting facility, and if networked intelligence is capable of delivering services that offer considerably more value, it is clear that such features as personal numbers and incoming call screening may become important revenue earners for both fixed and cellular network operators as well as, perhaps, independent services providers.

These changes will clearly have major impacts on lifestyles. For example, improved telecommunications services will make it much easier for widely dispersed groups of like-minded people – from scuba divers to antique car buffs – to develop relationships and stay in touch. In addition, thanks to telecommunications, more people will be able to work effectively from home, or, more likely, to work in several locations, including home. The consequences of teleworking for corporate structures and relationships, and its impact on transportation systems, are far from fully understood, but are likely to be significant. (For further discussion of lifestyle changes, see the article by Heidi Bomengen and David Fishman in this issue of *Prism.)*

Competition and Regulation

Intense competition will be needed to stimulate the development of these services at affordable prices. This competition, in turn, will require a much more competition-friendly infrastructure containing the capability of very-high-speed, high-capacity networks, mostly based on fiber optic systems. Today's infrastructure is competition-unfriendly. In most countries, it is still based on connecting a telco's customers to the telco's subscriber lines to the telco's switches, which are connected to the telco's transmission facilities.

However, the United States, the United Kingdom, and Japan have opened their long distance networks to competition, and other countries are moving in that direction. The prospective competition-friendly infrastructure model treats the fiber to the curb and transmission systems as common highways to be used by all kinds of service providers, including switching services. Because telcos may not, of their own accord, wish to put in competition-friendly infrastructures, growth-oriented (and initially interventionist) regulation is essential.

For example, digitalization is a competition-enabling technology, as it facilitates interconnection. In Japan, the regulator insisted that NTT advance its investment program so that digitalization of switches could be completed by 1998, three years earlier than NTT's most ambitious plan. Allowing NTT to generate additional revenues to pay for the conversion of the infrastructure to a digital highway, effectively reducing the scope of its monopoly in the long term, seems to be a most satisfactory use of regulation.

Other countries can learn some lessons from the experience of Japan and the United States. Both countries now have competitive long distance infrastructure operators. They both have been able to adjust the interconnect arrangements to bring about an orderly, albeit significant, loss of market share by the incumbent. They have also sustained healthy competitive pressure on a number of new entrants who have been forced to adopt widely differing competitive strategies.

In both countries, the powerful local operators (NTT in Japan and primarily the seven regional Bell telephone companies in the United States) do not have a legally enforced monopoly. Nevertheless, they are subject to heavy regulation because they are dominant by virtue of having a very high market share and enjoying the advantages of incumbency.

In both countries, the regulators feel that they have the final say in major investment programs undertaken by the dominant local carrier. We do not mean that the regulators behave like typical Ministries of Finance did previously, limiting overall investment, but rather that they influence the choice of technology and business strategies.

Interestingly, in the last few years there has been a partial convergence of regulation between Japan and the United States. This convergence is far from complete because Japan, while not afraid to adopt systems that are

„not invented here," is nevertheless careful to adapt or improve them in light of its local conditions. For example, Japan is concerned not to incur the continuing legal and regulatory overhead that is associated with U.S. telecommunications.

It is significant that Japan seems to have taken advantage of the good and bad points of the U.S. experience. The major difference is that Japan learned from the U.S. divestiture experience not to force NTT to divest (at least not yet), but rather to place it under more or less permanent threat of divestiture unless it implements many of the changes that divestiture was designed to bring about, such as reasonable interconnection with competitors and separate accounting for different segments of its business.

In this approach, of course, Japan's regulator has had the great advantage of being able to point to a previous example overseas (i.e., the United States) of what was likely to happen if a dominant telco were consigned to the mercies of the judicial system. Japan has therefore reaped some of the benefits of divestiture without the high legal and regulatory costs that this has entailed in the United States.

Also, Japan has no prior ban on participation by NTT in information services or enhanced services, which, it seems to us, has the merit of not requiring the regulator to define them, a task that sometimes seems as impossible and meaningless as the medieval argument about how many angels can dance on the head of a pin.

There is strong political pressure in the advanced countries to reduce tariffs for ordinary basic telephone service, as befits a utility in continuous expansion and with a falling cost base. On the other hand, U.S. and Japanese regulators seem eager to let the tariffs for optional new features float upward toward „what the market will bear" – a phrase that would scandalize many other regulators when applied to monopoly-provided services. Examples of „luxury" options include call waiting and touch-tone (multifrequency) dialing.

We should also point out that in most developing countries, where few new or optional features are available, pressures to raise unrealistically low local service tariffs are resisted for political reasons by state-controlled telecommunications administrations. This is a main reason why telephone networks are so poorly developed in these countries.

One of the best examples of a market-oriented tariff in use in Japan and the United States is the charge for subscriber use of touch-tone or multifrequency pushbutton telephones. Computerized switches can easily respond to this new alternative to the older „make and break" rotary dial telephone scheme at no extra cost. Users can keep their old telephones, but if they decide to change to touch-tone instruments, they save time in dialing calls and can also very easily access a host of other services from voice mail to menu-driven information services. In Europe there has been a more purist attitude toward tariffing, based in part on the belief that a service should not be charged for until it is available for everyone, and secondly on the principle that charges for monopoly services should be based on cost (i.e., minimized).

In contrast, the regulator in Japan says that the touch-tone tariff is cost-based, because a portion of the profit obtained from it must be reinvested in digital switches. This illustrates why cost is not always help-fill as a determinant of tariffs: tariffs can drive costs as much as the other way around. If there were charges for touch-tone telephones in Europe, European switch modernization programs could be accelerated to make this valuable feature available to everyone at a much earlier date, provided that European regulators were to take it upon themselves to dictate to the telcos how their revenues were to be reinvested.

However, from a marketing perspective, providing multifrequency push-button telephone service without additional charge may be the better strategy. This is because push-button telephones can be used as terminals to support new services such as audiotex, voice mail, and other revenue-generating services that are otherwise technically impractical. The operator must weigh the potential revenues from charging for touch-tone service itself against the potential revenues from new value-added services sold to the larger number of subscribers who would be attracted to „free" touch-tone service.

Although telcos are investing in technologies that are potentially competition-enabling, they may use them only to create more cost-effective versions of their present, closed infrastructures. Regulators can intercede to change this approach by taking two steps: allowing the commercialization of new monopoly services so as to maximize monopoly revenues, and dictating that these revenues be invested in competition-enabling versions of new technology, for example, „open" networks. Industry regulators may see the promotion of overall economic growth as their overriding priority. In that case, they will design regulation to achieve strategic, industry structure objectives. They will view flexible, market-oriented tariffing for innovative monopoly services, and active direction of telco investment plans, as important ways of promoting this growth. Universal service criteria and price controls will apply only to the most basic of services. This remaining *de facto* monopoly can be regulated by the simpler methods used in other utilities, such as electricity.

Over the critical transition period of the next 10 to 15 years, the challenge to the telecommunications industry will be to offer its customers the extraordinary benefits of new technology and open competition, while

safeguarding these same customers against increased costs and inconveniences that can be generated by intensive bureaucratic and legal regulation.

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