

Communication Technology Update

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August E. Grant, EDITOR

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August E. Grant, Editor

Jennifer Harman Meadows, Assistant Editor

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Editor	August E. Grant
Assistant Editor	Jennifer Harman Meadows
Cover Design	Deborah Morrison
	Peter-J. E. Noble
	Geoff J. Owens

Technology Futures

Managing Editor	Julia A. Marsh
Production Editor	Debra R. Robison
Art Director	Helen Mary V. Marek

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Preface

This is the fifth edition of the *Communication Technology Update*. Virtually every technology chapter has been completely rewritten from the previous edition, in part, to reflect the monumental rate of change in these technologies. Two other objectives were also paramount in creating this new edition. The total number of chapters has been reduced by combining similar and redundant information, thereby making it easier to understand the relationships among similar technologies. Each chapter has also been written with greater attention to understanding the history, structure, and trajectory of each technology.

As before, each chapter also presents the most recent developments in each technology, but this year's compilation is different from the previous four in that we plan to keep updating new developments using the *Communication Technology Update* Home Page on the Internet—<http://www.tfi.com/ctu>. The home page is designed as a supplement to the text, and it will provide links to a wide variety of information that will provide additional background and update developments that have occurred since publication of the text.

In order for the *Communication Technology Update* Home Page to be effective, we need your help.

If you work in or around the communications industry:

- Please send us the URL for your company's home page and any other on-line resource you believe provides a better understanding of your industry.

Preface

- Please send press releases and other information that updates any development discussed in the text.

If you are using this book as part of a college course:

- Please send us information on your course and any World Wide Web pages or other on-line resources created by your class or school so that we can “link” to your site.
- Please send us excerpts from student papers that discuss new developments since the *Update* was printed—we’ll publish them on-line with credit to the author and the university.

All users are requested to:

- Please send us any information on helpful links or information resources you discover that will help other users of the *Communication Technology Update* Home Page. (We’ll credit the first contributor of each link on-line.)
- Please send us commentary on any communication technology or development. We would like to use these to create an on-line “forum” that will contribute to understanding the technology.

This book uses a novel application of desktop publishing that allows us to have the book printed and for sale within two months after the last chapters are written. Because we know that changes in the technologies discussed will happen before the book is printed (no matter how fast we are), the *Communication Technology Update* Home Page has been created to provide up-to-date information no matter how long it has been since the chapter was written. If this experiment is successful, we plan to publish fewer editions of the printed text (allowing universities to use the same book for more than one term and professionals to have to buy fewer copies of the book), while still providing a complete picture of the latest developments in all areas of the communications media.

This compilation is the product of dozens of people who have worked right up to the deadline to provide the latest developments in all areas of communication technology. I’m especially grateful to my assistant editor, Jennifer Meadows, for the excellent way she worked with individual authors on their manuscripts to help achieve a coherent style throughout the text, as well as her management of dozens of text and graphics files. Although most of the chapters of this edition of the *Update* were written by specialists from universities across the United States, many important chapters were contributed by students in the Communication Technology and Policy sequence in the Department of Radio-Television-Film at the University of Texas at Austin. This text would not be possible without the fantastic team at Technology Futures, Inc., especially managing editor Julia Marsh, who developed the publication process that allows this book to go to

press so quickly. Finally I'm grateful to Chris, Bobby, and Pookie who have put up with a few weeks every year of unpredictable behavior on my part as the manuscript is nursed to completion.

Again, please use the *Communication Technology Update* Home Page to interact with other users of this book and to get brief updates on developments that have occurred since this book was printed. As always, I encourage you to suggest new topics, glossary additions, and possible authors for the next edition of this book by communicating directly with me via e-mail, fax, snail mail, or voice.

Augie Grant
Department of Radio-Television-Film
CMA 6.118
The University of Texas at Austin
Austin, TX 78712
Phone: (512) 471-6640
Fax: (512) 471-4077
Internet: augie@mail.utexas.edu

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The Umbrella Perspective on Communication Technology

August E. Grant, Ph.D.*

Communication technologies are the nervous system of contemporary society, transmitting and distributing sensory and control information, and interconnecting a myriad of interdependent units. Because these technologies are vital to commerce, control, and even interpersonal relationships, any change in communication technologies has the potential for profound impacts on virtually every area of society.

One of the hallmarks of the industrial revolution was the introduction of new communication technologies as mechanisms of control that played an important role in almost every area of production and distribution of manufactured goods (Beniger, 1986). These communication technologies have evolved throughout the past two centuries at an increasingly rapid rate. The evolution of these technologies shows no signs of slow-

* Associate Professor and Area Head of Communication Technology and Policy, Department of Radio-TV-Film, University of Texas at Austin (Austin, Texas).

ing, so an understanding of this evolution is vital for any individual wishing to attain or retain a position in business, government, or education.

This text provides you with a snapshot of this evolutionary process. The individual chapter authors have compiled facts and figures from thousands of sources to provide the latest information on 27 sets of communication technologies. Each discussion explains the roots and evolution, the recent developments, and the current status of the technology, as of mid-1996. In discussing each technology, we will deal not only with the hardware, but also with the software, the organizational structure, the political and economic influences, and with the individual users.

Although the focus throughout the book is on individual technologies, these individual snapshots comprise a larger mosaic representing the communication networks that bind individuals together and enable us to function as a society. No single technology can be understood without understanding the competing and complimentary technologies and the larger social environment within which these technologies exist. As discussed in the following section, all of these factors (and others) have been considered in preparing each chapter through application of the "umbrella perspective." Following this discussion, an overview of the remainder of the book is presented.

Defining Communication Technology

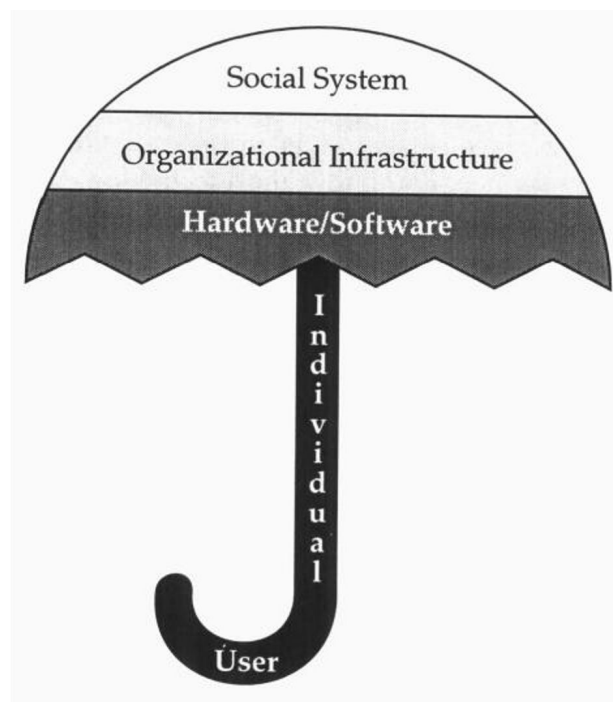
The most obvious aspect of communication technology is the hardware—the physical equipment related to the technology. The hardware is the most tangible part of a technology system, and new technologies typically spring from developments in hardware. However, understanding communication technology requires more than just studying the hardware. It is just as important to understand the messages communicated through the technology system. These messages will be referred to in this text as the "software." It must be noted that this definition of "software" is much broader than the definition used in computer programming. For example, our definition of computer software would include information manipulated by the computer (such as this text, a spreadsheet, or any other stream of data manipulated or stored by the computer), as well as the instructions used by the computer to manipulate the data.

The hardware and software must also be studied within a larger context. Rogers' (1986) definition of "communication technology" includes some of these contextual factors, defining it as "the hardware equipment, organizational structures, and social values by which individuals collect, process, and exchange information with other individuals" (p. 2). An even broader range of factors is suggested by Ball-Rokeach (1985) in her *Media System Dependency Theory*, which suggests that communication media can be understood by analyzing dependency relations within and across levels of analysis, including the individual, organizational, and system levels. Within the system level,

Ball-Rokeach (1985) identifies at least three systems for analysis: the media system, the political system, and the economic system.

These two approaches have been synthesized into the “Umbrella Perspective on Communication Technology” illustrated in Figure 1.1. The bottom level of the umbrella consists of the hardware and software of the technology as previously defined. The next level is the organizational infrastructure, the group of organizations involved in the production and distribution of the technology. The top level is the system level, including the political, economic, and media systems, as well as other groups of individuals or organizations serving a common set of functions in society. Finally, the “handle” for the umbrella is the individual user, implying that the relationship between the user and a technology must be examined in order to get a “handle” on the technology. The basic premise of the umbrella perspective is that all five areas of the umbrella must be examined in order to understand a technology.

Figure 1.1
The Umbrella Perspective on Communication Technology



Source: A. E. Grant

(The use of an “umbrella” to illustrate these five factors is the result of the manner in which they were drawn on a chalkboard during a lecture in 1988. The arrangement of the five attributes resembled an umbrella, and the name stuck. Although other dia-

grams have been used since to illustrate these five factors, the umbrella remains the most memorable of the lot.)

Factors within each level of the umbrella may be identified as enabling, limiting, motivating, and inhibiting. *Enabling* factors are those which make an application possible. For example, the fact that coaxial cable can carry dozens of channels is an enabling factor at the hardware level, and the decision of policy makers to allocate a portion of the spectrum for cellular telephone is an enabling factor at the system level (political system).

Limiting factors are the opposite of enabling factors. Although coaxial cable increased the number of television programs which could be delivered to a home, most coaxial networks cannot transmit more than 54 channels of programming. To the viewer, 54 channels might seem to be more than is needed, but to the programmer of a new cable television channel who is unable to get space on a filled-up cable system, this hardware factor represents a definite limitation. Similarly, the fact that the policy makers discussed above permitted only two companies to offer cellular telephone service in each market is a system-level limitation on that technology.

Motivating factors are those which provide a reason for the adoption of a technology. Technologies are not adopted just because they exist. Rather, individuals, organizations, and social systems must have a reason to take advantage of a technology. The desire of local telephone companies for increased profits, combined with the fact that growth in providing local telephone service is limited, is an organizational factor motivating the telcos to enter the markets for new communication technologies. Individual users who desire information more quickly can be motivated to adopt electronic information technologies.

Inhibiting factors are the opposite of motivating ones, and provide a disincentive for adoption or use of a communication technology. An example of an inhibiting factor at the software level might be a new electronic information technology that has the capability to update information more quickly than existing technologies, but does not use that capability to provide continuously-updated messages. One of the most important inhibiting factors for most new technologies is the cost to individual users. Each potential user must decide whether the cost is worth the service, considering his or her budget and the number of competing technologies.

All four types of factors—enabling, limiting, motivating, and inhibiting—can be identified at the system, organizational, software, and individual user levels. However, hardware can only be enabling or limiting; by itself, hardware does not provide any motivating factors. The motivating factors must always come from the messages transmitted (software) or one of the other levels of the umbrella.

The final dimension of the umbrella perspective relates to the environment within which communication technologies are introduced and operate. These factors can be termed “external” factors, while ones relating to the technology itself are “internal” factors. In order to understand a communication technology or to be able to predict the manner in which a technology will diffuse, both internal and external factors must be studied and compared.

Each communication technology discussed in this book has been analyzed using the umbrella perspective to ensure that all relevant factors have been included in the discussions. As you will see, in most cases, organizational and system-level factors (especially political factors) are more important in the development and adoption of communication technologies than the hardware itself. For example, political forces have, to date, prevented the establishment of a world standard for high-definition television production and transmission. As individual standards are selected in countries and regions, the standard selected is as likely to be the product of political and economic factors as of technical attributes of the system.

Organizational factors can have similar powerful effects. For example, the entry of a single company, IBM, into the personal computer business resulted in fundamental changes in the entire industry. Finally, the individuals who adopt (or choose not to adopt) a technology, along with their motivations and the manner in which they use the technology, have profound impacts upon the development and success of a technology following its initial introduction.

Each chapter in this book has been written from the umbrella perspective. The individual writers have endeavored to update developments in each area to the extent possible in the brief summaries provided. Obviously, not every technology experienced developments in each of the five areas, so each report is limited to areas in which relatively recent developments have taken place.

Overview of Book

The technologies discussed in this book have been organized into three sections: electronic mass media, computers and consumer electronics, and telephony and satellite technologies. These three sections are not necessarily exclusive; for example, direct broadcast satellites (DBS) could be classified as either an electronic mass medium or a satellite technology. The ultimate decision regarding where to put each technology was made by determining which set of current technologies most closely resembled the technology from the user's perspective. Thus, DBS was classified with electronic mass media. This process also locates a telephone-based technology—switched video services—in the electronic mass media section, and a cable television technology—cable telephony and data services—in the telephony section.

Each chapter is followed by a brief bibliography. These reference lists represent a broad overview of literally thousands of books and articles available which provide details about these technologies. It is hoped that the reader will not only use these specific references, but will examine the list of source material to determine the best places to find newer information since the publication of this *Update*.

Most of the technologies discussed in the following chapters are continually evolving. As this book was completed, many corporate mergers had been announced but not completed, regulations had been proposed but not passed, and technological developments were announced but not released. Our goal is for these chapters to establish a basic understanding of the structure, functions, and background for each technology, and for the supplementary Internet home page to provide brief synopses of the latest developments for each technology discussed. (The address for the home page is <http://www.tfi.com/ctu>.) In many cases, you and other readers will become familiar with developments in your areas of interest and expertise, and we hope that you will contribute your findings and observations, making the *Communication Technology Update* Home Page a dynamic example of the synergistic capabilities of interactive communication technology.

The final two chapters attempt to draw larger conclusions from the preceding discussions. The first of these two chapters presents a detailed statistical abstract of many of the technologies discussed, allowing you to more easily compare technologies. The final chapter then attempts to place these discussions in a larger context, noting commonalities among the technologies and trends over time. It is impossible for any text such as this one to ever be fully comprehensive, but it is hoped that this text provides the reader with a broad overview of the current developments in communication technology.

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Section II

ELECTRONIC MASS MEDIA

There's an old cliché about change: "It always takes longer than expected, and it's always bigger than expected." The electronic mass media discussed in the next 10 chapters provide a great illustration of this maxim. Many media explored in this section have been discussed for more than a decade, with 1980s prognosticators predicting widespread adoption before 1995 of many of these technologies, including high-definition television, direct broadcast satellites, and video on demand.

These and other technologies are just now arriving in the consumer marketplace in the United States—much later than predicted by some and with much greater impact than envisioned. For example, the race to develop HDTV fueled the development of digital compression technologies that promise to revolutionize the delivery of video and audio signals to the home. The incredible economic stakes involved in these technologies have attracted as much attention from policy makers as from investors. As the communication technology field has changed, the rules have finally changed as well with the passage in the United States of the Telecommunications Act of 1996.

The introduction of new media and changes in regulations have forced existing media to adapt to a new environment. Appropriately, this section begins with an exploration of the broadcast television industry, providing a framework and establishing a basis of comparison for the chapters that follow. Digital video compression, which promises to revolutionize all media, is explored next.

The cable television chapter clearly illustrates the impact of regulation on a technology. A few short years ago, most cable companies trumpeted plans for adoption of compression and other technologies to expand their service offerings. Many of these plans have since been put on hold, as cable companies continue to deal with the fallout of the 1992 Cable Act, and they prepare for the new opportunities provided by the Telecommunications Act of 1996. On the other hand, companies that produce programming for cable television are going strong. As pointed out in the chapter on Pay Television Services, newer forms of pay cable, including video on demand and pay-per-view, promise to increase the revenues of both programmers and cable operators. On the other

hand, the chapters on direct broadcast satellite services (DBS) and "wireless cable" (MMDS) explain how these new distribution media are challenging cable as the primary distributor of multichannel television services.

The telephone companies are also eager to enter the fray with switched video services, formerly known as video dialtone. This chapter illustrates a radically different technology for delivering television programming to the home, and it provides an illustration of the complexities of the regulatory process. Another technology that is caught between the regulatory process and technological innovation is high-definition television (HDTV). As reported in Chapter 10, new innovations in HDTV are being developed even as regulators attempt to test and approve existing HDTV standards. This section concludes with a discussion of the "oldest" technology discussed in this book—radio. The promise of digital broadcasting and the reality of regulatory change are propelling the radio industry toward a new structure and a new place in the communications arena, as radio broadcasters continue to define their medium.

In reading these chapters, you should consider two basic communication technology theories. Diffusion theory helps us to understand that the introduction of innovations is a process that occurs over time among members of a social system (Rogers, 1983). Different types of people adopt a technology at different times, and for different reasons. The smallest group of adopters are the innovators—they are first to adopt, but they usually adopt for reasons that are quite different from later adopters. Hence, it is dangerous to predict the ultimate success, failure, diffusion pattern, gratifications, etc. of a new technology by studying the first adopters. Diffusion theory also suggests five attributes of an innovation that are important to its success: compatibility, complexity, trialability, observability, and relative advantage (Rogers, 1983). In studying or predicting diffusion of a technology, use of these factors suggests analysis of competing technologies as being as important as attributes of the new technology.

A second theory to consider is the "Principle of Relative Constancy" (McCombs, 1972; McCombs & Nolan, 1992). This theoretical perspective suggests that, over time, the aggregate disposable income devoted to mass media as a proportion of gross national product is constant. In simple terms, people spend a limited amount of their income on the media discussed in this section, and that amount rarely increases when new media are introduced. In applying this theory to the electronic mass media discussed in the following chapters, consider which media will win a share of audience income, and what will happen to the losers.

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Television Broadcasting

Carolyn A. Lin*

Today's broadcast television industry resides in a rapidly-changing media environment (Wirth, 1990; Lin, 1994a). In particular, it faces fierce competition from within in the form of new off-air networks, as well as various emerging niche media outlets and communication conglomerates. In 1988, the arrival of a fourth broadcast network, Fox, shook up the long-standing three-way oligopoly of ABC, CBS, and NBC. Without even a full prime-time program schedule, Fox overtook CBS and ranked third in network ratings among key audience segments in the 1994-1995 TV season. In the same year, up-start networks UPN (United Paramount) and WB (Time Warner)—each offering only a limited prime-time schedule—also joined Fox to hasten the pace of inter-network competition.

There is other competition for the networks as well. Cable TV is in over 65% of American television households, and VCR penetration is approaching 90%. Direct broadcast satellite (DBS) services, such as PrimeStar and DirecTV, both offer over 150 channels of viewing choices to over three million subscriber households through a home satellite dish, bypassing both conventional broadcasting and cable TV outlets. Several more DBS services have been planned for launch in 1996 and 1997, some backed by

* Associate Professor and Graduate Program Director, Department of Communication, Cleveland State University (Cleveland, Ohio).