THE RESTRUCTURING OF TELECOMMUNICATIONS: TECHNOLOGY, ECONOMICS, AND POLICY

Peter Shields
Bowling Green State University, Ohio, USA

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Summary

In recent decades, the telecommunications sector has been transformed. This paper provides a perspective on key technical, economic, and policy dimensions of these changes. Particular attention is given to two recent developments pertaining to telecommunications networks: (a) the increasing sophistication of transmission and switching technology, and (b) the rapid proliferation of networks, including the emergence of the Internet. These developments, along with associated changes in industry structure, have created significant challenges for telecommunications policy makers. This paper considers two key policy issues. The first issue concerns the cornerstone principle of universal service. This is the notion that all citizens should have affordable access to a basic telecommunications service. Is the universal service concept still viable in an era of proliferating networks and growing competition? The second issue involves the rise of unprecedented privacy concerns that can be traced to the deployment of sophisticated network technologies.

1. Introduction

The telecommunications industry has been buffeted by dramatic changes in recent years. For most of the twentieth century, the provision of a narrow range of voice

telephony services (local, long-distance, and international) was entrusted to a large, vertically integrated monopolist: a public enterprise in most of the world, and a private, regulated corporation (AT&T) in the United States. All of this changed in the 1980s and 1990s with the rise of deregulation in the United States and the liberalization of telecommunications markets around the world. Worldwide, the competitive marketplace has now been embraced as the preferred means for organizing the supply of telecommunications services.

The emergence of a plethora of new technologies and services has accompanied this restructuring process. For example, the advent of high-capacity intelligent networks has multiplied the number of telecommunications service offerings (call number identification, home banking, Internet services, for example). Moreover, ongoing developments in digital technology are erasing the boundaries between telecommunications, broadcasting, and computer industries; digitization enables telecommunications operators to deliver digital audio, video, and text information over their networks, for example. Not surprisingly then, telephone, cable, broadcast, and computer companies are forging alliances across formerly rigid industry boundaries in order to take advantage of the new ways of doing business made possible by these technological developments. This convergence of technologies and industries is racing ahead of increasingly obsolete laws and policies that are rooted in the pre-convergence era.

This paper examines key technological, economic, and public policy dimensions of the seismic changes in telecommunications. First, the article tracks the evolution of the basic technological and economic characteristics of telecommunications networks. This is an important prerequisite for understanding the urgent policy issues that currently face the industry. Second, two key policy issues are discussed, namely the controversy concerning the provision of universal service, and the rise of telecommunications privacy and security concerns. Particular attention is given to events in the UK and the USA, as policy makers in these countries have pioneered new ways of managing the telecommunications "revolution."

2. Characteristics of Telecommunications Networks

Telecommunications involves carrying voice, data, or image signals between different users along networks. These networks consist of two key technological components: transmission equipment and switching technology. The characteristics of these components play an important role in determining the kind of services that can be provided over networks, and their cost. In recent decades, developments in transmission and switching have transformed the nature of telecommunications. These developments include a huge increase in the carrying capacity and intelligence of networks. In large measure, the latter can be traced to the emergence and deployment of digital switching. These technical changes have been accompanied by the rapid proliferation of networks.

2.1 Transmission

Until the 1970s, copper wire was the dominant transmission technology. Indeed, copper lines still link most users' premises to the local exchange. Copper lines are well suited

for carrying voice signals, but they have a rather limited capacity. This problem has been addressed, to some extent, by recent advances in data compression techniques such as asymmetrical digital subscriber line technology (ADSL). ADSL has allowed telecommunications operators to offer video programming as well as voice services, for example.

In the 1970s and 1980s, a new transmission technology, fiber optic cable, was substituted for copper wire on long-distance and international routes. Fiber optic cable offers huge savings over copper wire because it is has much higher capacity and is easier to lay. According to a recent estimate, the cost of laying submarine cable for intercontinental communications has decreased by a factor of 150 with the use of fiber optic technology. Much of the current discussion about the economics of network building centers on the issue of when it may be economical to substitute copper with fiber in the local exchange. In large measure, the answer will depend on how quickly consumers demand information services that will require fiber's greater capacity.

The electronic communication of voice, data, and image signals can also occur via wireless transmission technologies (satellite, cellular radio, microwave, personal communications services). Relative to wire-line transmission, wireless transmission offers end users the benefit of mobility. However, wireless transmission faces interference and bandwidth (capacity) problems. The bandwidth problem means that it will be difficult and costly to offer services that are more advanced via wireless equipment, at least in the near future.

2.2 Switching

Switches allow the routing of signals throughout networks. In the 1970s and 1980s, telecommunications operators began to replace traditional electromechanical switches with digital ones. Digital switching, which is based on the marriage of computer and traditional telephone switching technology, allows the electric paths through a telephone switch to be controlled by a program stored in computer memory instead of by the motion of electromechanical components. Digitization and computer control greatly increased switching quality and reliability. With digital technology, voice and data are conveyed in essentially the same way: that is, in electronic streams of zeroes and ones, or pulses and lack of pulses. The integration of voice and data traffic and the addition of video transmission services (video-on-demand, for example) will require switches that can handle a wide range of transmission speeds. Optical switching systems, which are currently under development, promise further increases in power and reductions in cost.

2.3. Signaling and Intelligence

A related key development has been the substantial increase in the intelligence of networks. In the era of electromechanical exchanges, signaling information (that is, coded information on such matters as the destination of calls and whether the called line is engaged) was conveyed within the same channel as the voice message. By contrast, in today's intelligent digital systems, a separate channel (out-of-band signaling) conveys this signaling information. This development, as well as the adoption of new signaling protocols (signaling system 7, or SS7) has permitted a richer set of offerings and more

utilization of networks. Plain old voice services are now complemented by a wide and rapidly changing array of new services; call number identification or "Caller ID," selective call forwarding, personal 800 numbers, selective call rejection or acceptance, and so forth.

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Biographical Sketch

Peter Shields is Associate Professor of Telecommunications at Bowling Green State University. He received his Ph.D. in communication from Ohio State University. His teaching and research areas include telecommunications policy and regulation, information technology and privacy, social theory and emerging media, and national security and telecommunications. Dr. Shields' work has appeared in such journals as *Telecommunications Policy*, *Media, Culture and Society*, *Gazette*, *Information Society*, *Policy Studies Journal*, *Communication Theory*, *European Journal of Communication*, *Journal of Communication*, *Media Development*, and *Media International Australia*. He is also coeditor of the book *International Satellite Broadcasting in South Asia: Political, Economic, and Cultural Implications* (University Press of America, 1998).