TeleGeography 1994

Global Telecommunications Traffic Statistics & Commentary

Gregory C. Staple, Editor

In cooperation with the International Institute of Communications (IIC)

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GLOBAL TELECOMMUNICATIONS HAS NOT LED TO THE END OF GEOGRAPHY SO MUCH AS THE EXPLOSION OF PLACE.

The Front Cover: Digital Planets

Back Page (p. 170): E-Mail Comet

Cover Illustration: Annemarie Feld, Gregory C. Staple,
Jessica A. Perlman, Zachary Schrag

telegeography \tĕl´ə-jē-ŏg´rə-fē \ *n* (1990) abbrv. of telecommunications geography [fr. Gk *tele*, far off, at a distance and L. *communicatus*, pp. of communicare to impart + fr. Gk *geo* (earth) + *graphein*, (to write)] 1. a new branch of geography that maps the global pattern of telephone traffic and other electronic communication flows; 2. places created by or perceived solely *via* telecommunications (e.g., a computer network address); 3. the telecommunications artifacts (radio antennae, terminals, signs) on a site; 4. the balance of telecommunications power in one country or region vis-a-vis another (cf. geopolitics, *archaic*).

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Preface

Welcome to the age of information superhighways, where there are networks of networks, and everything is becoming multimedia. Each year the pace of new telecommunications applications quickens, which makes tracking this industry so exciting. *TeleGeography 1994* is an invaluable collection of facts and figures, graphs and charts, maps and tables that combine to give a clear picture of the worldwide telecommunications industry.

Much of *TeleGeography's* value is in the emerging trends it tracks. Today, the trend to follow most closely is the powerful convergence of telecommunications, computers, information services, and entertainment. Boundaries between these businesses are blurring and collapsing. Just as we once thought global telecommunications would make national boundaries meaningless, so it becomes increasingly difficult to tell where telecommunications leaves off, or where information services and entertainment begin. As the technology evolves, these industries are reaching beyond the narrow confines of their core businesses and creating entirely new businesses.

TeleGeography 1994 is the road map that will carry us through these changes. By studying where the industry stands, we can gauge the direction in which it will evolve. Researchers, government agencies, regulators, and industry watchers have all come to rely on the data presented here. MCI is proud once again to underwrite this powerful information tool.

Gerald H. Taylor
President and Chief Operating Officer
MCI Communications Corporation

Acknowledgments

We are indebted to the numerous carriers, government departments, regulators and international organizations from around the world who responded to our requests for information. Special thanks are due as well to the dedicated people at these organizations and at the International Telecommunication Union (ITU) in Geneva who set aside the time necessary to ensure that the data reported here are as current as possible.

We also wish to thank the Commission of the European Communities (CEC), Directorate General XIII, for underwriting our research on European telecommunications and for permitting us to publish certain Commission data on traffic to and from member states. The CEC's independent effort to improve the scope of statistics on international telecommunications flows is ever welcome.

The new maps in this year's report and the broader national coverage were also supported, in part, by publication grants from MCI Communications Corporation and Stentor Resource Centre, Inc. As in the past, however, these grants were made without any precondition; TeleGeography, Inc. is solely responsible for the report's editorial contents.

Gregory C. Staple
Editor

Introduction

TeleGeography 1994 is a guide to people's changing sense of place and identity in the world, and to some agents of those changes, international telecommunication carriers. By monitoring traffic—the volume of telephone calls, faxes and e-mail between one country and another—this report marks the shifting relationships among the world's peoples and the communications businesses which serve them.

In 1993 telephone subscribers (and their machines) spent approximately 47 billion minutes talking to other countries. *TeleGeography* chronicles who was calling whom; how much France called Britain; Slovenia called Germany; India called Canada; the United States called Mexico. In all, there are telephone traffic statistics for over 60 countries and 800 different routes. *TeleGeography* also contains national statistics on the growth of the Internet, the world's largest computer network. A companion volume of statistics and commentary, *Direction of Traffic,* published jointly with the International Telecommunication Union (ITU), contains route-by-route telephone traffic data for the prior ten years: 1983 to 1992.

TRAFFIC FLOWS ARE MUCH MORE THAN TRADE STATISTICS. THEY CAN ALSO REVEAL THE MOVEMENTS OF PEOPLE, AND SHOW WHERE THE NATURAL CHANNELS OF HUMAN COMMUNICATIONS HAVE BEEN DAMMED AT THE BORDERS AND WHERE THEY FLOW FREELY.

The rich array of data in *Direction of Traffic* and *TeleGeography* allows one to piece together the "who" and "where" behind buzzwords such as "globalization," the "information society" and "interdependence." The billions of minutes of international telecommunication traffic are themselves opaque; we do not know the content of the messages, nor should we. But the new pattern of connections which they create—the telegeography—contains its own messages.

Telecommunications, like geography, is all about connections. Just as islands, mountain passes, straits, and plateaus gain importance from their connection to, or isolation from, other places, so do telephones. But the geography of communications is far more fluid. The connections available between one terminal or network and another reflect the choices we make as a society about technology, the construction of telecommunication facilities, who may own them and how much it costs to use them. As importantly, network connections largely rest on the uncertain ground of human conversation; the millions of words and texts, smiles and sobs, daily traversing the network create its unique and temporary topography. They make every new telecommunications circuit not just a commercial milestone or engineering landmark but an organic part of our changing social and economic terrain.

Telecommunications geography is human geography. The flow of traffic between one country and another is much more than a trade statistic; it can also reveal movements of people—migrants, guest workers, tourists and refugees. Likewise, traffic statistics disclose where the natural channels of human communications have been dammed at the borders and where they flow freely; where linguistic connections are strong and where they have thinned; which ethnic communities cohere and which have scattered across the electronic sea; which people of the world are rich in information and which have been left out.

TeleGeography 1994 concentrates on the commercial aspects of this new geography. (Readers more interested in the social, linguistic and cultural dimensions of the subject should consult *Direction of Traffic* as well and the sources cited therein.) The telecommunications data compiled here chart our modern trade routes—our global information highways and the changing fortunes of the carriers building them; their revenue base; market share and future prospects. As the industry's traditional structures erode, *TeleGeography* offers a map to the new world.

Slower growth and greater competition

The last decade has been a period of unparalleled international traffic growth—15% annually from 1983 to 1992—spurred by international direct dialing (IDD), over 200 million new local subscriber lines, high capacity undersea cables and satellites, and new services, particularly facsimile. Traffic per line rose from an average of 30 minutes per year in 1983 to 71 minutes in 1992. However, since 1991, growth rates have fallen in almost all of the world's regions. Global traffic growth declined from approximately 12% to 13% in 1992 to 11% in 1993 (47.4 billion minutes in 1993 vs. 42.8 billion minutes in 1992. See Figure 1.).

Despite the general slowing of growth of international traffic since 1991, not every country and carrier fared the same. The differences point to significant shifts in power within the telecommunications industry.

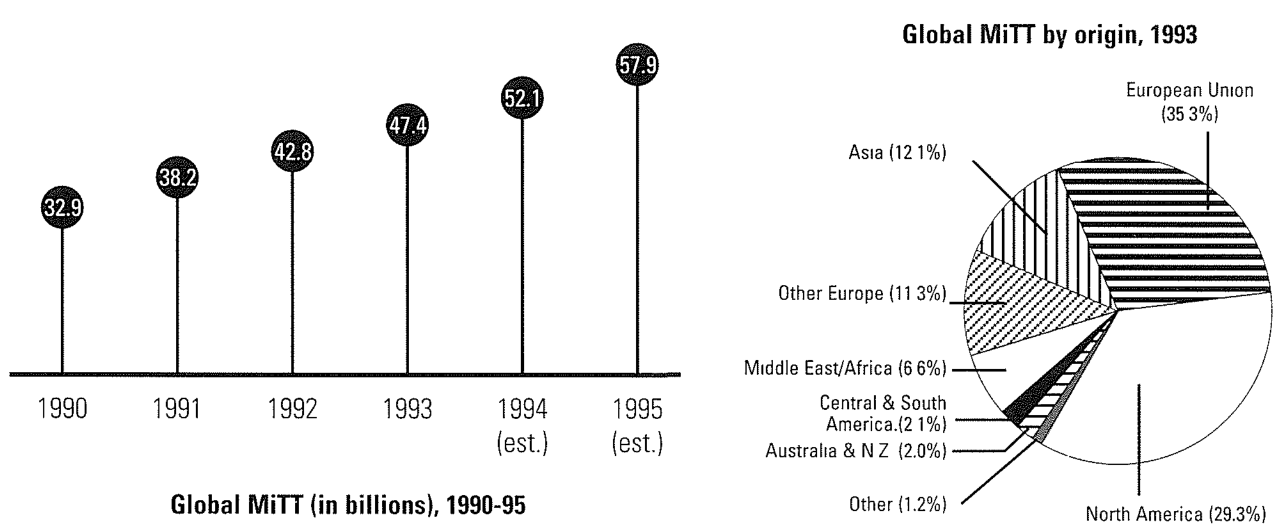
■ In 1993, Deutsche Telekom enjoyed traffic growth of 16.7%, despite a lingering recession (German GDP fell by 1.2% in the same year). Part of Telekom's success is attributable to the surge in telecommunications that has accompanied the economic integration of Central and Eastern Europe. Notably, in 1993 traffic from Poland, Hungary and the Czech Republic all grew over 15%—a plus for recent privatizations (more on this below). Excluding Germany, international traffic growth for members of the European Union (EU) was approximately 9%. In the U.K., for instance, outbound traffic for the country's two facilities-based carriers showed less than 5% growth on many routes, suggesting that alternative service providers—such as international private line (IPL) resellers, foreign based "call back" companies, and Home Country Direct calling card services—are gaining a greater share of the pie. See the article beginning on p. 38 for further details on the new competition in Europe.

■ Unlike Germany, Japan saw international traffic growth dampened by recession; outbound traffic rose only 9.9% in 1993 (it had averaged over 20% from 1985 to 1992) and grew 5.7% for the largest carrier, KDD. Yet, throughout the rest of Asia, growth rates of 15% to 20% per year remained the norm, as strong economies, emigration (to the West) and millions of new telephone lines translated into a continuing traffic boom. Outbound traffic from China grew over 40%, boosting the Chinese operator into the ranks of the top 15 carriers and adding new pressure for the government to license additional international gateways. See also Figure 2 and the article on Asia beginning on p. 39.

■ Growth in public network traffic to and from the United States weakened in 1993; total traffic increased barely 10% over 1992. Furthermore, the volume of foreign billed (mainly incoming) traffic for U.S. carriers grew but 4.6% from 1992, suggesting that the 12.7% growth in U.S. billed (mostly outbound) traffic was mainly attributable to a change in the billing point of the call (e.g., from Home Country Direct calls). U.S.-originated outbound traffic probably grew at a 6-7% rate in 1993. The major beneficiaries of this more slowly growing U.S. market were competing facilities-based carriers; MCI, Sprint and IDB—captured fully 75% of the additional 1.3 billion minutes of U.S. billed traffic added in 1993. MCI grew by 36% (adding three times the traffic of AT&T) to become the world's third largest carrier, and Sprint grew by 23%. AT&T's U.S.-billed traffic grew by only 4% and, for the first year since competition began in the U.S., the volume of AT&T's foreign billed traffic decreased from the prior year.

■ Canada's overseas carrier, Teleglobe, fared better than its U.S. counterparts, with total traffic growing 12.6%; foreign-billed traffic increased by 14.1% from 1992. Stentor, the consortium of provincial telephone carriers which formerly had a monopoly over traffic to the U.S., saw an absolute decline in traffic. In late 1992, regulators authorized the resale of IPLs for switched services on the U.S.-Canada route. Also in 1993, Canada's new facilities based long distance carrier, Unitel, began operations. In 1994, Unitel and facilities-based resellers are expected to gain 12% of the cross border traffic with other resellers capturing another 8%.

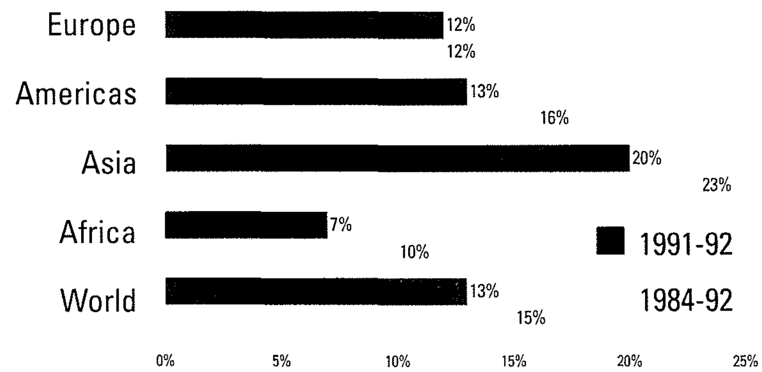
Figure 1. Global MiTT: Growth and Origin



Note: Data include outbound minutes of telecommunication traffic (MiTT) on public telephone network only.

Figure 2. Global MiTT: Growth by Country and Region

Country	% Growth 1992-93
Belgium	7.5
France	5.2
Germany	14.5
Hungary	16.0
Poland	28.2
Russia	14.5
U.K.	9.9
Brazil	7.4
Colombia	8.4
Venezuela	16.1
USA (out + in)	10.0
China	40.9
India	9.4
Japan	9.9
Korea	15.7
Malaysia	20.0



Note: Growth rates based on outbound minutes of telecommunication traffic (MiTT) on public telephone network only.

As competition grows from IPL resellers, foreign calling cards and other alternative service providers, it is becoming more difficult to measure accurately the size of international traffic flows and the market share of the main competitors. Further, carriers on each end of a given route may use different reporting standards for the same traffic stream. Accordingly, in using this report readers should be sure to consult the footnotes to each table and the discussion in the Methodology section (p.149).

Capitalizing on growth

When almost all the world's international carriers were state-owned, yearly traffic growth generally affected only the operator's budget or that of the central government. Corporatization and privatization have changed that. In more than 20 countries the shares of international carriers now may be bought and sold on local stock exchanges. Changes in a carriers' international traffic and revenue now echo—affecting both the carrier's share price and, given the shares' weight on the local stock exchange, the value of other publicly listed enterprises as well. In many middle-income countries, telephone carriers have the highest capitalization of any traded company and account for a substantial share—often 10% or more—of the total value of listed issues.

The new stock table which appears on p. 74 is designed to help readers evaluate the capital values placed on the international traffic data documented elsewhere in *TeleGeography*. At September 1, 1994, the table shows that publicly quoted carriers providing international service had a total stock market valuation of approximately $400 billion. Further, the stock market price for most carriers was 15 to 20 times the company's net earnings or profits. Assuming that each minute of international traffic generates average revenues of approximately $1 (see p. 34 below), and the average margin is at least 40%, then the 4.5 billion minutes of additional international traffic in 1993 had the potential to add approximately $30 to $35 billion to global equities. The actual value added to world stock markets was somewhat less, however, because many large carriers (e.g., Deutsche Telekom, France Telecom) are as yet unlisted.

Put another way, in 1993 there were approximately 47 billion minutes of international traffic, so that each 1% of additional traffic was approximately equal to $470 million in revenues, on average, or $190 million plus in profits. If this profit were all capitalized at current rates, then each percentage point of growth could add approximately $3-5 billion in value to global telecommunication equities.

Picture phones

Competition for these billion dollar stakes is, not surprisingly, driving carriers to find new ways to enlarge the international market. In the early 1990s, fax traffic and residential users helped to increase demand during an otherwise weak business market. What will take up the slack in the next decade? Will picture phones be the "killer application" of 2001?

Elliot Gold, the editor of *TeleSpan,* a leading newsletter on video conferencing, provides some answers in the first essay of the Articles section. (See p. 3) Gold states that one of the promises of video phones is their "magnificent multiplier." For example, a recent 18-month European videophone trial found that average videophone calls lasted up to ten minutes as compared to just over three minutes for voice calls. And video calls typically require twice as much band width, suggesting that revenue for video calls could be six times that of voice calls. The European trial and others in Japan and the U.S. lead Gold to project worldwide toll revenues from video phones of over $600 million by 1998 and more than $1 billion by 2000—a substantial sum, but still a very small fraction of future voice revenues.

What will make videophone services a mass market? One answer is the growth of several niche markets, such as desktop video conferencing (between office PCs) and network-based video games. However, before international video calls will become commonplace, manufacturers will need to agree on a standard; many U.S., Japanese and European video phones are still incompatible. Gold also rightly focuses on the need for local carriers to install a switching platform that will permit users to have access to the same custom calling features that are available for telephony—especially voice mail and call conferencing. Absent such interactive features, the revenue multiplication from video phones may be slow to materialize.

The challenge of convergence

The next article carries forward the discussion from *TeleGeography 1992* on how international carriers are coping with the challenge of providing such multimedia services. The article starts by reviewing the paradigm shift already underway in the provision of international voice services. The old paradigm was based on monopolistic, facilities-intensive or Heavy Carriers which provided service in only one country. In contrast, the new paradigm is based on competitive, privately owned, Light Carriers which offer end-to-end international service by reselling, repackaging or reprogramming the facilities and services of established carriers.

But even as international carriers begin to accept this new paradigm for telephony, the agenda for change is shifting. Innovative technology and market liberalization are now eroding the boundaries between voice, text and video services as surely as they did in the early 1990s between one national market and another. Tomorrow's international telecommunications network will be a conduit not only or even primarily for telephony but for multiple services: video telephony, computer software applications, color graphics and music. In today's jargon, the network will become a global information highway.

The role of international carriers and their new global alliances (Concert, AT&T WorldPartners, Unisource) in this network transformation deserves more attention:

- The current rate structure for international telephone services generates a $25 to $30 billion investment pool annually. How carriers use this surplus—the level and nature of the investment, and how much is passed on to telecom users and stockholders—will have a large impact on tomorrow's service offerings.

- There is a risk that regulators' preference for managed competition and traditional correspondent relations will encourage many international carriers to create a two-tier market structure for global services. Corporate users may benefit from new global alliances, whose multinational service platforms will pass on savings generated by end-to-end circuits, flexible routing and innovative software. Meanwhile, most international callers may be stuck with the higher rates and fewer options associated with the Heavy Carrier routing and interconnection arrangements of the past.

- The price and variety of multimedia will depend on the network architecture regulators encourage. Light Carriers have shown that there is more than one way to connect consumers to a network. So too has the Internet. In the telephone world, open access depends upon a user's ability to plug in a telephone (or fax machine) and obtain a dial-tone to call any other terminal on the network. In a multimedia world, the test may well be whether a party can connect a competing computer file server to any other data, audio or video file server on the network. A key question is whether the largely one-way Video-On-Demand (VOD) plans of some public operators can be harmonized with this two-way model.

On-line geography

Much as multimedia is now (wrongly) said to portend the death of books, telecommunication has long been hailed as the end of geography. But the opposite has occurred; by making almost any point on Earth (and beyond—see p. 170) accessible for a few dollars via a telephone or a point and click menu on a personal computer, the global network has led to the explosion of place. In a sense, travel or geography has become the common content of computer networks. Hence as the Canadian scholar Marshall McLuhan (1911-1980) first noted, rather than obliterating older forms, a new medium takes as its content the medium it replaces. Music and drama were the staples of early radio. Television gave new life to movies. And so the Internet, by abolishing the distance between the solitary desktops and computer screens of its twenty million users has given us a new geography on-line, a geography of rooms, malls, highways and frontiers.

The challenge of navigating this new electronic terrain is attracting the attention of the telecoms and computer communities alike. Traffic on computer networks has grown dramatically since the early 1990s, (see pp. 78-79) spurred in large part by the development of more user-friendly navigational tools or screen interfaces. As Bruce R. Schatz and Joseph B. Hardin recently wrote in *Science* (12 August 1994), computer networks have thereby been transformed from networks of machines into a distributed "information space." That means users can now "concentrate on the logical structure of the interconnection of information and data items rather than the underlying physical structure of computer and communication systems." Network geography has become information geography.

But, whether geography can help users to orient themselves in this new information space is the focus of our third major article by Zachary Schrag, the Deputy Editor of *TeleGeography.* According to Schrag, our current text-based interface with computer networks is being challenged by two movements. One group of programmers and designers is using graphical user interfaces (GUIs) based on geography (or geoGUIs) to make network information more visible. At the same time, another group is working on "intelligent agents" designed to make the computer networks invisible. Like computer macros and scripts, agents let computer users automate repetitive tasks such as logging onto a computer system or downloading information from a database. Unlike macros, agents also can go beyond a local computer to the network itself, retrieving information and sending messages and perhaps even conducting business.

Schrag concludes that maps and agents each have a future in cyberspace; the challenge will be to match function and form, to use a geoGUI when it helps users find what they want and to abolish it when it interferes.

For Schrag the future of cyberspace may not be unlike the history of radio. Conceived as a means of two way communication (radio was first used to send distress signals from ships) radio later achieved great commercial success as a broadcast medium to transmit music, news and other programs to millions of receivers. But it has never lost its original function. And ships, airplanes, trucks, taxi cabs and "ham" radio enthusiasts still depend upon two way transmission. Millions of new cellular telephone users do too. Thus, "if the radio, a single technology, could blossom as two radically different social phenomena, so could cyberspace," states Schrag.

TeleGeography 1995

Next year's edition will carry forward our main statistical enterprise: chronicling the changing pattern of international telephone and data traffic. We will also continue to monitor multimedia traffic as the market begins to reach a critical mass. In addition, we plan to expand the map section of the report to cover some of the vast new information spaces being opened up by the world's burgeoning on-line communities. Mapping these new worlds—which have no north or south, up or down—is one of the great challenges of post-modern cartography. We invite suggestions and comments from our readers on this new endeavor as well as the contents of this year's report.

Gregory C. Staple
Zachary M. Schrag
September 1994
Washington, D.C.

Articles

The Market for Picture Phones

Prospects for Sales and Traffic

By Elliot M. Gold

"Watson, stay put, I see you!" If Alexander Graham Bell had invented the videophone instead of the voice phone, that would have been his first utterance. When he spilled the battery acid on his hand, he could have shown the burn to Watson instead of saying "... come here, I need you." And had Watson been a medical doctor, Bell would have gotten a free examination over the phone, followed by a prescription sent by fax, no doubt.

Even though it didn't happen that way, Alexander Graham Bell was on the same wavelength as later inventors of videophones. Following his patent for the voice phone in 1876, Bell went on to invent and patent the Photophone, a voice phone that transmitted sound over light waves. With Bell's Photophone, a person's voice vibrated sunlight reflected on mirrors, literally flashing the message down the line, where it was converted back into audible sound waves for the listener to hear.

From Telephots to Videophone 2500

In the 88 years between Bell's introduction of the voice phone and AT&T's introduction of the Picturephone at the 1964 World's Fair, many explored the notion of videophones. Kit Galloway, possibly the world's leading collector of videophone artwork and paraphernalia, has found references to videophones beginning one year after Bell's voice phone patent was awarded. In one article located by Galloway, and appearing in the May 1918 *Electrical Experimenter,* author Hugo Gernsback lists some 12 designs and patents worldwide for Telephots (from the Greek *tele*—far—and *photos*—light). The first Telephot appears to have been invented by a Frenchman named d'Ardres in 1877, one year after Bell's voice phone.

Galloway's collection contains references to the first video phonebooths as well, called Telephonoscopiques. In a reference dated 1880, three years after d'Ardres' vision of the Telephot, an inventor predicts that "Telephonoscopique kiosks are to be found on every street corner, in the better neighborhoods, throughout France in the mid-twentieth century. Not only can you speak with your distant friends and loved ones in all the corners of the Empire, you can also see them at the same time." Galloway's collection includes artwork from the early 1900s showing the boy detective, Tom Swift, using a videophone in the story "Tom Swift and his Photo Telephone."

The first trials of "audiovisual" communications were apparently those run between 1935 and 1938 by the Deutsche Bundespost Telekom. Participants in four German cities used the phones in public studios. Since 1964, a proliferation of videophones have reached the market, not all of which would have satisfied the needs of the boy detective Tom Swift. In those 30 years, few, in fact, have attained the quality of AT&T's initial Picturephone.

Picturephone delivered smooth, full motion, black and white video (at a time when network television was still black and white) 30 years before jerky color was attained by others. But AT&T had to file a special construction tariff to offer 1 MHz circuits for Picturephone. The circuits proved too costly for telephone users of the late 1960s, and AT&T quietly removed Picturephone from the market in the early 1970s.

AT&T continued, however, to offer full motion black and white and color video over wideband circuits, principally to broadcasters. Dow Chemical, an early corporate user of two-way videoconferencing, paid AT&T $2,000 per hour in 1974 for a microwave video link between Dow's headquarters in Midland, MI, and its chemical manufacturing facility in Freeport, TX. Over the next decade, prices actually went up, and not down. In 1983, AT&T opened its digital Picturephone Meeting Service (PMS), with occasional use rates tariffed at $2,300 per hour for T2 digital hookups from New York to San Francisco. Though this attempt was a failure, over the past decade PTTs worldwide have profitably operated several dozen rooms with videoconferencing facilities for public use.

The major provider of public videoconferencing rooms in the United States today is Sprint, which has offered its Sprint Meeting Channel for over a decade. Using a combination of Sprint-owned public rooms, customer-owned shared rooms, and PTT public rooms, Sprint offers a network of scores of rooms worldwide.

This past year both Sprint and AT&T expanded their efforts in public room networks. Sprint has launched a joint marketing venture with Kinko's, an American chain of stores, many located near universities, which offer photocopying and

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computer services. Sprint is installing desktop videoconferencing equipment to offer lower cost public videoconferencing services, as an extension of the existing Meeting Channel. AT&T, which closed down its public rooms in Hilton hotels in 1984, is back in the business, offering digital videoconferencing rooms and analog VideoPhone 2500s to guests of Westin Hotels.

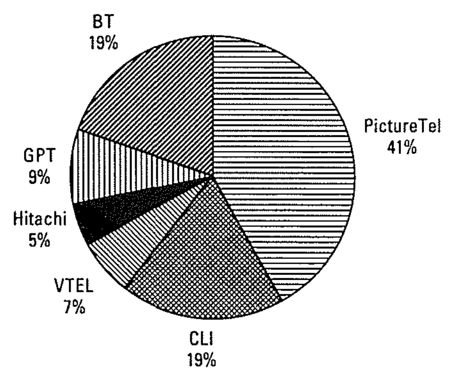
MCI's small network of public rooms have failed to return a profit. But an entrepreneurial venture called Affinity Communications has been reasonably successful renting out private PictureTel rooms around the U.S. and the world since 1992. Affinity has kept its capital costs low by simply offering a reservation service for companies with rooms to lease and for companies seeking to use them.

The inconvenience of public facilities and the expense of installing special lines have inspired inventors to try to cut transmission costs by delivering video over ordinary phone lines. Small companies such as Colorado Video and Robot Research, and much larger ones like NEC and Stromberg Carlson tried slo scan television technology, later marketed as Slow Scan and Freeze Frame video. By limiting video to snapshots and by dividing these snapshots into sets of 128 to 520 television lines, the manufacturers were able to transmit the video a line at a time over the relatively economical Plain Old Telephone System.

But early slo scan had serious limitations. A picture took longer to arrive than a Polaroid photo took to develop. Color slo scan transmission could take two or more minutes. And systems cost as much as $11,000 to $17,000 per end. While annual sales did reach thousands during the early 1980s, slo scan television attracted only very specialized applications such as tele-medicine in remote areas.

In 1984 Widcom demonstrated the first videophone that delivered full color motion video over a single switched 56 kbit/s digital phone line. The $56,000 system was purchased by Westinghouse, Bell & Howell, and even the White House. Widcom, though, became a footnote in history when the company was forced into bankruptcy by its overly zealous competitor, Compression Labs.

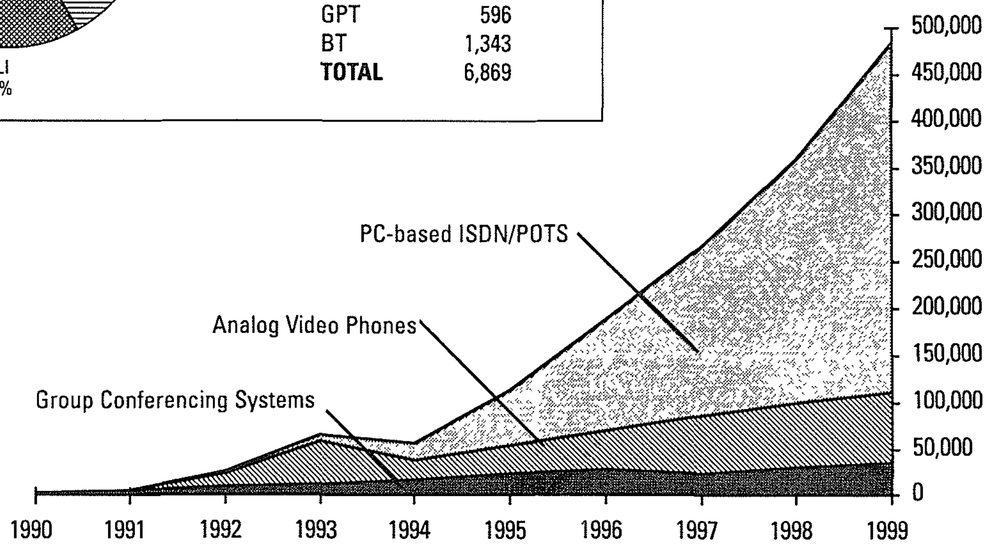
Figure1. Worldwide Picture Phone Equipment Sales (Units)



The Big Six

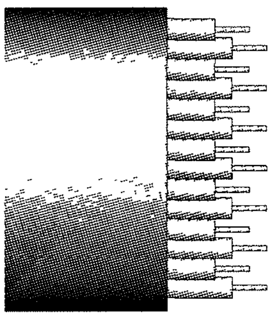
Sales of group videoconferencing systems by the world's six largest manufacturers for the first half of 1994.

PictureTel	2,885
CLI	1,279
VTEL	451
Hitachi	315
GPT	596
BT	1,343
TOTAL	6,869



Sales of systems in facilities or rooms.

Figure 2. The need for Bandwidth



Bandwidth	Resolution
90 Mbit/s = 4700 telephone lines	Full motion color television
2.0 Mbit/s = 104 telephone lines	High quality videoconference
1.5 Mbit/s = 78 telephone lines	Good quality image for business and industry meetings
384 kbit/s = 20 telephone lines	Interviews/Education/Training
64 kbit/s = 1 ISDN bearer channel	INDEO (PC-based), ISDN circuit
19.2 kbit/s = 1 4 kHz telephone line	Freeze frame (slo scan) telephone

Videophones returned to the telephone network in 1986 when Mitsubishi introduced the Luma 1000, a snapshot video system with an extraordinary set of features, including an on-line phone directory. The Luma listed for $1,450 and delivered a postage-stamp-sized black and white image in 10 seconds. Although there were some niche sales, such as to law enforcement agencies, Mitsubishi abandoned the Luma the next year in favor of the less expensive VisiTel or Luma 500 which, by eliminating many of the Luma 1000's features, managed a list price of $399 in 1987.

Mitsubishi manufactured 40,000 VisiTels, selling only a few thousand. After writing them off at the end of the 1980s, Mitsubishi turned its inventory over to the Home Shopping Network, which closed them out in a matter of days, at prices as low as $87 a pair.

AT&T returned to the market in January, 1992 with the VideoPhone 2500, which delivers jerky motion color video over an ordinary telephone line, and lists for $1,399 per end. AT&T has already sold 40,000 of the 60,000 VideoPhone 2500s manufactured.

Today, buyers can purchase stand-alone or PC-based videophones from more than four dozen telephone and computer manufacturers, including AT&T, BT, and Intel, with prices ranging from under $1,000 to $6,000 for PC add-on board sets, and from $1,399 to $6,000 for stand-alone systems.

How videophones work

Voice and full motion video begin their videophone journey as analog signals. While voice begins as a 3.0 kHz analog signal, video begins as a 4.6 MHz signal, some 1,500 times wider than voice signals. In order to preserve the quality of the signal and to abide by international telephony standards, voice is converted to 64 kbit/s, or one ISDN (Integrated Services Digital Network) basic rate circuit, while video is converted to 90 Mbit/s, the equivalent of two 45 Mbit/s or DS-3 channels, retaining the ratio of 1:1,500 between video and voice. This, principally, is the reason that until recently videophone transmission cost so much more than a voice call.

During the 1960s and 1970s, mathematicians and engineers began in earnest to work on the disparity between the bandwidth or data rate requirements for video and voice. Due to the nature of television, they knew that the information in a picture was highly redundant. They knew, for example, that the color and texture of a wall or of a person's skin would not vary greatly during a video call. And, because videophones were expected to view people seated in chairs, and not on top of race horses, their relative position wouldn't change significantly from one frame to another. Therefore, they considered dividing frames of video into "blocks" of redundant information.

After dividing the visual information into blocks, researchers theorized and then proved that the descriptive information in these blocks could be compressed greatly using mathematical algorithms, including some called "transforms."

As the name "transform" suggests, the redundant picture information in the blocks is "transformed" into coefficients describing the content of and the relative location of the video blocks as they move in a motion sequence. By compressing the video information and converting it into coefficients, the picture—or, more correctly, the description of the picture—occupies less storage and requires narrower transmission channels than it did when it was in its initial analog or digital format.

Research was conducted broadly at telephone companies, mainly at AT&T (by Netravelli) and at NTT, and at government aerospace and defense agencies such as NASA and DARPA and related subcontractors, principally Philco-Ford (later Ford Aerospace). Researchers such as Widergren, Pratt, Fralick, and Tesher quickly became entrepreneurs, founding Compression Labs in 1979 and Widergren Communications in 1983 to build the first video compression/decompression devices, called codecs.

AT&T and NTT/NEC demonstrated color motion video over a pair of T1 (1.54 Mbit/s) channels in the late 1970s. In 1981, Compression Labs reduced the requirement to a single T1, with Widcom's demonstration of 56 kbit/s transmission following in 1983.

Today, through very specialized mathematics and more powerful chips, the transmission requirement for quality color motion video has been reduced to an ISDN basic rate interface of 128 kbit/s. Lower quality color and motion can even be attained over an ordinary voice channel, by compressing the video and audio to a single 9.6-19.2 kbit/s data stream.

THE TENS OF MILLIONS OF PERSONAL COMPUTERS ALREADY IN USE COULD BECOME TENS OF MILLIONS OF VIDEO PHONES, IF USERS ARE WILLING TO PAY FOR ISDN.

Such compression rates have yielded a new possibility for video communication. Instead of buying special video phones, people can now use the personal computers and modems already sitting on their desks, though each party will need to pay for an ISDN line. Intel's INDEO System, which sells from $999 to $2,700 per computer, turns a $2,000 PC into a device to code video and voice, as well as for sharing documents with distant colleagues.

The tens of millions of personal computers already in use could potentially become tens of millions of video phones, if users are willing to pay for ISDN. Indeed, desktop video might be the "killer application" long sought by the phone companies for ISDN, just as group videoconferencing boosted use of 56 kbit/s circuits. AT&T struggled with the launch of its 56 kbit/s circuit switched digital capacity until 1989, when usage revenues came in 170% ahead of forecast. The company found that PictureTel's group videoconferencing, which AT&T sold through a joint marketing agreement for $30,000, and AT&T's own price cuts, making switched 56 kbit/s circuits as inexpensive as voice toll, were the winning combination.

Video phones could drive network traffic

Videophones provide carriers with a magnificent multiplier, one that multiplies the revenues they can receive from phone calls. Simply put, video calls are longer and often require twice as much bandwidth as voice calls, therefore generating six to twelve times as much toll as ordinary voice calls.

This fact came to light after an 18-month trial of ISDN videophones throughout Europe between 1992 and 1993 under a program called the European Videophone Experiment, EVE2. In the trial, PTTs in the United Kingdom, France, Germany, Italy, the Netherlands, and Norway installed videophones that communicated over an ISDN line, relying on standards set by the International Telecommunication Union (ITU) for group videoconferencing, called H.320.

The EVE2 experience in the United Kingdom and in Norway was that the average videophone call lasted up to 10 minutes, versus voice calls which typically last just over three minutes. These "holding times," as they are termed in telephony, were somewhat shorter in Italy and in Germany, but varied mostly by user and application. While users from some electronics firms, universities, and service companies reported average holding times of between eight and ten

Figure 3. Videophone Traffic Volumes and Revenues, 1991-99

	1991	1992	1993	1994	1995	1996	1997	1998	1999
Analog Videophones[1]	100	12,100	58,100	78,100	108,100	148,100	208,100	278,100	353,100
PC Based ISDN/POTS[1]	200	4,300	11,500	29,500	89,500	209,500	389,500	649,500	1,024,500
Average Minutes of Use/Week[2]				50	70	110	150	200	240
Minutes of Toll/Yr 48 Weeks[2]				258,240	663,936	1,888,128	4,302,720	8,904,960	15,869,952
Hours Toll/Yr [2]				4,304	11,066	31,469	71,712	148,416	264,499
Revenues[2]				$18,077	$46,475	$132,169	$301,190	$623,347	$1,110,897

[1]Cumulative
[2]Thousands

minutes, users from other industries reported holding times of only four minutes, or just over the length of their ordinary voice calls. Managers from BT, which participated in the trial, had average holding times of over 12 minutes, obviously affected by their own enthusiasm for the medium of the trial.

If we assume that holding times for videophone calls will gravitate to three times that of an ordinary voice call, and will use ISDN, which is generally tariffed as two voice circuits, we could expect revenues to be on the order of six times that of voice-only calls.

Others expect revenues to far exceed this, due to an anticipated need for video phone calls to bring together individuals in group conference calls. In Japan, NTT is a proponent of this theory. This past spring, NTT began to offer an ISDN videophone called the Pic Send-R (manufactured for NTT by Hitachi), which can be used to link up to five homes in a videoconference. The consumer videophone can display the faces of up to four callers, each in a quadrant of the screen.

An ordinary Pic Send-R call within Tokyo cost 10 yen ($0.10) for three minutes, or virtually the same as an ordinary voice call. This is because a point-to-point videophone call requires only a single 64 kbit/s channel on NTT's ISDN. When a caller adds a second site, however, the caller must convert the call to use two 64 kbit/s channels multiplying the number of yen spent every three minutes to 20 for the first link, 20 for the second link, or four times the cost of a simple voice call. With a five-way call, the bill quickly rises to 100 yen per three-minute segment, or a ten-fold increase over the toll generated by an ordinary consumer voice call.

VIDEOPHONE USERS WANT TO SEE MORE THAN JUST SOMEONE'S FACE DURING A VIDEOPHONE CALL. THEY WANT TO SHARE DATA AND GRAPHICS, ESPECIALLY IF THE CALLS ARE MADE FROM ONE PLACE OF BUSINESS TO ANOTHER.

My estimate is that worldwide toll revenues from videophones, both the analog variety and the PC-based ISDN variety, will exceed $1 billion a year by 1999 (see Figure 2).

Why haven't videophones sold yet?

Since Bell's voice phone patent was granted in 1876, almost 120 years ago, hundreds of millions of voice phones have been sold. As a measure of the voice phone's success, the Electronic Industries Association estimates that 25.8 million corded phones, 19.6 million cordless phones, and 4.5 million cellular phones were sold to consumers in the United States during 1993 alone. Why is it then that videophones, which are much flashier than voice phones, are seeing annual sales of only 20,000 to 30,000 worldwide?

My data indicate that, since the middle of 1992, approximately 80,000 videophones had been shipped worldwide. (Again, see Figure 1). Based on sales during the first six months of 1994, videophones will represent approximately one-third of the 60,000 visual communications devices sold worldwide in 1994. Just over 20,000 group videoconferencing devices will be sold for the year, up from the 12,000 to 16,000 sold in 1993. Between 16,000 and 20,000 desktop or PC-based videoconferencing systems will sell, along with no more than 20,000 videophones. This will grow the installed base of videophones, worldwide, to somewhere between 90,000 and 100,000, a mere pixel in the sales picture predicted by others.

There are several impediments to the sales of videophones. First, there is no one to call, yet. While the corded, cordless, and cellular phones sold each year can be used immediately to make voice connections to hundreds of millions of locations, videophone callers have no one to call and see.

Second, quality videophones are still much too expensive. Quality voice phones can be purchased for $20 to $30, but quality videophones can cost $3,000 to $6,000 per terminal (including the PC). Even poor quality videophones, like the AT&T VideoPhone 2500, cost $1,399 per terminal. Regular users of visual communications, in particular group videoconferencing systems, report that it is much easier to justify a $45,000 videoconferencing system to be used by many people, than a $3,000 to $6,000 device that sits on a desk for one person's use.

Finally, the use of videophones in Europe during the EVE2 trials indicates that videophone users want to see more than just someone's face during a videophone call. They want to share data and graphics, especially if the calls are made from one place of business to another. This is why the majority of videophones brought to the market in 1994 carried graphics capability for what is termed "group collaboration."

Where videophones do sell

The early adoption of new communications systems always clusters around a few niche markets. These markets typically include the military, government security agencies, law enforcement, high technology companies, and, last but not least, pornographers.

Government and defense agencies with a need for secrecy have been interested in videophones since the mid-1970s. After a year-long study, NATO contracted with the Jet

Propulsion Laboratory (JPL) in 1977 to install slo scan videophones, manufactured by Colorado Video, in Belgium for war games. In 1979 the Defense Advanced Research Projects Agency (DARPA) funded CLI to develop a 9.6 kbit/s motion videophone called the "Sketch Coder" which delivered outlines of participants and encrypted voice over secure voice circuits run under the streets of Washington, DC. The Sketch Coder was replaced at DARPA in 1983 by Widcom's 56 kbit/s videophone, which was developed partially through a DARPA grant to Bell & Howell, which held the license for a short period of time.

As more and more technology was applied to videophones, highly secret or "black agencies" of the federal government purchased hundreds of Widcom and PictureTel videoconferencing systems for use as videophones. They were sold through Datapoint as the Multimedia Information Network Exchange, MINX.

A MAJOR HURDLE PREVENTING THE LARGE-SCALE WORLD-WIDE DEPLOYMENT OF VIDEOPHONES IS A LACK OF CONSENSUS ON STANDARDS.

Secure federal agencies continue to be one of the largest users of videophones, with some PC-based videophones built by In-Soft connecting military vehicles, while several thousand encrypted Comtech Labs videophones have been sold to the government by AT&T and Motorola.

Law enforcement agencies have used analog full motion videophones since 1973, when the City of Philadelphia strung coaxial cable under the city streets to connect city jails with the downtown courthouse for arraignment hearings. The city was forced to do so when the state legislature passed a law requiring that arraignment hearings be held within 36 hours of the arrest of a felony suspect. Similar systems are now in operation throughout California, Texas, New Mexico, and the Boroughs of Brooklyn and Manhattan in New York City.

There is also a large installation of still videophones today in the law enforcement industry for "house arrest" and "home detention" programs. Since the late 1980s, parole agencies have experimented with videophones as an alternative to electronic anklets and bracelets, in order to tether parolees to their homes or halfway houses. By using random phone calls, parole agents now talk to and see for themselves whether parolees are where they are supposed to be. Unfortunately, abuses abound. One agency, the Justice Network, Inc., in Memphis, Tenn., places 24-65 calls to parolees within each 24-hour period, sending parolees who complain (due to a lack of sleep, no doubt) back to prison. Over 4,000 still videophones were in use for home detention in mid-1992, with the number now estimated to be closer to 6,000. The total law enforcement installed base, principally made up of still videophones, is now approaching 10,000.

High technology companies have always been among the first to use new communications, such as videophones. Unisys, the Jet Propulsion Laboratory, and Martin-Marietta are among more than a dozen high technology centers that have tested the use of videophones. Sales to these institutions amount to less than 100 systems, however.

It is always a surprise to the marketing managers of new communications products when their first buyers come from the pornography industry. This process has been going on for millenia, most recently in the use or abuse of 900 or "dial-a-porn" services. (See also the map on page 66.)

Videophones are no exception, and in the mid-1980s, manufacturers of still videophones found that many of their buyers wanted them for "party lines," or video bulletin boards. These services allowed partner seekers to post still videophone images, in any pose, on electronic bulletin boards. Hugh M. Hefner, founder and chairman of Playboy Enterprises, had his Playboy Mansion wired for Picturephone in the late 1960s, allowing Hef and his editors to review pictures being considered for upcoming issues of *Playboy* magazine.

The rich and famous are another reliably visible market for new communications technologies. AT&T reports that it has sold a good number of VideoPhone 2500s to basketball players in the National Basketball Association (NBA), for example.

Market catalysts

Analysts forecast that business will spend $1.5 billion on the purchase and use of videophones and videoconferencing in 1994 (ITCA). Yet, consumer markets may actually be more predictive of how videophone revenues could grow over the next 10 years.

Teenagers, for example, are already large consumers of conferencing and interactive graphics. In North America alone, the annual phone bill for three-way conference calling for teenagers will be $264 million in 1994. Three-way toll is estimated to add another $264 million, providing phone companies total revenues of $528 million from these young consumers. Interviews with public telephone carriers in Germany, the U.K., and Japan indicate, though, that teenage three-way calling might be a peculiarly American habit. A more international phenomenon is the ease with which teens navigate through extremely complex graphical interfaces—also known as video games—resulting in $6.3 billion in 1993 American sales for Nintendo and Sega. This affection for video games could end up generating videophone revenues, with the coming of new, communicating-interactive video games with the look and feel of videophones.

Already, ImagiNation, the joint venture between AT&T and Sierra OnLine, reported 40,000 households paying monthly subscriptions in excess of $400,000 by January, 1994. ImagiNation allows players to play video games with distant subscribers by linking them through a data and phone network. By applying a modem technology called VoiceSpan, developed by AT&T's Paradyne, ImagiNation subscribers can even talk to their fellow combatants while trying to mutilate them on a video screen shared over a phone line. Doom, the extremely popular video game, is increasingly being played as a communicating-interactive video game over pairs of ordinary voice telephone lines, one for 14.4 kbit/s sequential data and one for sequences of teenage squeals.

Like video games, cable television could act as a spearhead for video telephony. In the United States, the Federal Communications Commission has authorized local telephone companies to provide "video dial-tones" to residences, Though the experiments now underway are only one-way, with consumers receiving television programs and other video from their phone company, the project will result in much greater deployment of fiber optic lines, if only to the curbside, potentially allowing two-way, switched video communication. However, the ability (and desire) of local telephone companies to develop a video dial-tone service platform which is capable of providing two-way videophone service is a very big, unresolved issue.

The need for a standard

Another major hurdle preventing the large-scale worldwide deployment of videophones is a lack of consensus on standards. While the world's group videoconferencing systems manufacturers have adopted the ITU's H.320 standard, manufacturers in Europe, the United States, and Asia have adopted three different standards for personal video and videophone systems.

In Europe, the consortium that conducted EVE2 has adopted the H.320 standard for ISDN videophones. BT, Deutsche Bundespost Telekom, France Telecom, Norway's Televerket, PTT Telecom Netherlands, and the Societa Italiana per L'Esercizio delle Telecomunicazioni p.a. (SIP) are now selling H.320-compliant ISDN videophones.

In Asia, AT&T has convinced several Japanese manufacturers to adopt its Global VideoPhone Standard, GVS. This standard describes the mathematics that AT&T's VideoPhone 2500 uses to communicate voice and video over ordinary telephone lines. AT&T has already licensed Panasonic and Hitachi to manufacture videophones using GVS, while others, such as Sanyo, JVC, and Sharp, have signed agreements to resell the AT&T-manufactured VideoPhone 2500 in Japan.

Meanwhile, GEC Marconi, which has shipped nearly as many analog videophones worldwide as AT&T, is pushing its Marconi Video Telephone Standard, M-VTS, through carriers in the Pacific Rim, outside of Japan, and in Europe to sell against the H.320 ISDN videophones.

In the United States, Intel is promoting its own ISDN videophone standard, called INDEO (INtel viDEO). So far Intel has convinced nearly two dozen PC manufacturers, software publishers, and telephone companies, including AT&T, to produce products and services around INDEO. While both H.320 and INDEO use ISDN circuits, they are incompatible with one another. Likewise, both GVS and M-VTS use analog circuits but are incompatible.

AT&T has offered some hope of interconnectivity among these different standards. Its WorldWorx network offering, which is scheduled to be released in 1995, will provide conversion services between ISDN videophones using H.320 and INDEO by next year. Hewlett-Packard, Novell, PictureTel, and VideoServer are also members of the WorldWorx group. Still, the lack of consensus is a major roadblock to the growth of the videophone market.

Lastly, widespread videophone service will not be possible without significantly upgrading network switching capacities. Consumers will likely demand that videophones offer at least as many special features as today's voice phones. Anticipating this, carriers, most notably AT&T, have begun to develop software for network switches that will allow them to adapt the Custom Calling features offered today for voice calls to video, offering videophone call forwarding, three-way videophone calls, and videophone mail. AT&T expects to add these services, not currently available on networks, to its ISDN by late 1995, but Regional Bell Operating Companies are unlikely to offer them until 1996 or beyond.

Toward 2001

Videophones have had a slow start. But the resolution of compatibility issues, likely by 1996, should allow a sizable market to emerge. Consumer videophones, as part of video games, could present a very large market for local exchange carriers, if they lower access charges for ISDN for intra-LATA calls. For business, still expected to be the largest market, as many as 375,000 ISDN videophones could be sold annually by 1999.

And once consumers and business people have others to call, revenues from sales and toll will be counted in billions of dollars—long overdue for the visionaries of 1877.

For Further Reading...

Elliot Gold's *Telespan,* published 40 times a year, tracks the latest developments in picture phones and videoconferencing. For background reading, see the following books and articles:

Rochelle Broder, "H.320 Sharpens Videoconferencing Picture," *Network World,* August 8, 1994, p.55.

E. Dickerson and R. Bowers, *The Video Telephone, Impact of a New Era in Telecommunications* (Praeger Publishers, 1974).

J. Pierce and A. Noll, *Signals, The Science of Telecommunications* (Scientific American Library) 1990.

R. Pye and E. Williams, "Teleconferencing: Is Video Valuable or is Audio Adequate?" *Telecommunications Policy,* June 1977.

Andy Reinhardt, "Desktop Conferencing Takes Off," *Byte,* June 1994, pp.24-25.

——— "Video Conquers the Desktop," *Byte,* September 1993, pp.64-80.

INTERNATIONAL TELECOMMUNICATIONS

The Challenge of Convergence

by Gregory C. Staple

As network technologies redraw the boundaries between different national markets and communications services, international carriers face a dual challenge: how to compete globally in a multimedia market. Outdated regulations and uncertain competition rules have compounded the task. This essay explores these challenges. It begins with the industry paradigm shift already underway. See Figure 1.

Part 1. Introduction

Paradigm Shift

The old paradigm governing international telecommunications was characterized by state-owned national monopolies, typically Post Telegraph & Telephone (PTT) operators. Historically, these carriers did not operate directly in other countries but provided international service by connecting their cable and satellite "half circuits" with the matching facilities of a foreign carrier. As facilities based or "Heavy Carriers," the PTTs compensated one another by a 50/50 division of a wholesale facilities charge or accounting rate per minute of traffic. Each national carrier recouped this charge, plus a mark-up, which might be 150% or more, through its own international tariff.

At the beginning of the 1990s, however, pressure from new operators, rapidly falling transmission and switching costs and the rising demands of multinational users spurred an industry paradigm shift. The new paradigm is characterized by privately owned competitive carriers which offer direct end-to-end international service by reselling, repackaging or reprogramming the facilities and services of established carriers. This alternative regime has been termed the "Light Carrier" model. These two international service models were explored at length in *TeleGeography 1992.*[1]

The Light Carrier challenge to the status quo is largely based on economics. Fiber optic cables and high capacity digital switches increased trans-oceanic circuit capacity at least 50 fold during the 1980s and radically cut connection costs. Yet, in most countries, only a very small part of these savings were passed on to users. Light Carriers exploit this fact by acquiring (by lease or bulk tariff) the facilities necessary to provide an international dial-tone and then reselling them at a discount to the standard tariffs of the Heavy Carriers. For example, numerous companies resell the switched telephone service of U.S. international carriers; many resellers also solicit foreign customers through "call back" arrangements which offer foreigners a lower cost (U.S.) dial-tone for international calls upon dialing a pre-designated U.S. number.

Other European Light Carriers offer multinational companies services for refiling their outbound traffic via less expensive national carriers. Refiling, sometimes known as hubbing, generally refers to the practice whereby international traffic originating in Country A is collected by a company and transmitted (usually by private line) to Country B, where it is handed off to an international carrier for onward routing to take advantage of Country B's lower international service tariffs.[2] Analogous practices exist in the postal field. Foreign remailing—for example, bulk posting in the Netherlands of North America-bound business mail from the U.K. or Italy—is now common.

It has not taken long for Heavy Carriers to respond to these challenges. Since 1993, eleven of the fifteen largest international carriers, accounting for 55% of the world's international traffic, have entered alliances to provide a common brand of "seamless global services." These ventures include Concert, the BT/MCI company; the Sprint-France Telecom-DBP Telecom Alliance; AT&T World Partners and Unisource—the Swiss, Dutch, Swedish, Spanish consortium. See Part III below and Figures 5 to 8.

Heavy Carriers also have begun more aggressively to adopt Light Carrier strategies to establish a global presence. For instance, international simple resale (ISR)—leasing dedicated private line capacity to provide public switched telephony—was once viewed as a low cost entry vehicle for new carriers. But ISR licenses are now held by Sweden's Telia AB, Australia's Telstra and Singapore Telecom. Other Heavy Carriers—AT&T, C&W and BT—have ISR applications pending. See Figure 2.

Enter Multimedia

But even as international carriers begin to accept a new service paradigm for telephony, the agenda for change has shifted. Digital signal processing and transmission technologies are eroding the boundaries between voice, text and video services. Tomorrow's international telecommunications network will be a conduit not only or even primarily for

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telephony but for multiple services—video telephony, computer software applications, color graphics and music. In the current vernacular, the network will become a global information infrastructure (GII) or *infobahn.*[3] Thus the challenge for the world's major telephone operators is how profitably to build their own section of this superhighway.[4]

The network's multimedia future, like the pressure for globalization, has a differing priority from country to country. Outside of the wealthiest nations, a multimedia, broadband digital network has a limited attraction. For most carriers, whose penetration is typically less than 5 lines per 100 people, the priority is still providing basic telecommunication services.[5] Moreover, even in richer nations, the near term multimedia challenge for many operators centers on the market for new enterprise-based services—voice mail, e-mail, data processing and work group software. Yet, by the early 21st century, it appears that more and more carriers will restructure their network service arrangements to satisfy the needs for a robust multinational platform which can deliver not only voice but a variety of data and video services as well.

The public's stake in this network transformation and the role of international carriers deserves more attention:

- The current telephone rate structure for international telephony insures that the world's 600 million plus telephone subscribers provide an almost unparalleled global savings and investment pool for the industry. International telecom services will generate profits of $25-30 billion annually for the rest of the decade (1994 carrier revenues will total $55-60 billion. See Appendix 1.) How much of this surplus is invested in the network, what it is invested in, and how much is passed on to telecom users and stockholders will decisively affect tomorrow's network service offerings.

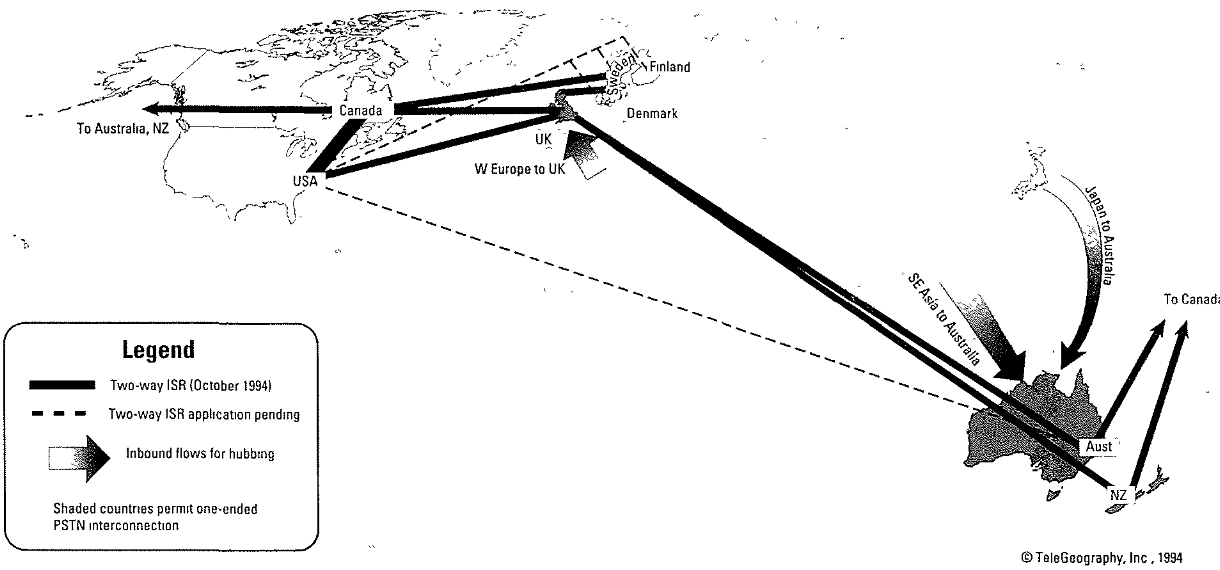
- There is a distinct risk that regulators' preference for managed competition, intentional or not, will lead many international carriers to limit rather than expand competition, and indeed to create a two-tier market structure for global services. The top tier of corporate users, their suppliers and customers will be served by new global alliances whose multinational service platform will pass on the cost savings from whole circuit provision, hubbing arrangements and innovative software. In contrast, regulators' support for traditional international routing and settlement rules—ostensibly designed to ensure a level playing field for local and foreign carriers alike—may relegate most international callers to a second tier of services with fewer options and higher rates.

- The service model for the GII—for global multimedia networks—as with the paradigm for international telephony before it, will affect the price and scope of services for years to come. The Heavy Carrier regime which built today's international network, despite its successes, severely limited network access by tens of millions of people through monopolistic pricing policies and restrictive interconnection. Light Carriers have shown there are other ways to bring international networks services to consumers. So too has the Internet, which has already demonstrated that one need not create a software company, be a record producer or build a world wide television network to become a global multimedia player. One need only be able to connect a computer file server with the audio or video or data bits one wishes to sell to other network users. Tomorrow's global multimedia networks should build on these foundations to

Figure 1. International Telecom Services: A Paradigm Shift

The Old World		***The New World***
HEAVY	→	LIGHT
FACILITIES BASED (owned)	→	NON-FACILITIES BASED (leased)
HARDWARE INTENSIVE	→	SOFTWARE DRIVEN
MONOPOLISTIC	→	COMPETITIVE
NATIONAL MARKETS	→	MULTINATIONAL MARKETS
HALF-CIRCUITS	→	END-TO END (WHOLE) CIRCUITS
ACCOUNTING RATES	→	TRAFFIC CONTRACTS/ACCESS CHARGES
PARALLEL TERMS FOR COMPETITORS	→	PREFERENTIAL TERMS FOR "PARTNERS"
VOICE SERVICES	→	MULTIMEDIA SERVICES

Figure 2. International Simple Resale (ISR)—1994



Note: ISR also possible in 1995-96 with Chile, New Zealand, and the Netherlands.

provide reasonably priced, non-discriminatory access to users around the world.

The remainder of this article is organized as follows: The next section, Part II, updates the breakdown of the one carrier, one country paradigm for international service and briefly discusses the key enabling technologies, such as ATM (Asynchronous Transfer Mode) switches, which are bringing together the market for voice, data and video services. Part III looks at the ways in which Heavy Carriers and Light Carriers are responding to the convergence between different national markets and previously separate communications services. It also profiles the new global alliances noted above. Part IV examines the regulatory response to convergence, focusing on the United States. Because the U.S. originates and terminates approximately 35% of the world's international traffic, U.S. regulation affects almost every other country. Part V offers some concluding thoughts about the regulatory imperative presented by market convergence.

Part II. Global markets, digital services

From National to Global Markets

Since the mid-19th century international telecommunications has been typified by joint ventures among national, often sovereign, monopolies or oligopolies. Through service was provided by interconnecting half circuits in international cable and, later, satellite facilities. This half-circuit regime, coupled with restrictive foreign investment rules, ensured that the market for international services was segmented almost exclusively along national lines. A carrier from Country A could not pick up traffic in Country B without the cooperation of Country B's national carrier(s) and vice versa.

As noted earlier, since the 1980s, technology and regulatory change have enlarged the geographic scope of carriers' markets, turning many national partners into global competitors. There are several causes. One is the demand of major telecom users to have greater control over the transnational communications networks used to support their global operations. These demands gradually have led governments to relax national restrictions on the lease, public network connection and resale of international private lines, thus allowing private companies to create *de facto* whole circuit networks.[6] For example, it is now lawful for a European multinational to acquire private lines among its Rome, Frankfurt, London and New York offices; to share part of the London-Frankfurt line with an affiliate; and to "refile" both companies' outbound international traffic in the U.S. via the New York office's Private Branch Exchange (PBX) which is directly connected to the public switched network.

Competition between national carriers has also increased as multinationals become more adept at locating telecom-intensive operations in countries with the most favorable regulations and tariffs. In so doing, users have introduced some degree of price competition among national carriers even though these carriers do not serve other countries directly. Carriers have also been led to make their offerings more responsive to the geographic scope of users' corporate activities rather than that of the carrier's franchise.

Second, as major carriers try to follow their prime business and residential customers when they travel, they further erode the barriers between national markets. International direct dialing (IDD) and "intelligent" software-based switches have enabled carriers to develop innovative billing and call set up arrangements to serve customers outside the operator's home market. The best known services—Home Country Direct and Home Country Beyond—permit calling card and credit card holders to use their national carrier to place international calls from almost anywhere in the world. Access is via local "free phone" numbers and international "800" (toll free) services. These services still preserve the underlying half-circuit, accounting rate regime. (The carrier billing a Home Country Direct call pays the carrier where the call originates a per minute settlement charge at least equal to the settlement it would retain from an outgoing call.) But they may expose a national carrier to direct tariff competition from numerous foreign carriers. As one U.S. carrier advertises, "How do you call a foreign country when you're already in one? Pick a card, any card."

THE DISAPPEARANCE OF DISTINCT NATIONAL MARKETS IS MIRRORED BY THE EROSION OF DISCRETE TELECOM SERVICE OFFERINGS.

Finally, national markets are converging because at least twenty countries now permit foreign operators to acquire a stake in local international carriers and thereby own the half circuit at each end of the transmission link. This type of facilities-based geographic convergence is still the exception rather than the rule, but it is already affecting business strategy (and the regulatory response) on several routes.

For example, the U.K.-based company, Cable & Wireless (C&W), owns 80% of Britain's Mercury (BCE Inc., the major shareholder in Canada's overseas carrier, Teleglobe, owns the other 20%); C&W also holds 17% of IDC (Japan), 40% of Tele-2 (Sweden), 24.5% of Optus (Australia), 58% of Hong Kong Telephone and a majority share of 17 different Caribbean carriers. Likewise, AT&T owns 20% of the Canadian long distance carrier Unitel (which also offers service to the U.S.); and a minority share in CANTV (Venezuela). France Telecom owns a minority share of the consortium controlling Telmex and 25% of Telecom Argentina, which serves the country's northern states; it also has proposed to buy a 10% stake in Sprint (U.S.). Telefonica of Spain owns a majority interest in the U.S. Puerto Rican carrier; a minority interest in Telefonica de Argentina, which serves the country's southern half; a 35% interest in Entel Peru; a controlling interest in Compania de Telefonos de Chile (CTC), a local carrier; and a minority interest in CANTV.

Even where direct foreign investment is not permitted, a foreign carrier may be permitted to lease a matching international half-circuit and to resell the capacity for end-to-end switched services by interconnecting the whole circuits with the switched network at both ends. Again, see Figure 2.

Taken together, these processes are gradually transforming the international service business. Markets once defined by national boundaries have become more elastic; user needs, billing and call set up practices, and foreign investment rules—not political geography or half-circuits—set the limits.

From Telephony to Digital Services

The disappearance of distinct national markets is mirrored by the erosion of discrete telecom service offerings. Again technology is the major driver. During most of the 20th century, international communications typically consisted of two or three distinct public services; telephony, telegraphy and telex (an automated tele-typewriter service). These services were based on different analog technologies, required different terminals; often used different international transmission facilities; and in several countries, notably the U.S., they were furnished by different record (telegram, telex) and voice (telephone) carriers.

During the 1970s new technologies began to challenge the basis for these distinct service categories and hence the viability of the underlying carriers. Of principal importance was the widespread business adoption of computers and the associated demand for communication links based on the digital standards used by computers to process information. Initially computer-to-computer (data) communications was carried on dedicated leased lines. The direct effect on the market for international telephone and telex service was limited. But, as advances in semiconductor and digital signal processing continued, computer technologies began to transform the telecommunication industry itself from an analog world of facilities-specific networks and services to a world of digital transmission and switching able to transmit voice, text, graphic and video information on the same physical network. Ever cheaper and more powerful semiconductor chips also led to the development of new terminals for electronically creating, storing and transmitting data over the public telephone network (e.g., via high speed facsimile machines and computer modems.)

By the early 1980s telecom carriers realized that they would need multi-service networks, based on digital technologies, in order to prosper in the long term. Otherwise the carrier's network would not be able to meet the needs of most business users and many new services, with potentially large revenues, would be impractical. Moreover, if the telephone company networks failed to keep pace with technology, then they risked being bypassed by the computer industry or even cable television providers which would create their own transmission networks for key clients. This threat was underscored in 1985 by IBM's acquisition of a minority stake (later sold) in MCI.

To their credit, in the 1980s leading telecom engineers sought to keep the network one step ahead of the demand for basic digital connectivity by promoting a bold new vision known as ISDN—the Integrated Digital Services Network (ISDN). ISDN entails a common set of digital transmission and switching standards which use 64 kilobit per second (kbit/s) circuit building blocks plus a signalling channel to produce a digital pipeline capable of carrying a wide range of services. And because ISDN standards are agreed internationally, in theory, ISDN permits new multimedia digital terminals to interact seamlessly around the world.[7]

CONVERGENCE IMPLIES NOT ONLY THE ENTRY OF TELECOM COMPANIES INTO DATA NETWORKING AND BROADCAST MARKETS, BUT ALSO THE ENTRY OF THESE INDUSTRIES INTO TELECOMMUNICATIONS.

This ISDN vision proved to be both too ambitious and not ambitious enough. On the one hand, international operators already committed to moving from an analog to a digital network, were reluctant to adopt ISDN as the basis for their new network when telephony—which still provided over 90% of their revenues—could be accommodated on non-ISDN digital channels. ISDN deployment was thus uneven and generally viewed as a "special" service with premium tariffs. Similarly, local and regional interests led actual ISDN standards to vary somewhat from country-to-country.

On the other hand, even as operators began to implement ISDN, the transmission rates for basic rate ISDN services (two 64 kbit/s B circuits + one 16 kbit/s D signalling channel) were increasingly viewed as too limited and inflexible to accommodate the new demands of very high speed computer workstations and real time video networks. Thus, by the early 1990's, a digital transmission and switching standard known at ATM—Asynchronous Transmission Mode—gained widespread support as the key enabling technology for broadband ISDN or B-ISDN (networks carrying 2 Mbit/s or more).[8] ATM is a flexible, software-defined switching protocol championed initially by the computer and networking industries. By breaking all transmissions into small uniform digital information packets or "cells" of 53 bytes (48 bytes of user data and a 5 byte "header" or address) ATM enables a network to carry efficiently very large streams of text, audio, graphics and video information over the same electronic channel.

Individual ATM cells are routed across a network according to the information in the header. As each cell arrives, an ATM switch reads the header and then routes the cell to a designated output port which is part of the ATM network's virtual path between the caller and receiver. This process occurs so rapidly—ATM switches may handle 5 Gbit/s or more, equivalent to over 75,000 uncompressed voice channels—that a user's data flow arrives in synch, although the data in neighboring ATM cells may have no relation to one another. ATM thus transforms the old analog, service specific (circuit switched) telephone networks of the world into digital, service independent (software controlled) virtual conduits for innumerable products.

The technologies underlying broadband digital networks and their ability to break down barriers between different service markets have profound implications for today's telecoms operators:

- As the network becomes an end-to-end digital highway, it will offer a new or alternative "route-to-market" for businesses that create or distribute information and entertainment: video rental shops, computer software manufacturers, record and CD stores, video game makers, broadcasters, film studios and book publishers. Convergence thus implies not only the entry of telecom companies into data networking (computing) and broadcast, video on demand (VOD), markets, but also the entry of these industries into telecommunications. This can already be seen in several countries as cable TV companies begin to offer telephone services, and computer companies begin to offer telephone switching and network-based software applications.

- Switching may become both more centralized and decentralized as advances in semi-conductor and software technologies increase the capacity of digital switches while sharply reducing their costs. Thus, on the one hand, new scale economies to switching may enhance the position of established operators. On the other hand, these technical trends suggest that the barriers to entry for new carriers will continue to fall and that more and more switching functions may be resident in users' terminals and local networks, making trunk transmission networks and switches comparatively "dumb." See Box 1.

For example, in 1993 Synoptics Communications, Inc., a Santa Clara, California company, announced an ATM switch with the ability to carry, receive and route 5 Gigabytes of information a second—about half the telephone switching capacity of all the central offices in New York City. Also in 1993 Microsoft, the world's largest software company, announced new application program interfaces (APIs) between its Windows PC operating systems and the telephone network. APIs permit software developers to make corporate PBXs into local network switches by adding network management software.[9] The entry of Microsoft and semiconductor companies, such as Motorola and IBM, into the telecoms market means that it will become easier and easier for any company independently to acquire telecoms switches simply by purchasing the right silicon chips and software modules.

■ The increasingly decentralized and plural telecoms architectures permitted by digital technologies also suggests that regulators will require existing operators to make their networks more and more "open" (i.e., accessible) to competing transmission and switching providers. In addition, the more the telephone network begins to resemble a distributed computer network, the more computer networks, such as the Internet—which now permits vendor and organization independent two-way access to over three million networked host computers or file servers—become the preferred model for the future. In the telephone world, open access depends upon a user's ability to plug in a telephone and obtain a dial-tone to call any other terminal on the network. For a multimedia network, the test may well be whether someone can plug in an independent file server which can connect with any other data, audio or video file server on the network.

■ Widespread adoption of ATM technologies may also lead to pressure for carriers to move beyond current "open network" architectures by unbundling the network into various service-independent transmission and switching modules. Stephen J. Downs and others contend, for example, that an ATM network is best understood as a neutral communication platform which enables the provision of multiple services rather than a network which provides multiple integrated services.[10] In this view, the provision of telephone service or video on demand or high speed data transmission services is logically separate from the provision of ATM transmission, switching and control functions—functions which might be provided by a whole new set of competitors (i.e., non-telecom companies).

■ Because the transition to ATM networks will be costly, involving installation of very complex new software based switches, there will be a transition period in which narrowband ISDN facilities and services enjoy favor. Advances in digital compression technologies, allowing full motion color video services to be distributed over a basic rate ISDN circuit may also give narrowband ISDN a boost. Thus, ISDN appears to be coming into its own even as new ATM technologies attract headlines. By the end of 1994, for example, approximately 625,000 ISDN lines (at 64 kbit/s) will be working in Europe and a like number in the U.S. A primary service driver for these ISDN lines is desktop (PC-to-PC)

Box 1. The Evolution of Network Intelligence

Toward "Smarter" Terminals and "Dumber" Networks

George Gilder, the prolific U S essayist and writer on information technologies—author of Microcosm *(Simon & Schuster, 1989) and* Life After Television *(Whittle Direct Books, 1990)—is a leading advocate of unbundling network "intelligence" (switching and signal processing) from network transmission capacity. In his new book,* Telecosm *(Simon & Shuster, 1994), Gilder sees this trend as an inevitable part of a larger evolution.*

"In the TV world," Gilder states, "you had a stripped-down receiver that could be cheaply manufactured by the millions and that relegated almost all the intelligent functions to the [broadcasting] station [T]elephone compan[ies] had all the intelligence in the central switches and the telephone was a dumb terminal. Even in the computer world, until the last decade you essentially had smart centralized mainframes and lots of dumb terminals attached Now all those models are collapsing Moore's law [posited by Intel's Chairman Gordon Moore], assuming the doubling of [semiconductor processing] capabilities every 18 months, [means] you will [soon] have super computer terminals. When you have super computer terminals capable of sending out huge floods of bits, what you really want is just dumb bandwidth to accommodate it [or] what's called 'dark fiber' The general evolution of networks will be toward having more intelligence relegated to servers on the edge of the network (which can be used for very specific applications) and more of the middle of the network will be raw bandwidth "

Excerpted from "George Gilder, an Interview with Eric Nee," Part II, Upside, *June 1994, pp 40-41.*

Figure 3. Estimated Range for Standard Period International Telephone Service Accounting Rates in SDRs by Carrier and Geographic Zone (1993)

Carrier	Estimated Accounting Rates (To/From)				
	North America	South America	Japan	India/Pakistan	Western Europe
"Tier I" European carrier (e.g. DBP Telekom; France Telecom)	0.4-0.7	1.4-1.8	1.4-1.5	1.5-1.8	0.2-0.35
"Tier II" European carrier (e.g. Italcable, OTE)	0.5-1.1	1.6-1.8	1.6-1.8	1.7-1.9	0.3-0.45
Middle Easter carrier (e.g. Saudi Arabia PTT)	1.4-1.6	1.8-2.2	1.6-2.2	1.4-1.7	0.4-1.0
Southern European/ Mediterranean carrier (e.g. Turkey PTT)	1.0-1.4	1.6-2.2	1.6-2.0	1.6-1.8	0.4-0.6

Notes: All rates stated in SDRs (In 1993, on average, 1 SDR = U.S. $1.37). On direct intercontinental routes, the settlement rate generally is equal to one-half the accounting rate, i.e., on a direct route where the accounting rate is 2 SDRs, the originating and terminating carrier typically receive 1 SDR each. Settlement rates for intra-European traffic, however, generally are asymmetric with the originating carrier receiving up to 60% of the accounting rate, depending on the share paid to transit carriers. Estimates are based on industry and government sources deemed to be reliable, but actual rates on any given route may vary.

video conferencing, aided by the recent commitment of computer and networking vendors.

Part III. Responding to convergence

It is an extraordinary challenge—geographical, technological and organizational— for operators to respond simultaneously to the erosion of national market boundaries and the convergence of voice, data and video services. Only a handful of Heavy Carriers appear to have an integrated strategy and, even then, the initiatives are still tentative. Further, as discussed below, no carrier wishes to move too far too fast into the new world without regulatory guidance.

Price Reform

Because national tariff disparities have played a large role in the breakdown of the one-country, one carrier market structure for international service, price reform and rate rebalancing (to reduce the share of network costs borne by long distance and international services) has formed an important part of many carriers' counter-strategies. On average, nominal international call prices have declined approximately 4% annually (in U.S. $) since 1983, suggesting that real prices (after inflation) are probably falling at almost 10% annually. See Appendix 1. Further, a comparison of two-way call prices among the 24 industrialized nations of the Paris based Organization for Economic Cooperation and Development (OECD) showed that in January 1994 only 17 out of 552 routes had outbound tariffs which were double the rate of the inbound tariff (i.e., a call in the other direction). See Appendix 2.

Moreover, whereas in 1991 a typical peak-rate (daytime) tariff from the U.S. to other OECD states was always less than the tariff in the opposite direction, by 1994 the U.S. peak-rate tariff was greater on a majority of routes. Again, see Appendix 2. (However, these rate comparisons do not reflect substantial off-peak discount programs and consumer calling plans available in the U.S. which often are not available in other countries.)

The price reforms initiated by some carriers have been matched by a slow, but continuing, downward adjustment of accounting rates. In 1992, the ITU-T Study Group III, formerly under the International Telegraph and Telephone Consultative Committee (CCITT), adopted Recommendation D. 140 which provides that "accounting rates for international telephone services should be cost-oriented" reflecting "relevant cost trends" and that these principles "should apply ... to all [routes] on a non-discriminatory basis."[11] ("Cost-oriented," of course, does not necessarily mean "cost-based," but few countries were willing to support a more strongly worded recommendation.) D.140 also commits countries to implement "cost-oriented" accounting rates expeditiously, with phased reduction expected over not more than five years, except possibly for developing nations. A profile of current international telephone accounting rates appears in Figure 3.

In 1992, the ITU-T tariff group for Europe and the Mediterranean (TEUREM) also adopted a revised accounting rate Recommendation D.300R, to reflect the cost reductions arising from progressive digitalization of transmission and switching facilities.[12] The new recommendation is expected to reduce accounting rates for TEUREM members by up to 20% between 1992 and 1995; this follows a 10% reduction in 1991-1992 under the prior version of D.300R. These actions by TEUREM have made intra-European accounting rates markedly more cost-oriented than intercontinental routes, creating wide disparities in the "landing fees" charged by European countries for regional traffic as compared to North American or Asian traffic. See Figure 4. These disparities, of course, provide a substantial incentive for extra-regional carriers to seek a European presence as well as for various forms of accounting rate bypass.[13]

Global Alliances

Since 1992, market pressure has led the world's largest carriers to create several global service platforms. These new joint ventures or partnerships seek to address the threat of private line bypass as well as the demands of multinational companies for a set of commonly managed services which are standard ("seamless") across national boundaries and networks. The form of these alliances, the structure of the global platforms, and the services on offer generally remain uncertain, in part because the regulatory ground rules for these new trans-national platforms have not been resolved.

At this writing, U.S. and European regulators have provisionally decided that, on balance, the alliances are in the public interest, provided certain competitive safeguards are adopted, e.g., to prevent preferential interconnection arrangements between global partners where one partner controls bottleneck facilities or holds a dominant position in its home market. As discussed below, however, the rationale for these new competition rules and the "no preferences" and "no special concessions" policy adopted by U.S. regulators are controversial. Special concessions between interconnecting service providers are an accepted practice in the international airline, banking and shipping industries where entry may also be restricted. Indeed, the concessions which airlines pass through to consumers (e.g., frequent flyer mileage credit, airport gate sharing, preferential baggage handling) are highly valued by users and enable one global service provider to distinguish its offerings from its competitors.

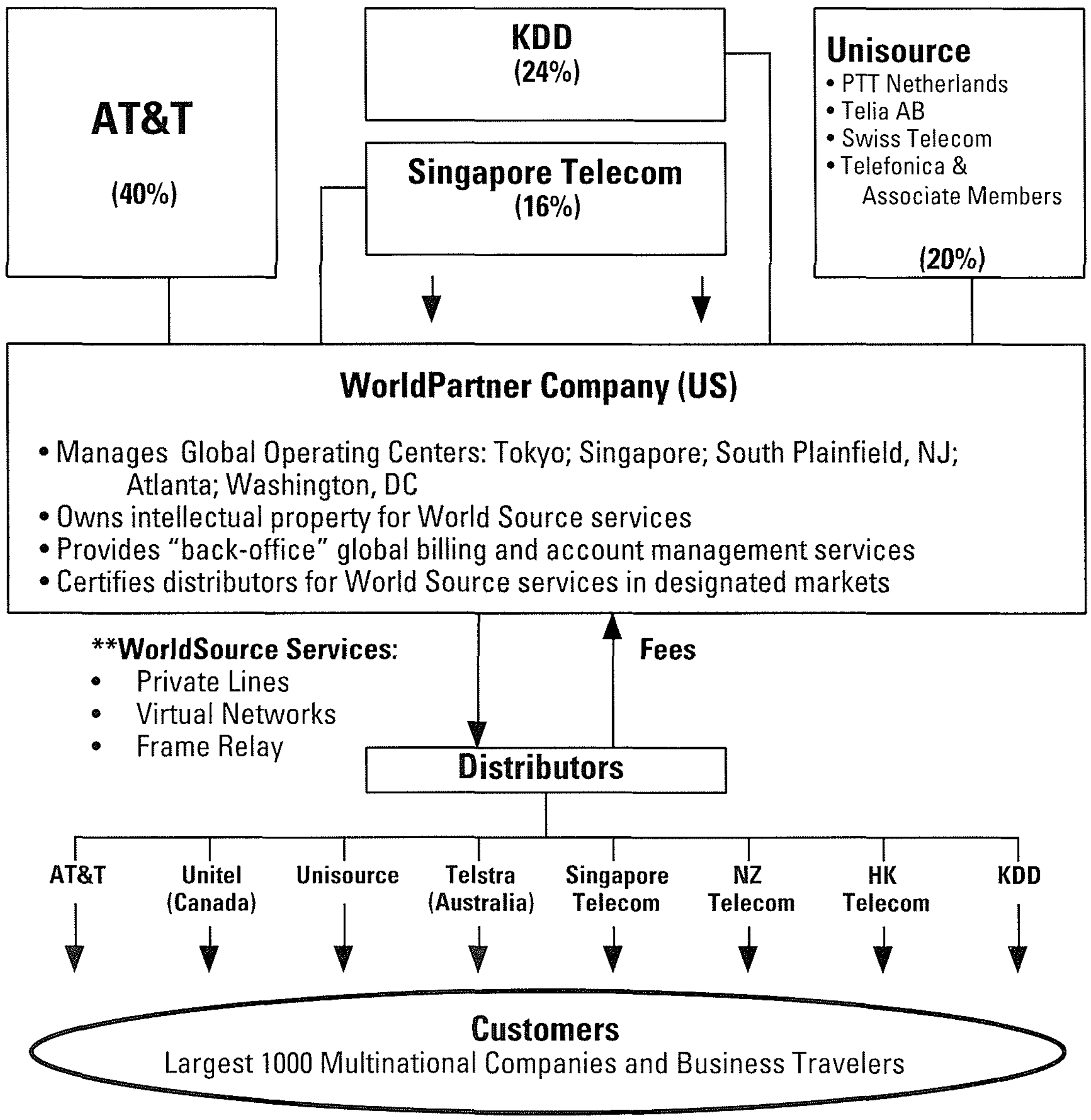
Figure 4. Settlement Rates vs. Estimated National "Access Charges" per Minute For Outbound U.S. Switched Voice Traffic (June 1994)

Termination Country	Settlement Rate	International Private Line (Foreign End)	+	Est'd PSN Breakout	=	Total
U.K. (BT)	$0.32	$0.05	+	$0.07	=	$0.12
Italy	$0.32	$0.07	+	$0.10	=	$0.17
Germany	$0.32	$0.06	+	$0.10	=	$0.16
France	$0.32	$0.06	+	$0.10	=	$0.16
Spain	$0.94	$0.07	+	$0.10	=	$0.17
Chile (Entel)	$0.80	$0.04	+	$0.07	=	$0.11
Argentina	$0.83	$0.09	+	$0.07	=	$0.16
Japan	$0.84	$0.08	+	$0.21	=	$0.29
Korea	$0.72	$0.08	+	$0.13	=	$0.21
Australia	$0.40	$0.05	+	$0.15	=	$0.20

Notes: Settlement rate is one-half peak period accounting rate; 1 SDR = $1.45 (June 1994). Private line cost based on tariff for 1.5 Mbit (T-1) cable circuit except for Argentina where 256 kbit leased satellite circuit used. Each 64 kbit circuit is used to derive 4 voice channels carrying 6000 minutes per month per channel (7200 minutes for Chile and Argentina). PSN breakout costs estimated from local tariffs, TEUREM settlement rates and industry reports.

Sources: FCC, AT&T

Figure 5. AT&T WorldPartner "Association"



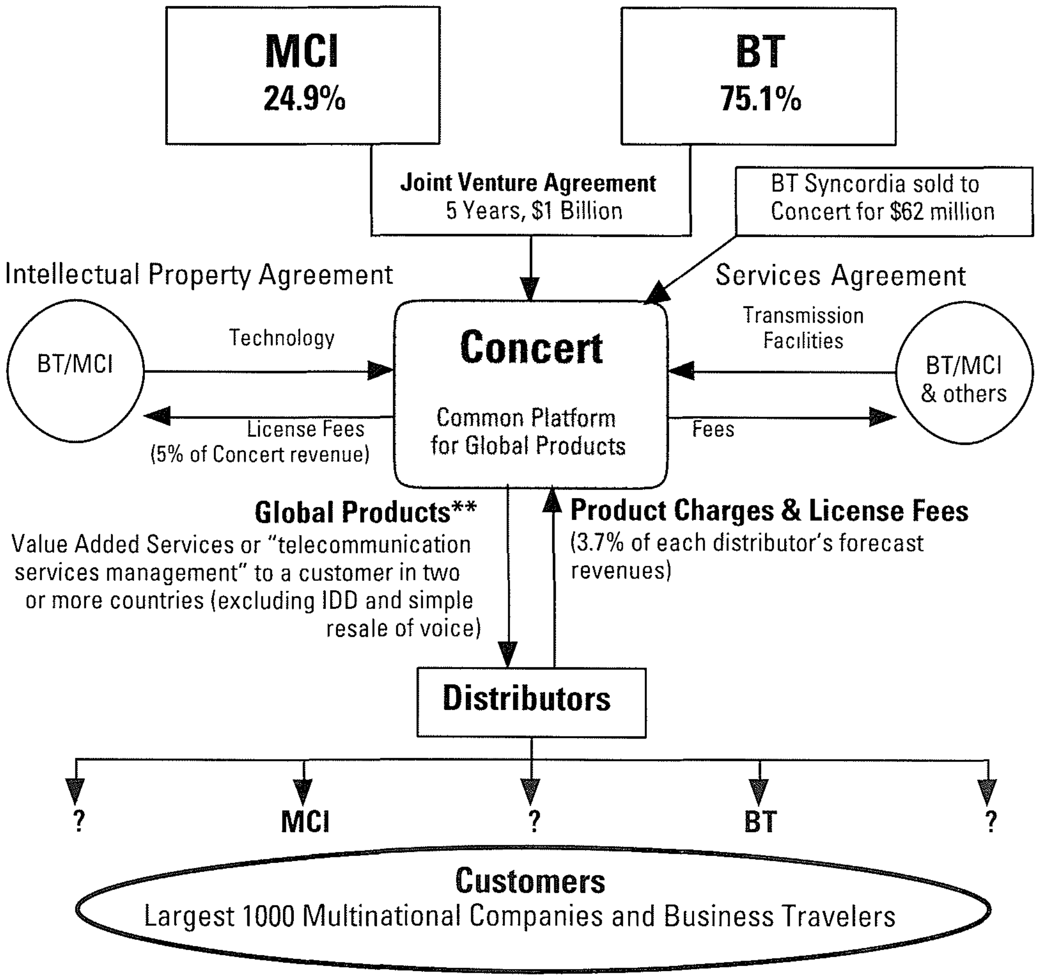
**A WorldPartner may join another global alliance. But WorldPartner Co. will not authorize competing distribution of WorldSource services, in territory where Partner has been certified.

Platforms and Services

There are four main global platforms under development: Concert, the BT/MCI joint venture; AT&T World Partners; Unisource, also a member of the AT&T Partnership; and the Sprint-France Telecom-DBP Telecom alliance. As shown in Figures 5 to 8, the operating structures of these four ventures share several common elements but there are important differences as well.[14]

First, the Concert, Sprint and, to a lesser degree, Unisource alliances involve the creation of a new, commonly owned company for acquiring half circuit transmission capacity and services which, in turn, will be made available to selected national distributors for providing customized whole circuit (end-to-end) service. This whole circuit model, of course, marks a break from the traditional half-circuit world of correspondent carriers today. But, pending relaxation of the rules on resale of international private lines, none of the alliance will offer end-to-end voice services apart from par-

Figure 6. BT-MCI Joint Venture

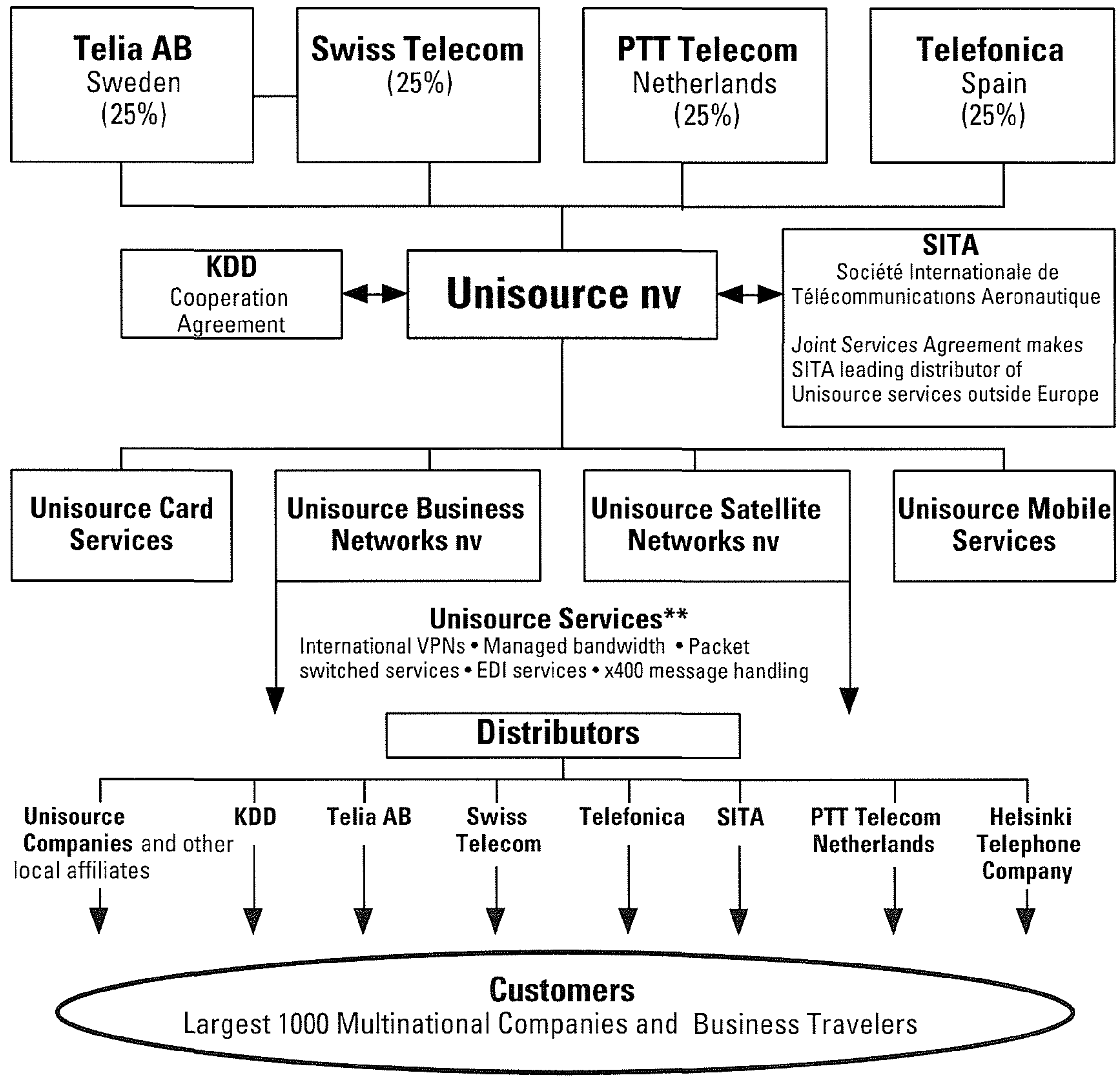


**Agreements between the parties restrict BT's provision of Concert's Global Products or similar services in MCI's territory (the Americas); MCI's provision of such products and services is restricted in BT's territory (the rest of the world).

ticipating carriers' existing Virtual Private Network (VPN) products, which reflect existing half-circuit, accounting rate arrangements. In the near term, therefore, enhanced services—data transmission, video conferencing—are likely to be the primary, stand-alone offerings of the new alliance companies.

The exclusivity and territorial allocation arrangements adopted by the global alliances vary. BT and MCI have each agreed not to market "core business" services provided by Concert or otherwise in each other's territory, (MCI's territory is the Americas and the Caribbean with BT serving the rest of the world). Breach of this agreement would cause a party to lose significant shareholder rights. (The exclusivity agreement, however, does not apply to Country Direct services.) The AT&T WorldPartners and Unisource alliances apparently are non-exclusive. For example, a Unisource company may provide competing international services directly in the U.S. or other markets where Unisource and AT&T WorldPartners operate.

Figure 7. Unisource Alliance

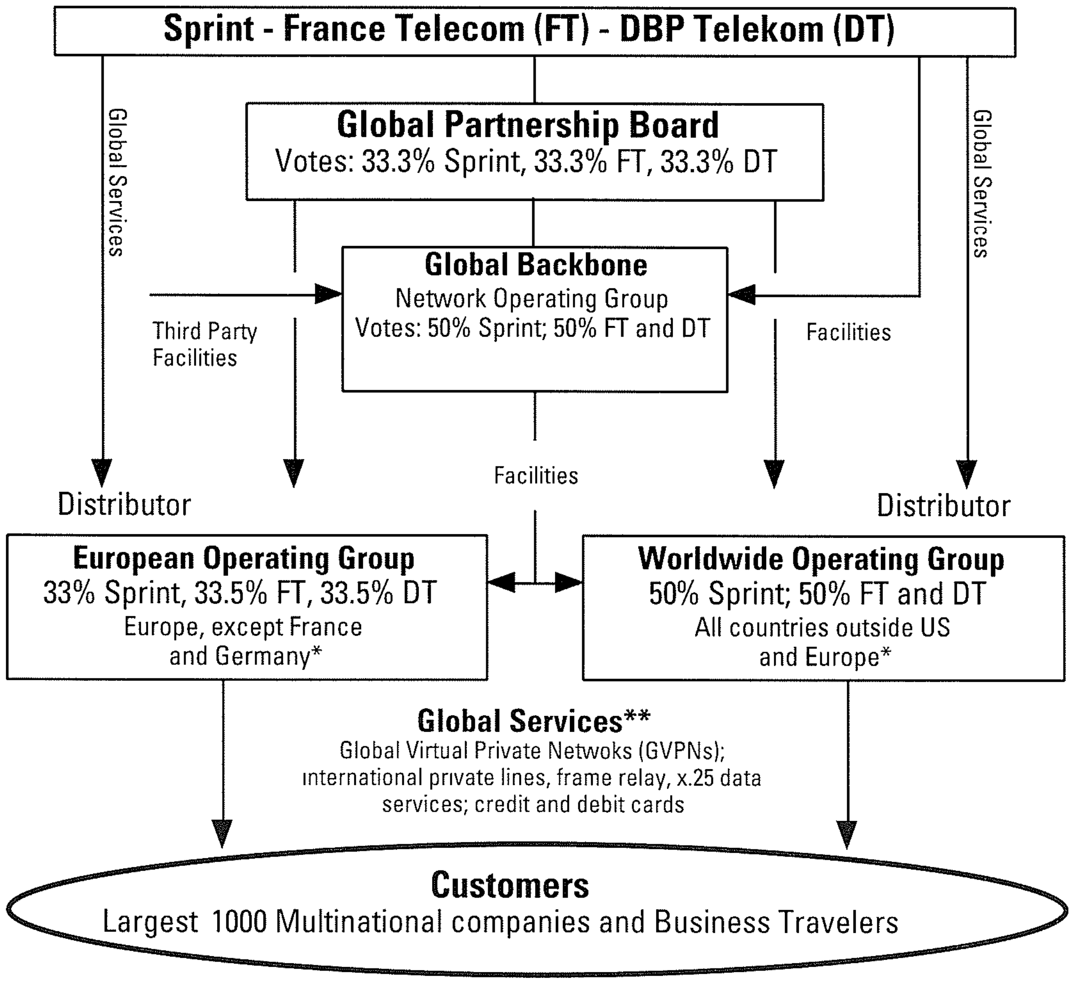


**Distributors of Unisource Services are not precluded from handling other global services, and Unisource members will also distribute AT&T WorldSource services in Europe.

The limited scope of these ventures' initial services reflects the fact that the new global platforms do not fit into the current financial and regulatory mold for public operators. Branded services imply exclusivity. Partnerships imply preferences; partners receive better terms and conditions than non-partners. In contrast, the common carrier world of international telephony generally requires carriers to provide a standard service to all interconnecting carriers and, in many countries, to resell basic services to any third party upon request.

In the short run, therefore, these new global platforms are likely to lead to a two-tier international market—one where basic switched telephony largely remains in the half-circuit accounting rate world, while "value added" (data, video) and private network service, including voice services which are part of these private nets, are shifted to a new platform. Because international telephony is a large profit center for most carriers, there is little incentive to shift switched voice services to a new joint venture company so long as an operator's major correspondents don't seek to bypass it via ISR

Figure 8. Sprint-France Telecom-DBP Telekom Partnership



**Partnership has said that European and Worldwide Operating Groups will be the exclusive vehicle for providing each company's Global Services in designated markets.

or otherwise. In the longer run, however, the carriers' new global platforms will almost certainly provide a vehicle for a mix of voice, data and video services. AT&T's recent domestic partnerships with major software and networking companies provides some indication of how such a multinational, multimedia platform may develop. See Box 2.

Light Carrier Activities

The main facilities-based responses to market convergence described above also have several Light Carrier counterparts, including ISR, calling cards, country direct calling programs and call-back. Since 1992, a growing range of carriers have begun to make use of ISR. Established operators (Telia, BT, C&W, Singapore Telecom) as well as new carriers (ACC, MFS and Pacific Gateway in the U.S.; fONOROLA in Canada ; and AAP in Australia) have all announced ISR services. Use of ISR to hub or refile regional traffic via the U.K. and Australia, where one-ended interconnection with the public network is permitted, has proven to be particularly popular.[15]

Box 2. AT&T's Software Dial-Tone

AT&T's agreements with the Lotus Development Corp , Novel Inc. and Xerox suggest that computer software will be among the key dial-up services offered by AT&T's future global network Even if a software or video dial tone is not distributed by the company's global partners, as with today's international call back services, entrepreneurs are likely to find a way to resell AT&T's new services around the world.

AT&T Network Notes

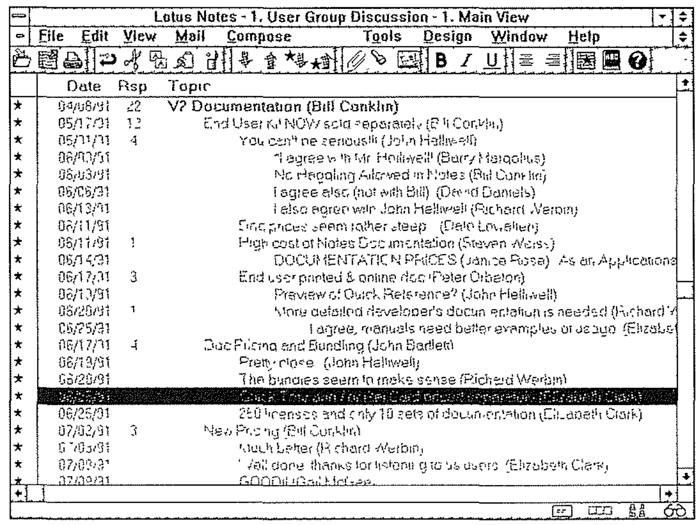
Part of AT&T's strategy is its March 1994 agreement with Lotus to make Lotus Notes available on AT&T's public network. Lotus Notes is a suite of programs for improving the efficiency of work groups and organizations Today the Notes "groupware" programs typically reside on an organization's central computer file server, but if they were based on the public network, users could access, track, share and organize information together even if they were not part of a corporate network or only occasionally part of a network team

The Notes "work space" consists of several "windows" or icons on a computer screen (right). Each icon represents a Notes software application or database such as a report to be edited, an e-mail file, a document archive, customer service records or a price directory An administrator decides which individuals and work groups may edit or add to a particular database, which may include text, spreadsheets, graphics, sound, or video

Notes is now used by approximately 1 million people in 3500 companies But Lotus believes that Notes has a much wider appeal as a tool for the new "flatter, leaner corporation" for which horizontal communication between changing teams of people has become more common than top-down links. Lotus also contends that Notes suits an economy in which more and more people work together despite being in different cities or time zones. For example, Notes could provide a common customer-support database for geographically dispersed marketing and sales staff Mail-order companies could create a common set of order forms and updated product literature accessible by anyone with a PC or a touch tone phone.

Following the AT&T announcement, Lotus began to ship "Phone Notes" to enable software developers to incorporate voice messages into a Notes document. With Phone Notes, one can have a text file translated by computer into a voice message and then leave a voice response.

AT&T's software dial tone strategy is likely to have at least two benefits for the company First, it should stimulate long distance traffic. Most computer users spend far more time in front of their terminals or connected to a company database than they do on the telephone Second, by making Notes a gateway for telephone users, the company may be able to convert more basic telephone traffic into computer traffic—value added and unregulated As James Cosgrove, AT&T's Vice President of Data Communication Services stated, AT&T's goal is to "move from provision circuits to hosting applications" on its network.



AT&T Netware Connect

AT&T's software dial tone strategy also has led to an agreement with Novel to enable Novel's Netware, communications software, which now links over 30 million users, to operate over the AT&T network. Instead of leasing dedicated phone lines, a company seeking to establish a new data link to a supplier or a remote site could simply dial into AT&T's public network and communicate with any site that subscribes to the new AT&T Netware Connect Service In addition, AT&T has announced an agreement with the Xerox Corporation to deploy new Xerox software which will allow printers and computers to transmit images over telephone lines.

AT&T's new software and video network applications are supported by a partnership of companies committed to providing a choice of compatible hardware and software for network access under the AT&T "World Worx" brand In addition to Novel and Lotus, partners include IBM, PictureTel Corp. and Sun Microsystems

 —G S

The demand for pre-paid telephone debit cards—in effect another form of service resale—has also grown at over 20% each year since 1990. Over 1 billion pre-paid cards are now bought annually throughout the world with an estimated 10%-20% of the cards' value used for international calls. During the last two years, several U.S. based companies, including USWest and Ameritech, have begun to play a significant role by marketing so called remote memory cards. These cards may be used to place long distance or international calls from any telephone (a central computer keeps track of the card's value) and thus have greater appeal in the U.S. where, unlike Europe and Japan, most pay telephones are still coin operated.[16]

The proliferation of different national telephone debit and credit cards by carriers and non-carriers alike (the market is largely unregulated) has led many users to look for a single card. One option is the new Unisource Calling Card recently announced by the Card Services division of the Unisource alliance. Unisource claims that its card is truly multi-national and will be accepted by all Unisource parent companies as well as cooperating carriers in other countries. The Dutch PTT, a Unisource member, has also introduced the first bi-national (Dutch-German) debit card which is accepted by card phones in both countries.

TO BE A GLOBAL MULTIMEDIA PLAYER IN THE AGE OF THE INTERNET, ONE NEED ONLY PUT THE SOFTWARE OR VIDEO FOOTAGE WHICH PEOPLE WANT ON A PUBLICLY ACCESSIBLE NETWORK FILE SERVER AND CHARGE A VIABLE ACCESS FEE.

In a similar vein, AT&T has announced a second generation of integrated Home Country Direct services to be offered by a new WorldPlus, Inc. subsidiary. WorldPlus plans to license a global Country-Direct and traveler's assistance platform to national operators. Wherever WorldPlus services are available, subscribers can dial a toll-free access number, key in personal account and identification data, and then use voice commands (in their chosen language) to chose a service. Options include in-country or third country calls, conference calling and global messaging service, including a personal voice mail box. WorldPlus calls generally will be priced at a premium to IDD: $1.99 per minute within Europe and $3.00 to $4.00 on most routes to Asia and South America. However, for many travelers, AT&T is plainly hoping that easy access, standardized billing and payment options outweigh the additional charges. A new MCI WorldPhone card offers similar service to those of AT&T WorldPlus.

Beyond Call Back

The spread of ISR and various card services has also boosted the international call back business by increasing access options and reducing return traffic costs. Many call back services rely upon uncompleted call signalling between customers in high tariff countries and operators in a low tariff one (e.g., a foreign call back subscriber signals a U.S. company that she wants an open line to the U.S. by dialing a designated U.S. number and hanging up after several rings). As discussed in Part IV below, in April 1994, the FCC gave call-back services a "green light" by rejecting AT&T objections to FCC resale applications filed by two such companies.[17] Although most call back companies are still U.S. based, several businesses now operate in Europe and Asia, making access to the lowest cost international dial-tone a more and more competitive business. That may prompt some Light Carriers to take on the multimedia challenge too.

For if network technologies and smart terminals permit call-back companies and other resellers to successfully provide international telephone service without owning any undersea cables or satellites, it is likely that a similar vehicle can be developed to provide a global "software" or "video" dial-tone. One natural home for such new services is the Internet, the worldwide computer network, rather than the public telephone system. However, International Discount Telecommunication (IDT), one of the original call-back companies, now based in Hackensack, New Jersey, has developed a promising hybrid. To generate more interest in its main international calling business, the company has begun providing free global access (via call back, if desired) to a U.S. based Internet gateway. And, to spread its "pax communications" message, IDT has begun working with international human rights groups to make available "banned" political and literary texts on a U.S.-based Internet host computer. The documents can then be dialed up from anywhere in the world.[18]

Although IDT's Internet service is anything but commercial, the company has recognized that convergence will require new carriers to be both "Light" and "Soft"—that is, to market something more than low cost bandwidth (although there will always be a market for that). IDT's experiment also suggests another lesson: To be a global multimedia player in the age of the Internet, one need not build a global network, a film studio, or a software company. Instead, just put the software or video footage which people want on a publicly accessible network file server and charge a viable access fee, preferably on a per minute basis, much as the telephone companies do today for long distance talk.[19]

The Internet, like today's public telephone network, also provides a preferable multimedia model for tomorrow because it is two-way. Any telephone terminal can be called by any other terminal; any Internet file server can reach any other. Which, as discussed in the next section, is why some of the most difficult regulatory battles ahead are likely to center on access to the new global multimedia platform. Will the multimedia platforms developed by new global alliances be considered proprietary (private carriers) or must the basic components (international transmission facilities, local transport, switching) be unbundled and made available for resale on a common carrier basis? Will local telephone companies seeking to provide one-way Video on Demand (VOD) services also be required to offer a comparable video platform for two way video conferencing throughout their franchised area? Or, from another perspective, will today's oligopoly markets for telephony and "free" markets for computer and video services both be replaced by managed competition or will one or the other "pure" model prevail?

TECHNOLOGY AND ECONOMICS ARE RAPIDLY UNDERCUTTING THE PUBLIC INTEREST RATIONALE FOR GEOGRAPHY AND SERVICE-SPECIFIC REGULATION.

These questions bring us to the last section of this essay.

Part IV. Regulation

As national carriers seek to compete in each other's home markets and digital technologies make telecommunication part of a much larger market for electronic services, regulators face choices as difficult as those confronting public operators. Telecom regulators (whether in a ministry or independent agency) have long considered themselves to be sovereign—the gatekeepers of the national market and the arbiter of the boundary lines between one communications service and another. And for much of the 20th century these boundary lines were respected. The quite different legal regimes (and industries) which exist almost everywhere for telephony, television and cable TV testify to regulators' historical power. Today, however, technology and economics are rapidly undercutting the public interest rationale for geography and service-specific regulation. Technology holds out the promises of abundance. And, in the absence of scarcity most consumers (when asked) seem to prefer having the market rather than government decide the players and the products, and where such products can be offered.

Regulators have just begun to transform our relatively closed set of compartmentalized national communication markets into a more open global market for digital services. In many cases international regulatory policy has been subordinated to domestic political considerations (e.g., sorting out market access disputes between cable television, telephone and broadcast interests). Beyond that, outside the larger industrialized countries, the forces of convergence are still weak; as mentioned earlier, in a majority of countries the telephone network (let alone computer networking and cable TV) still connects less than 5 people in 100. Yet, wherever located, as carriers evolve from national telephone utilities to pan-national electronic service businesses, the process will have a global impact; that is one of the meanings of convergence. It is not too early to ask therefore how well regulators are coping. Our point of departure is the U.S. for several reasons.[20]

Approximately 35% of the world's international traffic—over 16.5 billion minutes in 1993—originated or terminated in the U.S. American policies regarding the terms on which international carriers can pick up and deliver this traffic accordingly have a large impact on the structure of the global market. Second, the U.S. Government, under President Clinton, has made the promotion of an electronic infrastructure—an information superhighway—a national and international priority and has agreed upon a set of guiding principles for implementing this agenda.

The vision was articulated in March 1994 by Vice President Gore at the ITU World Telecommunication Development Conference in Buenos Aires: "In this decade ... we now have at hand the technological breakthroughs and economic means to ... create a planetary information network that transmits messages and images with the speed of light from the largest city to the smallest village in every continent ... President Clinton and I believe that an essential prerequisite to sustainable development, for all members of the human family, is the creation of the network of networks ... a Global Information Infrastructure [GII] circl[ing] the globe with information superhighways on which all people can travel."[21]

In the United States, Gore continued, "we aspire to build our information highways [the National Information Infrastructure or NII] according to ... five principles: first, encourage private investment; second, promote competition; third, create a flexible regulatory framework that can keep pace with rapid technological and market changes; fourth, promote open access to the network for all information providers; and fifth ensure universal service."[22] These five principles have been seconded by Clinton's new FCC Chairman, Reed Hundt, an experienced anti-trust lawyer and friend of Clinton.[23]

Finally, the U.S. is an instructive test bed for regulation in the age of convergence because U.S. companies—AT&T,

MCI, Lotus, Novell, Microsoft, TCI, Time-Warner—are at the center of the new multinational and multi-media alliances. Thus, it is U.S. regulators who are often the first to address the market entry and competition issues raised by these new alliances. Indeed, the importance of these issues to America's economy has led U.S. law makers to consider a major "rewrite" of the 1934 Communications Act. Although legislative reform eventually stalled in the Senate in September 1994, new reform measures will be reintroduced in 1995 when a new Congress takes office. These bills are likely to promote direct competition between local telephone and cable television companies for voice and video services. Future legislation is also expected to phase out the provisions of the 1984 AT&T antitrust consent decree (the MFJ or Modified Final Judgment) which bar the Regional Bell Operating Companies (RBOCs) from providing long distance and international service.[24]

This new legal blueprint for the U.S. communication industry could have a decided effect on the strategies of many North American carriers by the year 2000. See Box 3, On a national level, the FCC and, in certain cases, the Antitrust Division of the U.S. Department of Justice (DOJ), will be the primary managers of the U.S. transition.

The FCC's Current Agenda

Before looking more closely at the FCC's current international policy agenda, some background is helpful. The Hundt Commission has a large policy inheritance; some parts are of continuing value, some might best be revised or scrapped.

On the plus side is the FCC's decade-old decision not to regulate international value-added or enhanced services. In 1985, following the agency's landmark Computer II order, drawing a regulatory line between telephone (basic common carrier) and computer (enhanced or value added) services, the FCC confirmed that the Computer II rules applied to international telecom services.[25] The regulatory "safe haven" created by this FCC order has enabled scores of U.S.

Box 3. Who Will Carry North America's International Traffic In 2001?

The North American market—Canada, the U S and Mexico—accounted for almost 40% of the world's international telephone traffic in 1993. By the year 2000, this traffic base is likely to double to over 35 billion minutes. Trade agreements notwithstanding (basic telecommunication services fall outside of NAFTA, the North American Free Trade Agreement) the market is now divided along national lines

Until at least March 1997, Teleglobe will be Canada's only overseas carrier Stentor (formerly Telecom Canada) and Unitel, Canada's second facilities-based long distance carrier, compete with each other to provide service to the U S Telmex has a monopoly over Mexico's international traffic until at least August 1996. Thus, aside from calling cards and cross-border private lines, U.S , Canadian and Mexican carriers must now rely primarily upon their own national customers By 2001, however, there are several factors which may lead North American calls to become more segmented by carrier and product, rather than national point of origin

One factor driving the market realignment is the new "strategic alliances" between major long distance carriers In 1993, MCI, which has approximately 20% of the U.S. long distance market, formed an alliance with Stentor, which has over 85% of the Canadian long distance market And in 1994, MCI formed a joint venture with Grupo Financiero Banamex-Accival (Banacci) to bid for a second long distance and international services license in Mexico. AT&T, in turn, has acquired a 20% interest (the maximum legally permitted) in Unitel and has formed a joint venture with Grupo Alfa to bid for a new long distance license in Mexico Sprint also has cross-border alliances It has a 25% interest in Call-Net, Canada's largest long-distance reseller, and a 33% proposed interest in Mexico's Iusacell, a regional cellular telephone carrier, which also plans to file for a long-distance license. These regional alliances have already led to joint cross border (U.S -Canada) business services and calling plans, more are expected

A second driver of change is the rapid growth of mobile phones The largest U.S cellular telephone carrier, McCaw Communications, recently acquired by AT&T, Rogers Communications in Canada and Iusacell, have all forged national mobile networks. Each is also party to roaming arrangements for cross-border mobile traffic. Nextel Communications, Inc , which plans competing national mobile service in the U.S , has entered into partnerships with Corporación Mobilecom S A. in Mexico and Clearnet Communications, Inc , in Canada. Further, these services will soon be supplemented in the U.S by satellite mobile services from the American Mobile Satellite Corporation (AMSC) AMSC may also compete with other "global" satellite mobile systems in Canada and Mexico. There are now over 20 million cellular telephones in North America and even if the new U.S Personal Communication Service (PCS) grows slowly, there are likely to be over 50 million mobile phones in the region by the end of the 1990s and foreign companies to resell the capacity of international private lines and offer a wider-and-wider array of "enhanced" services outside the telephone world's half-circuit, accounting rate regime. Such services generally are subject to bilateral International Value Added Network (IVAN) agreements.[26] And, while these IVAN agreements may become of less value once unlimited resale of international private lines occurs, they have often let new carriers establish a foreign market presence which may be broadened as local service rules are liberalized. IVAN agreements also provide a barrier against re-regulation of value-added services.

Second, since the early 1980's the FCC has permitted unlimited facilities-based competition for voice services. There are now over twenty facilities-based international carriers in the U.S. including several carriers with majority foreign ownership, such as Cable & Wireless Communication, Inc. (U.K.), Telefonica Larga Distancia de Puerto Rico (Spain), and fONOROLA (Canada).[27] The FCC's decision to grant foreign carriers authority to own and operate U.S. based international carriers, and thus to correspond with themselves (i.e., to establish a whole circuit service), has not been without controversy. Such authorizations have all been subject to "competitive safeguards" and reporting (transparency) rules.[28] Further, as discussed below, the Hundt Commission has recently revisited this critical issue in two cases, one involving the BT investment in MCI and a second involving an application by a subsidiary of ENTEL-Chile to acquire a controlling interest in a U.S. start-up carrier, AmericaTel.

One of the principal issues raised by the BT/MCI joint venture and the AmericaTel case is the terms and conditions on which a foreign owned U.S. carrier may interconnect with its non-U.S. affiliate when the affiliate has a dominant market position or controls "bottleneck" local exchange facilities. This issue implicates a third inheritance—the FCC's International Settlement Policy (ISP).[29] In simple terms (although the policy has been anything but that to adminis-

A third factor realigning the market is competition for value added services MCI, AT&T, Sprint and other carriers already provide electronic mail and many data services across the three countries These services have been almost entirely deregulated and NAFTA ensures that they will stay so Thus, as new computer-based and interactive (e.g , multimedia) services take a larger slice of consumer telecom budgets, competition along service rather than national lines will intensify

Finally, the region's future market will be influenced by new players Additional international licenses for facilities-based carriers are likely to be granted by Mexico (1996 or 1997) and Canada (1997 or 1998) Further, within the next two years new U.S. telecoms legislation likely will permit the seven U.S RBOCs (Regional Bell Operating Companies) to provide international service by the year 2000.

Several future scenarios deserve consideration. One sees the evolution of the current MCI, Sprint, and AT&T strategic alliances, with equity holdings enlarged as foreign ownership limitations in Canada and the U.S are relaxed. Another scenario sees the growth of a new "carriers' carrier" for North America, such as Teleglobe or Comsat or LDDS, which would bid to provide low cost international connections for second-tier carriers, cellular providers and resellers. Similarly other "carriers' carriers" might emerge with service specialties (e g , for enhanced fax, picture phones, television relay service). A third scenario sees the development of two or three new international carriers, possibly based on one or more of the RBOCs Such carriers might have a regional focus (Latin America or eastern Russia and China) and logically might team with independent U S. operators (BC Tel, Hawaiian Telephone, Alascom) or foreign carriers (France Telecom, Telefonica, NTT) which already have investments in the region

These scenarios may not be mutually exclusive The volume of international traffic to and from North America probably is large enough to support several more international carriers, especially if they bring with them a share of a region's long distance calls, typically eight to nine times the size of its international traffic But every scenario is likely to involve some tough regulatory fights. Long distance tariffs still vary markedly across the region, and the U S , Canada and Mexico still negotiate foreign accounting rates separately. Further, Canada has a Canada-carriers only policy for routing all domestic long distance and international traffic. Similarly, Telmex is not anxious to share its $750 million annual surplus of foreign settlement revenues (largely from the U S) with other regional carriers

In sum, despite commercial and regulatory friction, two or more continent-wide international carriers are likely to arise by the year 2000. As that occurs, the geographical divisions within the North American market will give way to market segments which more closely track the region's major operators and services

—G.S.

ter) the ISP requires all U.S.-based international carriers offering switched services to accept: (1) the same (parallel) accounting rate settlements with a given foreign carrier; and (2) the proportionate return of traffic—that is, a carrier may only land inbound U.S. traffic from a given country in proportion to its outbound traffic stream on the same route. This policy was mainly adopted to ensure that a monopoly foreign carrier did not obtain more favorable terms by "whipsawing" (playing off) one competing U.S. carrier against another; the policy also ensured that any new U.S. carrier would obtain a "fair share" of inbound (typically more profitable) traffic based upon its U.S. market share.

The FCC may waive the ISP if it serves the public interest to do so. But to date, waivers have been of limited scope. Even on routes where there are competing carriers at both ends (approximately 40% of outbound U.S. traffic now terminates on routes where two or more privately owned international carriers are authorized at the foreign end) parallel accounting rates and proportional return—that is, managed competition—are still the rule.

THE HUNDT FCC HAS A LARGE POLICY INHERITANCE; SOME PARTS ARE OF CONTINUING VALUE, SOME MIGHT BEST BE REVISED OR SCRAPPED.

The future of ISP in a competitive global market is, in turn, linked to the future of a fourth policy inheritance: International Simple Resale (ISR). In 1991, after an extensive proceeding, the FCC decided that unlimited resale of international private lines was not in the public interest because it might permit carriers, including foreign operators, to bypass inbound U.S. accounting rates, whereas U.S. carriers might not have similar opportunities in the foreign operator's home country.[30] Thus, even though one-ended resale might help to lower accounting rates and tariffs, foreign callers and carriers would be the primary beneficiaries. Accordingly, the FCC held that ISR would only be permitted on routes where the foreign country provided resale opportunities "equivalent" to those available under U.S. law. And, to prevent the policy being undermined, ISR carriers would not be able to refile traffic via the U.S. to or from third countries not deemed "equivalent" by the FCC absent the consent of the countries affected. In determining where "equivalence" exists, the FCC stated that it would consider various factors, including local licensing, tariffing and network access conditions. Under this standard, by October 1994, the FCC had only approved ISR between the U.S. and Canada and the U.K.; ISR applications to Australia, Sweden, Finland, and Denmark are pending. See Figure 2.

Finally, the Hundt Commission inherited the FCC's alien ownership policies which, unlike the other policies discussed above, have a statutory basis in Section 310(b) of the Communications Act.[31] The Act bars foreign companies and individuals from owning more than 20% directly or, absent an FCC waiver, more than 25% indirectly of an entity holding a radio license; the Act does not apply to non-radio authorizations such as those granted under Section 214. Since the mid-1980s, however, the FCC has applied these foreign ownership rules liberally, permitting several U.S. communication companies to sell a majority interest to foreigners so long as the company's Section 310 radio assets are first spun-off to a separate U.S. controlled operating company.

At the end of 1993, these were the main FCC policies governing the structure of the international services industry. Taken together, the policies straddle the old world and the new, seeking to balance the interests of carriers and consumers both in the U.S. and overseas. On the one hand, the policies firmly commit the U.S. to facilities-based competition for basic international services by U.S. and foreign operators; international private lines may be freely resold for value added services. Yet, on the other hand, the parallel settlement and proportional return requirements of the ISP, the limits on resale of international private lines for basic services, including third country refile (hubbing), all insure that competitors primarily adhere to the old, half-circuit, accounting rate model where traffic routing and prices are fixed bilaterally.

Similarly, although the ISP inspired "competitive safeguards" placed on international facilities authorizations granted to foreign owned U.S. carriers are designed to preclude favoritism among affiliated carriers, where neither carrier has a dominant position in its home market (i.e., controls "bottleneck" local exchange facilities) such policies amount to a form of managed competition or market sharing. This raises the question of whether the FCC should now view the ISP and similar "competitive safeguards" as a transitional regime which can be dismantled when competition exists at both ends of an international route or whether such rules have more enduring value.

What Happens Next?

In September 1993, the tensions between the FCC's various international policies and the uncertain market access standard for foreign owned carriers led AT&T to petition the FCC for a comprehensive international policy review.[32] Despite AT&T's own global service initiatives, the company's petition did not ask the Commission to revisit the rationale for the ISP or the related anti-hubbing rules in view of current market conditions. AT&T took the opposite approach; it urged the FCC to bar access to the U.S. market by any foreign-owned or "affiliated" carrier (which AT&T defined as a U.S. carrier having 5% foreign interest) unless the carrier demonstrated that "comparable market access conditions" existed in the carrier's home market.

Further, AT&T argued that no FCC authorization should be granted to such a carrier unless the carrier agreed to various operating conditions which would: (a) forbid "exclusive arrangements for provision of basic or *enhanced* services [emphasis supplied]"; (b) implement the current ISP rules regarding parallel settlements and proportional return; (c) prohibit the refiling of U.S. originated or terminated traffic without the consent of the originating and terminating carrier;[33] (d) forbid preferential transit rights or other special concession; and (e) make available to all U.S. carriers tariffed interconnection and distribution arrangements in the foreign carrier's home market on the same terms as the foreign carrier provides to its U.S. affiliate.

THE AMERICATEL APPLICATION GAVE THE HUNDT COMMISSION ITS FIRST OPPORTUNITY TO APPLY THE AGENCY'S PRIOR MARKET ENTRY STANDARDS FOR FOREIGN CARRIERS.

Despite its largely one-sided approach to the problems of convergence, the issues flagged by the AT&T petition—exclusive end-to-end service arrangements, traffic refiling, transit terms, the conditions for domestic interconnection—are central to the industry's transition from one service paradigm to another. However, it will probably take the FCC and other regulators years to decide whether AT&T's proposals offer the right solution.

The first indication of how the Hundt Commission might resolve some of these issues was provided in an April 1994 order regarding the legality of U.S.-based "call back" services.[34] The case involved applications by VIAUSA, Ltd. and another carrier to resell the international switched telephone services of U.S. carriers for "call back" and other services. In granting the application, over the objections of AT&T and several South American operators, the FCC ruled that uncompleted international call signalling (sometimes known as "code calling") was not an unreasonable practice under the Communications Act. Further, the FCC stated that international resale, including call back resale, is in the public interest because it places downward pressure on foreign collection rates, thereby benefiting U.S. consumers.

The FCC's affirmation of the consumer benefits flowing from call back, arguably pointed the Commission toward weighing user interests more heavily than carrier interests in reviewing the call routing restrictions at the core of the agency's ISP and ISR rules. Yet, the Commission's next major international policy decisions—the AmericaTel and MCI orders—appear to reaffirm the *status quo,* at least pending a more considered review of recent changes in the international marketplace.

The AmericaTel Case

The AmericaTel application to transfer a controlling interest in a facilities-based U.S. international carrier to ENTEL-Chile, pending since early 1993, gave the Hundt commission its first opportunity to apply the agency's prior market entry standards for foreign carriers. In June 1994 the FCC approved AmericaTel's application.[35] In so doing, however, the FCC made it clear that even carriers based in a nominally competitive market such as Chile, where five facilities based international carriers have been authorized, may not provide service to and from the U.S. without agreeing to numerous "competitive safeguards" and disclosure requirements—requirements which go beyond past FCC orders.

In its AmericaTel order the FCC reiterated that applications by a foreign carriers will be reviewed on a case-by-case basis: the public interest favoring open entry will be balanced against "the potential for discrimination by a foreign carrier against unaffiliated U.S. carriers." Discrimination may exist, said the agency, absent market entry opportunities for U.S. carriers on the foreign end, in light of demands by U.S. multinational firms for end-to-end telecommunication services. "[F]oreign carriers that are permitted to offer end-to-end service on a U.S. international route could obtain an unfair advantage unless U.S. carriers are permitted to do the same." Hence, the FCC said that it would consider, as one factor in its public interest balance, the degree to which Chilean regulation provided U.S. firms with "effective opportunities to compete" with ENTEL-Chile.

After a careful review of the Chilean market, the FCC held that U.S. carriers could compete with ENTEL-Chile and that although ENTEL-Chile did not control key international gateway or long distance facilities, its local affiliate, CTC, did own "bottleneck local telephone facilities" and thus "may have an incentive to discriminate" in favor of ENTEL-Chile and AmericaTel.

Consequently, AmericaTel's application was granted by the FCC only upon AmericaTel's acceptance of numerous conditions. They require that AmericaTel: (a) abide by the ISP; (b) accept "no special concessions" from any other foreign carriers—that is, no "preferential or exclusive operating agreements or marketing arrangements for ... basic services or transit traffic not available on a nondiscriminatory basis to all competing U.S. carriers"; (c) obtain route-by-route and, for Chile, circuit-by-circuit authorization from the FCC;

(d) file copies of any operating agreements that affect traffic or revenue flows between the U.S. and Chile; (e) file tariffs for all U.S. international services with full cost support data for the U.S.-Chile service (including domestic network access costs); and (f) file annual regulatory progress reports for five years which detail implementation of Chile's multi-carrier system, provide ENTEL Chile's market share for telephone service on its 15 largest international routes and compare ENTEL-Chile's accounting rates on these routes with the Chile-U.S. rate.

The BT/MCI Case

The "competitive safeguards" and reporting conditions adopted in the AmericaTel case were also reflected in the FCC's July 1994 decision approving BT's 20% investment in MCI and the Concert joint venture for end-to-end global service.[36] However, the FCC's action in the BT/MCI case was also affected by the activities of the Antitrust Division of the U.S. Department of Justice (DOJ). In July 1994, the DOJ also concluded its year-long investigation of the BT-MCI deal by filing simultaneously an antitrust complaint in U.S. District Court, Washington, D.C. and a proposed Final Judgment or consent decree (negotiated in advance with MCI and Concert) to resolve the DOJ's concerns.[37] The complaint alleges that MCI's sale of 20% of its stock to BT, the creation of Concert and related agreements "may substantially reduce competition" in basic and enhanced international telecommunication markets because BT's home market power and "bottleneck" local facilities gives BT the ability (and incentive) to favor its U.S. affiliate over other carriers. It is alleged that MCI's proposed transaction is thus unlawful under Section 7 of the Clayton Act, which bars agreements between companies where "in any line of commerce ... the effect ... may be substantially to lessen competition."

The proposed MCI Final Judgment would remedy these alleged violations by (a) requiring MCI and Concert to disclose to the DOJ and U.S. carriers competing on the U.S.-U.K. route (but not others) the rates, terms and conditions under which they would gain access to BT's home network; (b) barring MCI and Concert from misusing proprietary information obtained from MCI or BT correspondents; and (c) preventing MCI from providing Concert or BT with U.S. facilities for ISR until the U.K. grants ISR licenses to seven U.S. carriers, including AT&T and Sprint, and BT offers said carriers the "opportunity to interconnect with [its] network on standard, nondiscriminatory and published terms ... without limitation on the amount of traffic carried."

Under U.S. law the proposed Final Judgment is not self-executing; following public comment, the Judgment must be reviewed by a District Court Judge (in this case Thomas F. Hogan) to determine whether it is in the public interest—a process which may not be completed until 1995, following which further court appeals are possible.

The FCC's Order regarding the BT/MCI transaction also breaks new ground. The agency first ruled that BT's 20% investment in MCI, even when combined with the existing 8% foreign ownership in MCI, was consistent with the public interest under Section 310 of the Communications Act.

THE FCC'S ORDER REGARDING THE BT/MCI TRANSACTION IS ALSO SIGNIFICANT. IT PROHIBITS MCI FROM ACCEPTING ANY SPECIAL CONCESSIONS FROM BT OR ANY OTHER FOREIGN CARRIER.

The FCC went on to hold that its concerns regarding BT's incentive to prefer MCI and Concert over other carriers would be satisfied, in part, by MCI's voluntary agreement to incorporate a new "no special concessions" clause in all of its Section 214 authorizations. The clause would prohibit MCI from accepting concessions from any foreign carrier not available to similar U.S. carriers regarding traffic or settlement flows between the U.S. and any foreign country.

According to the FCC, the "no special concession" clause would preclude MCI from accepting "preferential or exclusive operating agreements or marketing arrangements for the provision of basic telecommunication services ... including new basic services." The clause would also prohibit MCI and BT from entering into "any arrangement ... for the joint handling of basic traffic originating or terminating in third countries" (e.g., transit agreements, hubbing) on terms not available to all competing U.S. carriers.

Third, in line with the AmericaTel order, the FCC required MCI to adopt several "competitive safeguards" and reporting rules. MCI must also obtain BT's agreement that it will not offer special concessions to Concert regarding the provision of basic services. MCI must disclose publicly its international facilities, revenue and traffic on the U.S.-U.K. routes quarterly and file with the FCC copies of all agreements relating to the routing of traffic and settlement of accounts on the U.S.-U.K. route. MCI must also obtain prior FCC approval for BT to change its ownership or voting interest in MCI.

Finally, at the request of MCI and BT, the FCC did not rule on whether Concert is subject to Title II as a common carrier. This is a crucial point; the parties consider Concert to be a non-carrier furnishing facilities and proprietary services solely to BT and MCI. The FCC decision not to second guess Concert's status, at least temporarily, thus preserves the structure of the parties' joint venture and precludes competing carriers from gaining direct access to Concert, as opposed to the basic common carrier services which BT or MCI might furnish to Concert.

In sum, read together, the FCC's AmericaTel and BT/MCI orders leave the FCC with one foot planted in each world. The old international regime, based on the ISP's parallel accounting rate, non-discrimination and no special concession rules remain in place and, moreover have been buttressed with new reporting rules. Where a U.S. carrier wishes to correspond with a foreign affiliate having any market power or "bottleneck" local exchange facilities, the FCC's view is that local (foreign) regulation and competition laws cannot be relied upon to protect U.S. interests. But the FCC finds some promise in the new world: foreign owned U.S. carriers and new multi-carrier joint ventures should be authorized provided they agree to compete on the same terms open to non-affiliated and non-foreign owned U.S. carriers.

Which brings us to the last portion of this essay—the FCC's approach to the convergence between telecommunication and other services.

From Telephony To Video Dial-tones

Current FCC regulation, as described above, assumes the communications market is primarily segmented by geography and services. There is one set of rules for basic common carrier services; another for enhanced services (over which the FCC has jurisdiction but chooses not to exercise it); and a third regime exists for non-common carrier services, notably broadcasting. This last regime has no ISP, no anti-hubbing policy, no requirement for non-discriminatory foreign access, no bar to special concessions for international services. Likewise, whereas international common carrier services must be provided on a non-discriminatory basis, under tariff to all—and extensive rate averaging and tariff-based contribution mechanisms make such service almost universally available—broadcasters and other video program distributors, like on-line computer services and e-mail providers, may pick and choose their customers and have extensive pricing flexibility.

How is the FCC to reconcile these three or more regimes when the international switched telephone network becomes an end-to-end digital pipe simultaneously providing dial-up voice, video and data services to millions of international users? Does proportional return of traffic make sense in a world of video dial-tones? Is a "no-special concessions" policy in the public interest between foreign affiliated computer game distributors or on-line software vendors or video on demand entertainment producers? Or is such a policy relevant only if the service provider is vertically integrated with a common carrier?

> ***DOES PROPORTIONAL RETURN OF TRAFFIC MAKE SENSE IN A WORLD OF VIDEO DIAL-TONES? IS A "NO-SPECIAL CONCESSIONS" POLICY IN THE PUBLIC INTEREST BETWEEN FOREIGN AFFILIATED COMPUTER GAME DISTRIBUTORS OR ON-LINE SOFTWARE VENDORS OR VIDEO ON DEMAND ENTERTAINMENT PRODUCERS?***

And what about IVANs; will they provide a regulatory safe-haven for the next generation of international digital video and data services or has their day passed? Can (or should) a level of playing field be established solely by providing non-discriminatory tariffed access to basic transmission facilities? And is this approach viable (or even desirable) when there are multiple basic service providers or when network technologies—e.g., ATM—make it possible to separate basic network control, routing and service functions from raw transmission capacity?

Not surprisingly, the FCC, like other regulators, has just begun to address these issues. So far as video services are concerned, the focus has been almost exclusively domestic. Since August 1992, when then FCC Chairman Alfred Sikes persuaded the agency to authorize telephone companies to provide video dial-tone services, the agency has struggled to implement this new policy.[38] Yet, video dial-tone services are primarily viewed as a one-way offering (e.g., a local exchange carrier downloads movies resident on a central video file server to local subscribers) with limited interactivity. The provision of a two-way, switched video platform which would be functionally the same as today's switched telephone service has received more limited attention. One reason is that, in theory, most U.S. telephone companies already have a platform for switched video; it is called ISDN and users who want dial-up video links between different national (or international) points are urged to subscribe. However, the carriers' current ISDN offerings are far from ubiquitous and are designed for dedicated site-to-site services—subscribers without an ISDN link are (literally) out of the picture.

Even a casual review of the delays which have plagued the FCC's video dial-tone initiative demonstrate the significant regulatory hurdles which must be crossed to create a more broadly-based switched video platform in the U.S. Since 1992, only five video dial-tone trials have been approved and it was not until July 1994 that the agency finally granted the first commercial video dial-tone application filed by a Bell Atlantic subsidiary, New Jersey Bell (NJB).[39]

The NJB authorization reflects the FCC's two tiered basic/enhanced regulatory model. NJB was permitted to establish a basic common carrier platform to distribute video programming to local exchange customers and to offer its own video services on deregulated (enhanced) terms subject to certain safeguards to prevent cross-subsidies (from basic ratepayers) and to ensure that sufficient distribution capacity is available to accommodate foreseeable demand from non-affiliated entities. Thus, the FCC required NJB to tariff its basic video dial-tone platform; to create separate accounts for the service (to be disclosed quarterly to the FCC); and to ensure a minimum of 300 video channels for service beginning in 1995. The Commission also reserved the right to change these terms and conditions following its review of NJB's tariff when the agency must resolve the details of allocating NJB's local exchange costs among the video dial-tone and other regulated services.

THE OLD MODEL OF REGULATION IS AS MUCH IN NEED OF A THOROUGH OVERHAUL AS THE BUSINESS PRACTICES OF THE CARRIERS THEMSELVES.

In short, the FCC's initial video dial-tone order—which involved service to but 38,000 NJB subscribers—suggests that the domestic task of creating a multimedia regulatory regime (even without new legislation) will be complex and protracted. To some observers, in fact, the disputes between the U.S. telephone and broadcasting/cable TV industries regarding video services seem to mirror those of the 1970s and 1980s between the data services and telephone industries.

For international carriers, this is not encouraging. Notably, it was not until 1985—almost 15 years after the FCC began its proceeding to deregulate computer communication services—that the agency confirmed that its the new domestic U.S. regime would apply to international enhanced services. It took another 5 years before IVAN agreements were in place to ensure that these services could actually be provided to such countries as Japan, Hong Kong and the U.K. Thus, if history repeats itself, U.S. companies—whether foreign affiliated or not—could well find themselves waiting out another 15 to 20 year set of regulatory and court proceedings to provide trans-national video services.

Part V. Conclusion

Shortly after FCC Chairman Reed Hundt assumed office, several FCC staffers were seen wearing T-shirts with the following message: "Read the law. Study the economics. Do the right thing." This advice may sound simplistic but it points in the right direction; sound public policy in the telecommunications area involves a question of balance. Purely legalistic or economic considerations may ignore political and commercial realities.

Likewise, although regulators are most likely to hear repeatedly from the carriers directly affected by their decisions, these provider interests must be balanced against the concerns of the hundreds of millions of telecommunications users whose interests may be only occasionally voiced. And today this balance between provider and user interests also requires taking into account companies and consumers in the broadcasting, computer services and publishing fields as well.

Doing the right thing also means understanding technology —advice strangely absent from the FCC's T-shirt. For technology has been the great driver of change in the telecommunications market, changes whose consequences have become ever more far reaching with the deployment of advanced semi-conductors and fiber optic cables. As Vice President Gore told the Buenos Aires conference, "the economics of networks have changed so radically that the ... competitive, private market can build much of the GII ... [However], hand in hand with the need for private investment and competition is the necessity of appropriate and flexible regulation ...." This is especially so in the international arena. In barely a decade, the industry has changed from a supply constrained business with trans-oceanic telephone circuits costing $100,000 or more to an industry with substantial excess capacity on major routes and circuit costs less than that of a wide screen TV. And even before the widespread adoption of ATM, innovative digital transmission, signalling and switching technologies will permit international networks to be subdivided on an end-to-end basis into tens of virtual networks for competing carriers and different services, only a small portion of which may be real-time voice communications.

In these circumstances, regulators as much as industry face a turning point. The old model of regulation, designed as it was for a monopoly world of nationalistic state-owned "Heavy Carriers" corresponding solely with one another, is as much in need of a thorough overhaul as the business practices of the carriers themselves. However, industry has been quicker off the mark. Spurred by the demands of users, a new breed of "Light Carriers" and the recent explosion of international traffic on the Internet, the world's major carriers have forged a series of new joint ventures which have the potential for delivering substantial price and service benefits to users far beyond the multinational companies which have been initially targeted.

The question of the day is whether regulators will meet this challenge largely by falling back on traditional rules; by making marginal changes, primarily to ensure that one carrier is in no better position to exploit the future than another—in short, on managed competition. Or will regulators give carriers greater freedom of action to pursue new service models even though this may disadvantage some carriers or let other national champions fall by the way. Similarly, even if "competitive safeguards" have a role so long as affiliated foreign carriers have the capacity to leverage bottleneck facilities, will regulators have the courage to rethink these rules when affiliated foreign carriers lack market power or bottleneck facilities in any market?

Beyond that—and perhaps most importantly in the longer run—will regulators take a fresh look at the relevant international service rules when the operators involved provide solely enhanced services which are indistinguishable, bit for bit, from computer-based or video-based services which have long been deregulated? The answers to these questions are far from academic. They affect tens of billions of dollars of investment and an equal level of consumer expenditure. There are also very large employment consequences which have become of pressing concern to almost every government.

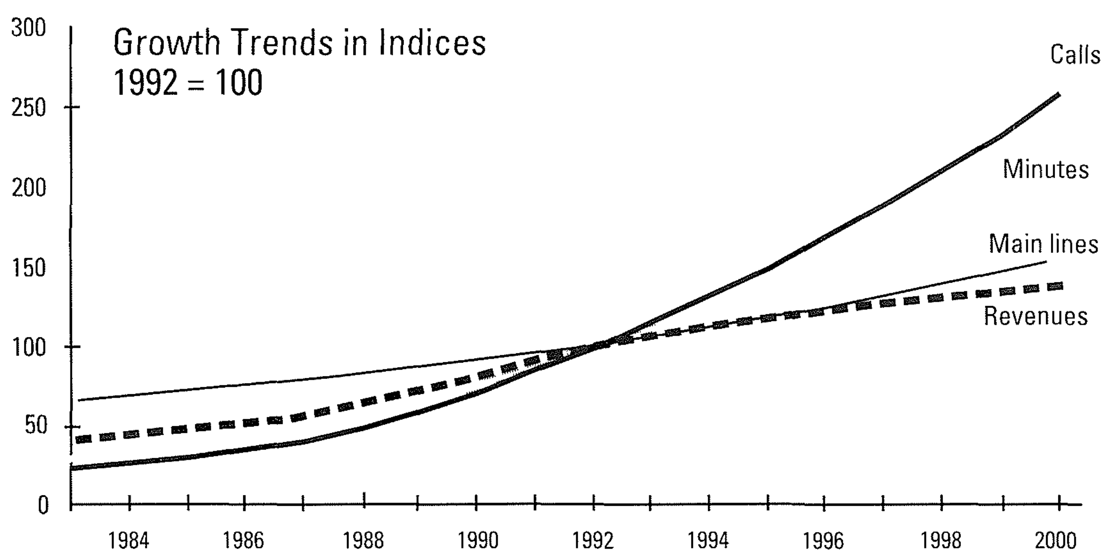
It is time, in short, for a reappraisal of prevailing international telecommunication regulation—a reappraisal that is at least as bold as that undertaken by the industry's users and carriers. The one billion telecommunication subscribers who will be connected to the world's networks by the year 2000 deserve no less.

Appendix 1: Trends in the global information economy

Traffic growth trends, 1984-1993 and projections, 1994-2000

	Historical trend			*Base case*		*10% growth*		*12% growth*	
Indicator	**1984**	**1993**	**CAGR 1984-93**	**2000**	**CAGR 1994-2000**	**2000**	**CAGR 1994-2000**	**2000**	**CAGR 1994-2000**
Calls (Bn)	2.7	12.3	18.4%	26.9	11.8%	30.9	14.0%	34.9	16.1%
Estimated call length (mins)	4.9	4.0	-2.2%	3.0	-4.0%	3.0	-4.0%	3.0	-4.0%
Minutes (Bn)	12.9	47.5	15.5%	80.6	7.8%	92.6	10.0%	104.8	12.0%
Per subscriber	33.2	78.3	10.0%	91.0	0.2%	104.6	4.2%	118.4	6.1%
Revenue (US$bn)	19.5	50.2	11.1%	63.9	3.5%	83.0	7.5%	94.0	9.4%
Price per MiTT ($)	1.51	1.06	-3.9%	0.79	-4.0%	0.79	-4.0%	0.79	-4.0%
Main lines (M)	390	607	5.0%	885	5.5%	885	5.5%	885	5.5%
Mobile subscribers (M)	0.2	32.7	73.7%	168	26.4%	168.4	26.4%	168.4	26.4%
Expansion (MiTT) due to:	**1984**	**1993**	**1984-93**	**2000**	**1994-2000**	**2000**	**1993-2000**	**2000**	**1993-2000**
Network expansion	570	2,441	30.7%	4,101	69.6%	4,406	54.0%	4,775	45.1%
Organic growth	832	2,670	69.3%	620	30.4%	6,670	46.0%	11,691[a]	55.3%
Total	1,402	5,111	100.0%	4,721	100.0%	11,077	100.0%	16,465	100.0%

Note: 1984-1993 based on reported data. 1994-2000 based on ITU forecasts. Traffic growth due to network expansion implies extra traffic generated by new subscribers. Organic growth implies extra traffic generated by existing subscribers.
[a]*Includes estimate for traffic generated by new mobile subscribers.*
Source: ITU/BDT telecommunication indicator database and ITU estimates.



Note: 1983-92, reported data; 1993 ITU estimates; 1994-2000 ITU projections for the "base case" (above).
Source: ITU/BDT telecommunication indicator database plus ITU estimates.

Appendix 2: Peak-Rate International Tariffs between OECD Countries—January 1, 1994

In US dollars per minute based on average cost of four-minute call

From: / *To:*	Aust.	Austria	Belg.	Canada	Denm'k	Finland	France	Germ.	Greece	Iceland	Ireland	Italy	Japan	Luxemb.	NL	NZ.	Norway	Portugal	Spain	Sweden	Switz.	Turkey	U K	U S
Australia[1]	n.a	1.17	1.17	0.92	1.04	1.04	1.04	1.11	1.30	1.83	0.88	0.95	1.17	1.30	1.04	0.71	1.04	1.30	1.43	1.04	1.17	1.30	0.88	0.88
Austria	**2.41**	n.a.	0.75	1.55	0.75	1.15	0.75	0.75	**1.15**	1.15	1.15	0.75	2.41	0.75	0.75	2.41	1.15	1.15	1.15	1.15	0.75	1.15	1.15	1.55
Belgium	1.45	0.58	n.a	1.02	0.58	0.72	0.48	0.48	0.62	0.96	0.58	0.58	1.45	0.43	0.48	1.45	0.72	0.62	0.62	0.72	0.58	0.87	0.48	1.02
Canada[2]	0.92	0.99	1.13	n.a.	0.85	0.85	0.74	0.98	1.45	1.01	1.01	1.18	1.25	1.16	0.67	0.92	0.85	1.31	1.66	0.67	0.67	1.72	0.61	0.41
Denmark	2.01	0.62	0.54	1.54	n.a	0.46	0.62	0.54	0.69	0.93	0.62	0.69	2.47	0.62	0.62	3.09	0.46	0.69	0.69	0.46	0.62	0.93	0.62	1.54
Finland	1.03	0.67	0.67	1.03	0.34	n.a.	0.67	0.67	0.67	0.67	0.67	0.67	1.73	0.67	0.67	1.73	0.34	0.67	0.67	0.34	0.67	0.67	0.67	1.03
France	1.92	0.92	0.54	1.00	0.65	0.92	n a	0.54	0.65	0.92	0.65	0.54	1.92	0.54	0.54	1.92	0.92	0.65	0.54	0.92	0.54	0.92	0.54	1.00
Germany	1.89	0.70	0.70	1.19	0.70	0.78	0.70	n.a.	0.70	0.78	0.70	0.70	1.89	0.70	0.70	1.89	0.78	0.70	0.70	0.78	0.70	0.78	0.70	1.19
Greece	1.31	0.44	0.56	1.31	0.56	0.67	0.56	0.56	n a	1.01	0.56	0.56	2.04	0.56	0.56	2.04	0.67	0.56	0.56	0.67	0.44	0.44	0.56	1.31
Iceland	1.77	1.02	1.02	1.17	0.69	0.72	0.81	0.69	1.17	n.a.	1.02	1.17	2.38	1.02	0.72	2.38	0.69	1.02	0.81	0.69	1.02	1.17	0.81	1.02
Ireland	1.33	0.70	0.53	1.01	0.70	0.70	0.53	0.53	0.70	0.70	n.a.	0.70	1.76	0.53	0.53	1.33	0.70	0.70	0.70	0.70	0.70	1.00	0.44	1.01
Italy	1.86	0.58	0.66	1.43	0.58	0.66	0.58	0.58	0.58	0.83	0.66	n.a.	1.86	0.58	0.66	1.86	0.66	0.66	0.66	0.58	0.58	0.83	0.58	1.43
Japan (KDD)	2.32	2.99	**2.99**	2.32	2.99	2.99	2.95	2.95	2.99	2.99	2.99	2.99	n.a.	2.99	2.99	2.34	**2.99**	2.99	2.99	**2.99**	2.99	2.99	2.95	1.89
Luxembourg	**2.71**	0.66	0.48	1.45	0.66	0.90	0.66	0.66	0.66	1.45	0.66	0.66	2.71	n.a.	0.48	3.22	0.90	0.66	0.66	0.90	0.66	1.45	0.66	1.45
Netherlands	1.88	0.78	0.59	1.05	0.59	0.97	0.59	0.59	0.78	0.97	0.78	0.78	1.88	0.59	n.a.	1.88	0.78	0.78	0.78	0.78	0.59	0.97	0.59	1.05
N.Z. (TCNZ)	0.68	1.38	1.38	1.31	1.38	1.38	1.38	1.38	1.52	1.52	1.38	1.38	1.38	1.52	1.38	n.a.	1.38	1.52	1.52	1.38	1.38	1.52	1.31	1.31
Norway	1.29	0.65	0.65	0.87	0.34	0.34	0.65	0.65	0.65	0.65	0.65	0.65	1.29	0.65	0.65	1.29	n.a.	0.65	0.65	0.34	0.65	0.65	0.65	0.87
Portugal	1.74	0.97	0.97	1.74	0.97	1.18	0.97	0.97	0.97	1.18	0.97	0.97	2.22	0.97	0.97	2.85	1.18	n.a.	0.97	1.18	0.97	1.18	0.97	1.74
Spain	**3.07**	1.03	0.84	1.53	0.84	1.03	0.84	0.84	0.84	1.03	0.84	0.84	3.07	0.84	0.84	3.07	1.03	0.84	n a.	1.03	1.03	1.03	0.84	1.53
Sweden	1.36	0.64	0.53	0.89	0.29	0.29	0.64	0.53	0.82	0.53	0.53	0.64	1.77	0.64	0.53	1.36	0.29	0.82	0.82	n a.	0.64	0.82	0.53	0.89
Switzerland	1.22	0.68	0.68	1.02	0.68	0.68	0.68	0.68	**0.95**	0.95	0.95	0.68	1.62	0.68	0.61	2.17	0.68	0.95	0.95	0.68	n a.	0.95	0.54	1.02
Turkey	**2.74**	1.82	**1.82**	2.74	1.82	**1.82**	1.82	**1.82**	**1.22**	1.82	1.82	1.82	2.74	1.82	1.82	2.74	**1.82**	1.82	1.82	**1.82**	1.82	n.a.	**1.82**	2.74
U.K. (BT)	1.03	0.65	0.49	0.65	0.49	0.65	0.49	0.49	0.49	0.86	0.45	0.49	1.65	0.49	0.49	1.03	0.65	0.49	0.49	0.65	0.49	0.86	n.a.	0.65
USA (AT&T)	**1.76**	1.25	1.38	0.54	1.32	1.39	1.24	1.26	1.68	1.50	1.28	1.41	1.69	1.39	1.23	2.11	1.24	1.57	1.52	1.20	1.36	1.76	1.08	n a

1. Telstra
2 TeleGlobe/Bell Canada

Figures in bold signify a call which costs at least twice as much as the same call made in the opposite direction. Telephone call taxes are excluded.

Source: OECD call price database.

Notes

1. Gregory C. Staple, "Winning The Global Telecoms Market: The Old Service Paradigm And The Next One," *TeleGeography 1992* (IIC, London, 1992) p. 32. The Heavy Carrier/Light Carrier dichotomy has been adopted elsewhere. See e.g., Keith E. Bernard, "New Global Network Arrangements," *Telecommunications Policy*, Vol. 18, No. 5, July 1994, p. 378; *US Telecommunications Services in European Markets*, U.S. Office of Technology Assessment (GPO, Washington, D.C. 1993) p. 37.

2. See e.g., "Refile and Alternate Calling Procedures: Their Impact On Accounting Rates And Collection Charges," Organization For Economic Co-operation And Development Working Party On Telecommunication And Information Services Policies, DSTI/ICCP/TISP/AH(94) 1 (4 May 1994). "The net effect of refile and alternate calling procedures [e.g., call back] is to impose downward pressure on the prices relevant to the provision of international telephone services (collection charges and accounting rates) by arbitraging away market distortions which result from the lack of competition. These services introduce an element of competition for international telephone service. As such, refile and other alternate calling procedures play a useful role in the market place and need to be encouraged." *Id.* at pp. 16-17. See also M. Cave, "The Economic Consequence of the Introduction And Regulation of International Resale of Telecommunications Services," DSTI/ICCP/TISP/AH (94) 2.

3. The term GII is derived from the U.S. National Information Infrastructure (NII) program. See generally, "Remarks of Vice President Al Gore," International Telecommunication Union, World Telecommunications Development Conference, Buenos Aires, March 21, 1994. See also "The National Information Infrastructure: Agenda For Action," U.S. Department of Commerce, Information Infrastructure Task Force, September 15, 1993; "Public Hearing and Request for Comments on the International Aspects of the National Information Infrastructure," 59 Fed. Reg. 31979 (June 21, 1994).

4. Technological convergence has also brought cellular telephone and other "mobile" services directly into competition with wireline offerings. In many countries consumers can now choose between wire and wireless service for at least part of their local and long distance telecommunications. The development of transnational mobile services—satellite phone service, cross-border cellular roaming—is of special significance. Such services may bypass the existing facilities and settlement arrangements among wireline carriers, thus pointing the way toward alternative settlement and access charge regimes for the international telephone industry as a whole. See, e.g., Tim Kelly, Michael Minges and Gregory Staple, *Direction of Traffic*, (ITU/TeleGeography, Inc., Geneva, 1994), on pp. 30-31. See also "Green Paper on a common approach in the field of mobile and personal communications in the European Union," COM (94) 145 Final, 27 April 1994; Gregory C. Staple and Rob Frieden, "The New Space Race," *Infrastructure Finance*, June-July 1994, pp. 53-55.

5. A review of global telecommunications appears in *World Telecommunication Development Report 1994* (ITU, Geneva, 1994).

6. See Revised CCITT Recommendation D.1, "General Principles For the Lease of International (Continental and Intercontinental) Private Telecommunication Circuits and Networks (ITU, Geneva, May 1991).

7. For an introduction to ISDN, see A.M. Rutkowski, *Integrated Digital Services Network* (Artech House, Norwich, MA, 1985) and Jacques Arlandis, "ISDN A European Prospect", in Charles Steinfeld et al. Eds., *Telecommunications in Transition* (Sage Publications, Inc., London, 1994). Major ISDN standards can be found in CCITT Blue Book Volume II, Fascicles II.2 and II 3 and Volume III Fascicles III.8 and III.9 (ITU, Geneva, 1989).

8. For an introduction to ATM, see Stephen J. Downs, "Asynchronous Transfer Mode and Public Broadband Networks, the Policy Opportunities." *Telecommunications Policy*, Vol. 18, No. 2, March 1994, p. 114; Stewart Fist, "Getting to Grips With the Broadband Future," *Australian Communications*, September 1991, p 61.

9. *World Telecommunications Development Report*, *supra*, note 4, p. 34

10. See Stephen J. Downs "Asynchronous Transfer Mode ...," *Telecommunications Policy*, Vol. 18, *supra*, note 8.

11. See CCITT Circular No. 169, COM III/ST (October 7, 1992).

12. See CCITT, Report TEUREM-R3, (October 1991).

13. AT&T, for example, has recently proposed that U.S. carriers be granted the same facilities-based rights as U.K. carriers to gain the benefit of TEUREM rates for U.K. originated traffic. AT&T "Comments" In re ACC Global Corp and MFS International, Inc., File Nos. ITC-93-035, ITC-94-049 and 051, filed August 3, 1994.

14. These figures are based on industry interviews and *In re Request of MCI and BT, Declaratory Ruling and Order*, File No. I-S-P-93-013, FCC 94-188, released July 25, 1994; *NewSource*, Unisource customer magazine, Spring 1994, No. 2; and *Telecommunications Reports*, May 31, 1993, p. 23 and June 20, 1994, p. 9.

15. For details on the U.S. ISR regime, see *fONOROLA/ EMI Order*, 7 FCC Rcd. 7312 (1992); for Canada, see *Teleglobe Canada Inc. - Regulation after the Transitional Period*, Telecom Decision 91-21 (1991) (CRTC Decision 91-21); for the U.K., see *Competition and Choice: Telecommunications Policy For the 1990s*, CM 1460 (HMSO, London, 1991) p. 15; for Australia, see "Austel's Investigation Into International Resale, Final Report." Austel, 28 March 1994. On September 19, 1994, the FCC granted the application of two carriers to provide ISR services between the U.S. and U.K. subject to the U.K. designation of the U.S. as equivalent for ISR purposes.

16. See e.g., *International Telephone Cards*, Issue 13, July 1994.

17. *In re VIA USA Ltd. et al., Order, Authorization and Certificate*, FCC 94-86; released May 11, 1994.

18. See Peter H. Lewis, "On The Internet, Dissident Shots Heard Round The World," *The New York Times*, June 5, 1994, Section 4, p. 1; IDT's Digital Freedom Network can be accessed *via* gopher.iia.org.

19. The video analogue of IDT's "human rights" file server is suggested by a review of the new Karaoke "video jukebox" produced by JVC. The "jukebox" holds up to 100 CDs with 74 minutes of full motion videos. "Imagine for a moment that the system's video server—a high speed robot that takes just five seconds to go from one song on one disc to another—is at the end of a phone line ..." Bob

Johnstone, "They Feel Like Singing," *Wired*, July 1994, p. 30. See also Nicholas Negroponte, "Prime Time Is My Time." *Wired*, August 1994, p. 134. "In the near future, individuals will be able to run video servers in the same way that 57,000 Americans run computer bulletin boards today. That's a television landscape ... like the Internet. [Not] [p]oint to multipoint ... [but] multipoint to multipoint ..."

20. For an insightful review of the challenges facing U.K. regulators, see Ian DT Vallance, "Managing A Hybrid," Financial Times World Telecommunications Conference, London, 7 December, 1993. See also Marcel Haag and Hans Schoof, "Telecommunications Regulation and Cable TV Infrastructure in the European Union," *Telecommunications Policy*, Vol. 28, No. 5, July 1994, p. 367.

21. "Remarks of Vice President Al Gore" *supra*, note 3.

22. *Ibid.*

23. See e g., Testimony of Reed M. Hundt, Chairman, FCC, before the House Subcommittee on Telecommunications, "On the Global Information Infrastructure And the Role of Satellites." July 28, 1994.

24. In June 1994 the U.S. House of Representatives passed H.R. 3626, the "Antritrust and Communications Reform Act of 1994." It permits any Regional Bell Operating Company (RBOC) to provide international services once the FCC finds that it is in the public interest and the U.S. Department of Justice rules that the RBOC would not use its power over local exchange facilities to impede competition. See *Congressional Record—House*, p. H5189, June 28, 1994. The U.S. Senate's proposed reform bill, S. 1822, made it more difficult for an RBOC to provide international and other long distance services. Among other things, S. 1822 delayed an RBOC's entry into these markets for 2 years or until the FCC adopts new universal service regulations; the FCC must also find that the RBOC provides nondiscriminatory network access for competitors, including dialing parity and number portability. See Senate Report, No. 103-367 on S. 1822, September 14, 1994. In late September, however, following a bitter division of opinion between the RBOCs, the principal sponsor of S. 1822 decided not to introduce the bill to the full Senate, thus halting legistative reform until at least 1995.

25. The FCC's definition of enhanced services is codified at 47 Code of Federal Regulation (CFR) Section 64.702. The application of this definition to international services was confirmed in *GTE Telenet Communications Corp.*, 100 FCC 2d 776 (1985).

26. See generally, "International Value-Added Network Services—An Introduction", NTIA publication TM-90-256 (U.S. Dept. of Commerce, Washington, D.C., 1990)

27. See e.g., *Telefonica Larga Distancia de Puerto Rico*, 8 FCC Rcd 107 (1992).

28. Beyond that,the FCC has yet to act on a 1991 application by U.S.-based Cable & Wireless Communications, Inc., to acquire facilities for the provision of switched voice and private line service with affiliated companies in the U.K. and Hong Kong. See FCC *Public Notice*, Report No. I-6642, released December 26, 1991, re File Nos. I-T-C-92-065 and -066. An application by the U S. affiliate of Telefonica for connecting undersea cable circuits to Spain has also been deferred. See *In the Matter of Telefonica Larga Distancia de Puerto Rico, Inc.;* File. No. I-T-C 92-242 et al., released August 8, 1994.

29. See e.g., *Implementation and Scope of Uniform Settlements Policy for Parallel International Communications Routes, Report and Order*, CC Docket No. 85-204, 51 *Fed. Reg.* 4736 (Feb. 7, 1986); 47 CFR Section 43.51.

30. *International Resale Order*, 7 FCC Rcd 559 (1992); *Order on Reconsideration*, 7 FCC Rcd 7927 (1992).

31. 47 United States Code (USC) Section 310(b)

32 "AT&T Petition for Rulemaking, Market Entry and Regulation of International Common Carriers With Foreign Affiliation," RM-8355, filed September 22, 1993.

33. AT&T later advised the FCC, however, that it does not favor placing routing conditions on U.S. resale carriers. "[M]arket forces have already shown routing conditions to be ineffective and unenforceable in practice." AT&T "Comments," *supra*, note 13 at 6.

34. See *VIA USA Ltd., et al., supra*, note 17. Notably, the FCC's Order did not rule on the legality of "call back" under international law (i.e., the ITU's International Telecommunications Regulations (ITR)) because the issue had not been properly raised by AT&T. See e.g., International Telecommunications Regulations, Final Acts of WATC-88, Articles 1.1, 1.5 and 3.3 and Appendix 1. (ITU, Geneva, 1989). For this and other reasons, on September 2, 1994, the FCC said it would reconsider the VIA USA order and invited a new round of public comments.

35. *In the Matter of AmericaTel Corporation,* File No. I-T-C-93-160-TC, released July 11, 1994.

36. *Declaratory Ruling and Order*, *supra*, note 14.

37. *U.S. v. MCI Communications Corp. et al.*, Case No. 94CV01317, (D.D.C., filed June 15, 1994). For further details, see "Proposed Final Judgment and Competitive Impact Statement United States v. MCI Communications Corporation and BT Forty-Eight Company ('NewCo')," 59 Fed. Reg 33009 (June 27, 1994). European competition rules are also relevant to the BT/MCI joint venture and similar alliances. See "Notice Pursuant to Article 19(3) of Council Regulation No. 17 and Article 3 of Protocol 21 of the EEA Agreement Concerning a request for negative clearance or an exemption pursuant to Article 83(3) of BT-MCI," (94/C 93/03) and "1991 Guidelines On The Application of EEC Competition Rules In The Telecommunications Sector," 91/C233/02, Official Journal of the European Communities, C233/2, 06.09.91.

38. The FCC adopted its video dial-tone policy in *Telephone Company-Cable Television Cross-Ownership Rules*, 7 FCC Rcd 781 (1992). Petitions for reconsideration of this order and court appeals are still pending. However, the U.S. Court of Appeals recently upheld the FCC's determination that neither a telephone company providing "video dial-tone" service nor a video programmer that uses the service to reach subscribers is required to have a local cable television franchise as a cable operator. *National Cable Televisions Association, Inc., et al. v. FCC,* D.C. Cir. Nos 91-1656 et al. Slip Opinion dated August 26, 1994.

39 See "In re New Jersey Bell Telephone Company," File No. W-P-C-6840, FCC 94-180, released July 18, 1994.

COMPETITION IN EUROPE

By Graham Finnie

By European standards, the past year was an *annus mirabilis* for the telecommunications services market. Decisive action changed the terms on which most services will be provided across Europe, whether by established carriers or newcomers. However, much still remains to be resolved if Europe is to catch up with other regions.

Change came on two fronts: regulatory and commercial. On the regulatory side, the European Commission, the policy-making arm of the European Union, won a series of important victories, paving the way for across-the-board competition before the decade is out.

First, in the summer of 1993, it won the agreement of the Council of Ministers for its plan to end existing state monopolies over basic telephone service.[1] The agreement calls on all member states to liberalize all voice services by January 1, 1998. As of this writing, only Greece was expected to ask for an extension, to 2003. Though the European Parliament rejected the plan in July 1994, its rejection was widely seen as part of a long-standing power struggle between it and the European Commission and is unlikely to prevent liberalization from taking place.

Second, in mid-1994, the Council backed a plan outlined in an earlier Green (discussion) Paper for complete liberalization of mobile communications services.[2] Ministers did not (as many expected) resist a clause that would allow mobile operators to install their own infrastructure.

Thirdly, the Commission succeeded in getting a higher priority for its final goal, the liberalization of physical telecommunications infrastructure (transmission equipment and wires). A committee of industrialists set up by European Commissioner Martin Bangemann and led by Olivetti chairman Carlo de Benedetti called publicly in June 1994 for further liberalization, including the freedom to build infrastructure.[3] A study on the issue is likely to be released in late 1994 or early 1995, and the odds are high that limited liberalization of infrastucture will begin within two years.

Parallel with these EU-wide developments, there was much national activity, mostly suggesting that the tide has turned decisively in favor of greater competition:

- **Germany:** At least six companies, including IDB Worldcom, BT and Sprint are providing both voice and data services to corporate customers.

- **Sweden:** Parliament passed a new telecommunications act in June 1993, allowing across-the-board competition with virtually no restrictions of any kind.

- **Denmark:** The government agreed to allow simple resale of domestic voice telephone services from mid-1994, and began negotiations to allow international simple resale to selected countries.

- **Finland:** Facilties-based competition in international services began in July 1994 with the launch of Oy Finnet International AB, owned by Finland's local telephone companies, and Telivo, a subsidiary of a local power company. Domestic services are already liberalized.

- **Netherlands:** The government agreed to allow a second provider of infrastructure (based around the electric and gas utilities, railway companies and cable TV providers).

- **United Kingdom:** The government licensed more than 10 providers of public telecommunications services and resellers in the wake of its 1991 decision to end the BT/Mercury domestic duopoly;

- **France:** Piecemeal liberalization continued apace; the government permitted Compagnie Generale des Eaux (CGE) and Societe Francaise du Radiotelephone (SFR) to respectively run trial services and build their own infrastructure for services.

Meanwhile, long-forecast changes to the industry's supply structure began to take shape. Apart from the various super-carrier alliances, guerrilla action around the edges of the existing regulatory rules resulted in a number of important breakthroughs.

The most highly-publicized was the proposed agreement between the self-styled European VPN Users Association (EVUA) and AT&T/Unisource. The EVUA, a loose grouping of large users such as Rank Xerox, Du Pont and ICI, sought large discounts on PSTN tariffs (up to 40%) in return for routing traffic via designated carriers. Key to that and other deals was the European Commission's narrow definition of voice telephony: "the commercial provision for the public... of real-time speech via the public switched network...".[4] This meant that closed-user groups could be offered voice telephone service. Though no formal definition of closed-user groups exists in EU law, the Commission's competition directorate (DG4) told the EVUA that its plans were legal.[5]

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New Carriers in Asia

By Stuart Corner

The telecommunications market in the Asia Pacific region is short on common denominators. The range of infrastructures, regulatory regimes, service providers and user sophistication levels is as diverse as the cultures. Vietnam, for example, with less than 1 telephone per 100 people relies on Australia's Telstra to provide its international services. More developed, totally digital networks like those in Singapore and New Zealand provide telephone services to 40% and 44% of citizens respectively. New Zealand has probably the world's most laissez faire policy on regulating telecommunications. Singapore Telecom still enjoys a monopoly over both fixed and cellular services.

The region's enormous demand for services, from the most basic to the most sophisticated, has produced a broad spectrum of service providers. They include alliances of the mainstream international carriers, the traditional "Heavy Carriers," through managed network and value added service operators to the "Lightest" carriers of all: callback operators. using a minimum of hardware to exploit the anomalies in international call rates.

Callback operators are primarily meeting consumers' simple needs for cheaper communications. Corporations have more complex demands, such as uniformity of service in every country where they operate. These multinational customers want to be able to run many applications at once, including video and large file transfers. They require bandwidth on demand, reliability, security, and, above all, coordinated and centralized ordering, network management and billing.

Australia' s liberal but carefully structured regulatory regime has given Australian customers exposure to a wider range of carriers than almost any country in the region. In Australia only transmission links are reserved to the two licensed fixed network carriers, Telstra and Optus. Any organization can lease capacity on these links, install its own switches and provide services. Alternatively it can buy end user services from the licensed carriers and repackage and resell these in any way that is profitable. Any international service is permitted, including international simple resale ISR with circuits connected to the network at one or both ends.

Concert in Sydney

BT has already established a considerable presence in Australia as a quasi carrier. In late 1992 it won a contract from the government of the state of New South Wales (NSW) to provide communications for all government enterprises and has now installed a network of three Nortel DMS central office switches and about a dozen Nortel Meridian PABXes interconnected by lines leased from the two licensed carriers; the network serves over 100,000 users. This strong presence and Australia's liberal legislation made the NSW system the natural choice to be a key network management node in the BT/MCI Concert network, and the first in the region in which Concert's global managed virtual private network (VPN) services are available.

The one major carrier that has so far stood aloof from the new global alliances is Cable and Wireless (C&W); Chairman Lord Young disparaged the concept at the company's annual meeting this year, saying that forming an international alliance was becoming "almost a test of the chairman's virility." C&W's subsidiaries think otherwise. Mercury Communications in the U.K. (majority owned by C&W) wanted to join the AT&T led WorldPartners but was dissuaded by Australia's second carrier Optus (25% owned by C&W) and IDC, the Japanese international carrier in which C&W is a leading shareholder. Both were concerned at the added advantage it would give their WorldPartners member competitors, Telstra and KDD. Yet, in the summer of 1994, Hongkong Telecom, another C&W affiliate, became a WorldPartner distributor.

BT and MCI are not free from such possible conflicts either. Prior to their alliance MCI owned 25 percent of an Australian "light carrier," AAP Telecommunications. MCI's shares are now being sold back to AAPT. AAPT provides standard telephone and virtual private network services to corporate clients by using its own switches and lines leased from the carriers. Although BT does not compete for business in the corporate market at present, it is expected to do so soon, and certainly after Australia's fixed network duopoly ends in 1997.

Moving towards the "lighter" end of the scale, Australia saw for a while one of the first examples of a company providing international simple resale using leased lines. The company, MIG International, targeted the domestic market, mostly South American nationals resident in Australia wanting to call friends and relatives at home. Its calls were delivered to South America via a U.S. based company, International Telecommunications Corporation (ITC).

MIG ran into difficulties, however, perhaps because Australia's IDD

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rates are already amongst the lowest in the world. For other Light Carriers the finance sector with its demands for sophisticated reliable and secure worldwide communications represents a much better opportunity to exploit relaxed regulations and add some real value to basic carrier capacity instead of simply cutting costs. One such company, Saturn Global Networks, also had its genesis in Australia. The company is a wholly owned subsidiary of U.K. money brokers MW Marshall and was set up in 1992 to take over Marshall's existing international network and expand it as a profitable business in its own right. This background enabled Saturn to gain the business of major Australian customers in the financial market sector.

Saturn Global Networks provides services to multiple international destinations at speeds up to 64 kbits/sec. In Australia, the company operates under an international service provider class license. It has recently expanded in to Hong Kong, Europe, and the U.S., where it has partnered with WorldCom.

IN COUNTRIES WHERE DEMAND IS STRONG BUT REGULATION STRONGER, CANNY OPERATORS ARE FINDING WAYS AROUND THE REGULATIONS WHICH ALLOW THEM TO OFFER INTERNATIONAL SERVICES AT CHEAPER RATES.

Singcom in Melbourne

Singcom is another international service provider operating under a service provider's license. The company is majority owned by Singapore Telecom International, and is able to offer an end to end service between Melbourne and Singapore by virtue of ST's monopoly over international services out of Singapore; Telstra has no reciprocal rights in Singapore. Singcom offers store and forward fax services and worldwide packet switched service. It acquired an Australia wide X.25 network which provides services to anywhere in the world via Telepac, the Singapore packet-switched network.

In other countries where demand is strong but regulation stronger, canny operators are finding ways around the regulations which allow them to offer international services at cheaper rates. A brief overview of recent developments follows:

■ **Hong Kong:** In theory Hongkong Telecom (HKT) has a monopoly on international telephone calls but is nevertheless facing competition. City Telecom, which began in September 1992, has become the major long distance call competitor to Hongkong Telecom and, by the end of 1993, had 61,000 customers. It circumvents Hongkong Telecom's monopoly on facility-based international services by using a toll-free number out of Canada and using "an indirectly leased line" from HKT. Similar services are offered by AT&T and others. The local regulator, the Office of Telecommunication Affairs (Ofta), has said the services are legal.

City Telecom's network enables it to undercut HKTI's IDD rate to Canada, the USA, Australia and some European nations. But because of the stricter regulations and less advanced networks in China and other developing Asian countries, the company has been unable to offer its services to most other countries.

■ **Japan:** International simple resale is now under consideration but is unlikely to be permitted before 1996. However, a recent decision to allow Japan's domestic satellite operators to provide international leased line services is expected to give a boost to Special Type II international carriers (international value added service providers) and to greatly expand their range of opportunities. At present 27 such companies are registered with the Ministry of Posts and Telecommunications (MPT) to provide voice, data and image services.

■ **India:** India's bureaucracy. is stifling liberalization of the country's telecommunications. Although the Indian government announced in May 1994 that at least one additional license would be granted for local telephone networks on a regional basis, with up to 49% foreign ownership permitted, no grants have been finalized yet, and international service will remain a monopoly of Videsh Sanchar. Over 60 bids for private sector lease financing of new exchange lines are also pending. Further, India is still without cellular service (though license awards have been announced) and has only recently granted paging licenses.

Despite the hurdles facing new facilities-based telephone networks, "Light Carrier" services are showing signs of emerging. In August 1994 a local company, Compton Graves, announced plans to launch a fax store and forward in conjunction with SDI of the U.S. and fax broadcast service in conjunction with Faxcast of the U.K.. Faxcast uses satellite capacity or capacity in the vertical blanking interval of a normal TV broadcast.

Meanwhile U.S. carriers AT&T and Sprint are capitalizing on India's high international call rates by offering cut price collect call rates to the U.S., and have waged a small price war in recent months. Sprint is also involved in electronic mail services with local company RPG Telecom.

Private Vsat networks are coming into operation, but the Government has imposed very stringent guidelines on the services, including requiring operators to get prior approval for tariffs. Seven potential operators of services have emerged, but as of August 1994 only two had reached formal agreements with the government: Comsat Max, 50 percent owned by Comsat International and Hughes Escorts, part owned by Hughes Corporation.

■ **Malaysia:** Most value added services are open to provision by private operators, subject to grant of a license. However the telecommunications minister indicated in July 1994 that licenses could be restricted to operators offering new services for fear of overcrowding the market. When the country's first EDI service, Dangangnet, was launched in August 1993 the government said no others would be permitted because the country was "too small for more than one." EDIM, which operates Dangangnet, is a consortium formed under the auspices of the national Chamber of Commerce and has a 15 year license.

There is no audiotex (pay per call) type service in Malaysia at present but in June Telekom Malaysia announced the formation of a joint venture with PS Ultgevrijbedrijven BV of the Netherlands to develop audiotex in Malaysia. The cellular operator Celcom had held an audiotex license for over a year but could offer services only to cellular callers because of difficulties in negotiating a fixed network interconnect agreement with Telekom Malaysia.

International packet switched data services are offered through a joint venture between BT's Global Data Service and Telekom Malaysia but are accessible only from Kuala Lumpur and Petaling Jaya.

■ **Philippines:** To improve its inadequate telecommunications infrastructure (1 million lines for 65 million people) the Philippines Government has licensed seven international gateways and three additional license applications are pending. The Government has also required international gateway operators to become full service carriers by installing local networks in both profitable and non-profitable areas. Similar requirements are imposed on cellular operators and the result is that several consortia have announced ambitious plans for international gateways or cellular networks and fibre backbone networks to link these with their local networks. As a result, by 1997, the Philippines should have at least a half dozen full service (local, long distance, and international) carriers. Other network services are open to restricted competition. There are five licensed paging operators and five Vsat operators.

Box 1. World Bank Report on Telecom Sector Reform

Resistance to multiple service providers will only prolong the "telecommunications crisis in Asia," according to Telecommunications Sector Reform in Asia: Towards a New Pragmatism (Discussion Paper #232) *a World Bank report by Peter Smith, a senior telecom specialist at the Bank, and Gregory C Staple, a legal consultant The report predicts that the cost to national economies of providing only limited or no service to millions of its citizens will be greater than any loss of economies of scale from franchising new operators It brushes aside arguments that multiple service providers are inefficient because, it says, the current gap between supply and demand in low income countries is so great that concern about "duplicative investments" is misplaced*

To support its case, the World Bank says that more than 2.8 billion people in lower income countries in Asia must "make do" with just over 25 million lines, and that despite recent expansion plans, average annual growth in the number of lines in Asia between 1982-1991 was only seven percent, increasing waiting lists in most countries However, the report warns that merely privatizing and divesting a state-owned operator is not necessarily a solution, citing the Philippines as an example of substandard private sector performance. The report suggests that in low income countries with less than two main lines per hundred people (Bangladesh, Cambodia, China, India, Indonesia, Laos, Pakistan, Sri Lanka, Vietnam) the overriding issue is not privatisation but how to attract capital from the private sector to accelerate network growth

The report recommends a "bottom up" approach to telecommunications reform, financed by a mixture of public and private capital, which would entail the franchising of multiple service providers, build-operate-transfer concessions, joint ventures and revenue sharing schemes. It also warns against capital-intensive programs that are currently in vogue and suggests that cheaper options, such as increasing public payphones, and using wireless, trunked mobile, paging and voicemail services could provide a more pragmatic alternative

However, the report says that even the most ambitious expansion plans will be compromised by ineffective regulation which it describes as "the weakest part of sector reform in poor countries". It suggests that an independent, publicly accountable regulatory body with a clear legislative mandate is crucial to reform and that the "no regulation option" adopted in New Zealand is "illusory" and prone to disadvantage new operators

Adapted from Telenews Asia, *10 February 1994, p 2*

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Similarly, the fact that separate virtual private networks (VPNs) can be provided over a common infrastructure allows for economies of scale. On international links, this traffic can be "refiled" via the networks of national carriers with the lowest international tariffs, then forwarded over highly-loaded leased circuits. Such arrangements bypass local tariffs and the accounting rate structure, allowing substantial (20%+) discounts against PSTN rates.

The EVUA deal was only one of many special deals; most European carriers now offer published discounts of 10-30% to large customers. Some customers have won discounts of 50% or more—hidden from prying regulators by non-disclosure agreements. The more aggressive European carriers are all offering new calling card services. And the massive branding campaigns by AT&T (WorldPlus) and MCI (WorldPhone) show that the new super-carriers are targeting residential customers as well as the large corporate market. Both products allow users to make calls and receive voice messages, and switch calls via a European hub (the U.K. or Sweden) rather than through the U.S., as previously.

> *"SHOW ME A COMPANY WITH A FIVE-YEAR STRATEGY FOR EUROPEAN TELECOMMUNICATIONS, AND I'LL SHOW YOU A COMPANY THAT DOESN'T UNDERSTAND WHAT'S GOING ON."*

Brash new entrants are also putting pressure on prices. They include several "Light Carriers," the most important of whom are four U.S.-based carriers:

- **IDB Worldcom.** Much the best-established, and to some degree part of the "establishment" (owning the U.S. half-circuits in several transatlantic cables, for example), IDB affiliates are especially active in the U.K. and Germany, where IDB is the largest international reseller.
- **International Discount Telecommunications (IDT).** Now three years old, IDT is investing in new technologies (especially compression technologies) which it hopes will keep it ahead of competitors. The company has attracted funding from Mario Gabelli, a well known U.S. fund manager.
- **Viatel.** Part-owned by financier George Soros and Comsat, the largest U.S. provider of international satellite capacity, Viatel claimed 1992 sales of over $20 million, a three-fold increase over the previous year.
- **Esprit Telecom** is targetting larger businesses and says it will build infrastructure as soon as it is allowed to.

Each of these carriers benefits from lean operations, aggressive sales teams and ambitions that extend well beyond simple callback services and price arbitrage.[6]

Competition has also intensified in the data communications services market. The Services Directive, passed by the European Commission in 1990 and upheld by the European Court of Justice in November 1992, has freed up this market, encouraging new entrants.[7] For example, AT&T, BT, Infonet, Reuters/Wiltel, SITA (through its Scitor subsidiary), Sprint and Transpac (a France Telecom affiliate) are all offering cross-border public frame relay services, Most of these companies also intend to provide Asynchronous Transfer Mode services, probably within the next two years, raising the possibility that these operations may become the vehicle for corporate multimedia traffic that includes voice and video as well as data.

The European Commission, meanwhile, has placed much faith in cable television companies, encouraged by experience in the U.K., where half the homes cabled for TV are also taking telephone service from the cable TV provider (400,000 by mid-1994). Despite Europe's extraordinary regulatory, commercial and technical patchwork, competitive provision of telecommunications services over cable TV infrastructure is likely to emerge in at least the Netherlands, France and Spain. Initially, provision of real-time voice telephony will probably be excluded in most of those countries—though not where it is part of a multimedia service.

Yet for all these advances, fear, uncertainty and doubt continue to stalk the European telecommunications services landscape. "Show me a company with a five-year strategy for European telecommunications," said one cynical executive recently, "and I'll show you a company that doesn't understand what's going on."

One reason is that many key regulatory issues remain unresolved. In particular, Europe must decide how and when to liberalize infrastructure, introduce an effective policy on interconnection, and decide how to control the dominant players as they seek out new business across borders.

At this writing, so far as infrastructure competition is concerned, the most likely outcome is a compromise in which existing infrastructure owners will be allowed beginning in 1995 to offer data communications services and services to closed user groups, but not voice services to the general public. More substantial liberalization might follow in 1998.

At the Corfu meeting in June 1994, European leaders agreed to push ahead with some form of infrastructure liberalization and bring forward publication of a Green Paper to late 1994. But on many issues—e.g., defining infrastructure, picking providers, protecting universal service and so on—there remain significant differences of opinion.

The European Commission also lacks an effective policy on interconnection of dominant and competing networks once services are liberalized in 1998. As competition develops and the accounting rate mechanism atrophies (few believe it will survive the decade in Europe), this issue will come alive. For new entrants without foreign affiliates to terminate traffic, accounting rates are likely to be replaced by some kind of access or termination fee—an interconnection charge by any other name. When a foreign affiliate exists, there still needs to be a workable regime for handing off traffic between competing local networks, something the U.K. experience suggests will be hard to implement.

The European Commission has already indicated that local access fees do not have to be based on cost. It has bowed to PTO (Post, Telecommunications Operators) arguments that unless cross-subsidies are continued, they may no longer be able to provide universal service. This position may gain additional support if the principle of universal service is extended to include access to the "information highway" and its multimedia services.

Until now, the main vehicle for interconnection policy has been Open Network Provision (ONP), a set of rules that establishes the general conditions under which dominant or monopoly operators must make resources available to users and third-party service providers. However, the new emphasis on "subsidiarity," an EU principle that states that decisions should be taken at the lowest possible governmental level, means that the European Commission is delegating much of the detailed enforcement to national telecommunications regulators, who have very different views about interconnection.

ONP rules, among other things, anticipate that most interconnection agreements can be reached by straightforward commercial negotiation, though history suggests that the parties inevitably end up in the regulator's office, or in court. Indeed, if the U.K.'s battle over interconnection (ten-years-old and still running) is any guide, such disputes will be a perennial feature of the new landscape.

Other regulatory problems are likely to impede unfettered competition. For example, many ambitious new providers need high bandwidth pipes: 8 Mbit/s, 34 Mbit/s, 140/155 Mbit/s or even more. At present, however, PTOs are under no obligation to provide such services; most have no published tariffs for services above 2 Mbit/s, and are understandably reluctant to provide them to competitors. In June 1994, one competitor, Metropolitan Fiber Systems, was quoted an 18-month lead time on a circuit between Frankfurt and London, at a price per bit ten times the prevailing rate in the U.S.

Similarly, national and pan-European rules to prevent predatory and uncompetitive behavior by PTOs in other markets are muddled and inconsistent. In Sweden, for example, BT took Transpac to the regulators, complaining that its contract price for a corporate network was below cost and cross-subsidized from monopoly income earned in France. Yet BT itself stood (informally) accused by the two Swedish operators, Telia and Tele2, of predatory pricing; it allegedly undercut the Swedes by up to 80%, prices that BT defends as a necessary entry fee to a new market. Meanwhile, Telia itself charges customers 30% less to make calls from London to Paris via Stockholm than it does for a direct call from Stockholm to Paris. Such anomalies and disputes are likely to spread throughout Europe as regulatory barriers fall and PTOs seek to make up for loss of market share at home.

For Europe's PTOs, rapidly escalating competition—both real and virtual—will have two certain effects: loss of market share and falling prices for basic services such as voice telephony and private lines. This will mean some tough-minded decisions over the next two or three years. Most PTOs will face politically difficult large-scale staff lay-offs, divestiture and separation of some businesses, further alliance-building and market segmentation. Some may choose to go all-out for a broadband local infrastructure, leaving partners to bear the risk in global networking; others, conversely, may place heavy emphasis on the construction of global businesses and look for partners or even buyers for local infrastructure.

But all PTOs are likely to lobby national and European regulators to give them time to adjust—in particular, by enforcing the payment of access and interconnection charges that reflect universal service obligations, fully distributed (historic) costs and only gradual removal of historic cross-subsidies. The regulators' response may set the pace of change in European telecommunications over the next few years.

Notes

1 Council Resolution of 22 July 1993 on the review of the situation in the telecommunications sector (93/C213/01).

2. "Green Paper on a common approach in the field of mobile and personal communications in the European Union," COM (94) 145 Final 127 April 1994.

3. "Europe and the global information society," Recommendation to the European Council High Level Group on the Information Society, Brussels, 26 May 1994.

4. See Council Directive 90/387/EEC, OJL 19211 24 07.90, Article 2, Clause 7.

5 *Communications Week International*, 11 April 1994, p 1

6 See *Communications Week International*, 28 March 1994, Network Review section, for further details.

7. Commission Directive of 28 June 1990 on competition in the markets for telecommunications services (90/338/EEC), OJL 192/10, 27 7 90.

NAVIGATING CYBERSPACE—MAPS AND AGENTS

Different Uses of Computer Networks Call for Different Interfaces

By Zachary M. Schrag

Is geography the future of cyberspace? Or will software agents take the "space" out of cyberspace altogether? Today's computer networks—the Internet, the commercial online services, and others—are made of words, lots and lots of words, and words are slow and ungainly. While verbs like "online cruising" and "net-surfing" imply exciting encounters, for the most part logging onto a computer network means reading page after page of text, then typing a command to get some more text. Even where icons and graphics have made some headway, such as on the rapidly growing service known as the World Wide Web, they are often used just to break up the text, rather than as the dominant elements on the screen. Text has its fans, but few people think that the status quo, with its endless stream of menus and command lines, addresses and prompts, will last long into the next century.

Given the ability of computers to produce, transmit, and reproduce drawings, photographs, sounds, and even moving videos, a text-based cyberspace seems anachronistic, old-fashioned. It resembles a news broadcast from the early days of television, when a stationary camera was pointed at an announcer in a studio, reading from a prepared script just as in the days of radio. It was television, all right, but it had not begun to exploit the possibilities of the medium.

What will replace text as the dominant element of computer communications? One possible answer is geography. Though we call our present-day computer networks "cyberspace," they are nothing like the world envisioned by science fiction author William Gibson when he coined the word ten years ago. His cyberspace was a simulated city, where one saw not text and icons but computer-generated, three-dimensional images of buildings, streets, and walls, and objects that represented information and software.

Though the technology needed to achieve Gibson's vision does not yet exist, advances in virtual reality (VR) make it seem not far away. Already programmers, authors, and architects—such as the contributors to *Cyberspace: First Steps* (ed. Michael Benedikt, MIT Press, 1991)—are working hard to plan this new sphere of human existence. They imagine the technology of virtual reality being grafted onto the present data communications network, so that virtual office towers rise into the sky and the electronic city is born. Instead of abstractly "telnetting" to a distant computer site, we would walk or fly there. And once there, we could navigate through rooms, down hallways, and into gardens to find whatever it is we were looking for. A new geography would be established to complement the old.

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At the same time, however, there is another movement afoot. While one set of programmers is laboring with head-mounted displays and rendering algorithms to make software "objects" visible, another group is working on "intelligent agents," designed to make the computer networks invisible.

Like macros and scripts, agents let computer users automate repetitive tasks such as logging onto a computer system or downloading information from a database. Unlike macros, agents have the potential to go beyond their masters' computers to the network itself, retrieving information, sending messages, and perhaps buying goods. Already subscribers to Hoover, an agent produced by the Sandpoint Corporation of Cambridge, Mass., can skip the drudgery of scanning database after database or asking around for the best university or corporate computer to raid for files. Instead, for about $250 a month they can ask Hoover to go fetch, and it will assemble material on whatever subject is needed. Similarly, Mead Data Central's Eclipse service will search hundreds of newspapers for articles including terms specified by the user, then send him the results as often as he likes. Thus, the agent acts like a trustworthy chauffeur, sparing its master the need to ever consult a map himself.

Which will it be: a cyberspace future in which everything is geography or nothing is? Each scenario has a definite appeal, and its own uses, so I expect that both will emerge. The challenge will be to match each function of cyberspace with the appropriate form, to use geography when it can be used and to abolish it when it interferes.

The movement toward geography

There is no denying that the analogies between data communications and geographical space come naturally and in large number. For just as a city is more than a collection of buildings, and a forest is more than a collection of tress, cyberspace is more than a collection of linked computers, and geographical terms can help us understand its nature.

The terms "information superhighway" and "infobahn" have been become ridiculed cliches, with weak jokes about rest stops, road-kill, and speeding tickets. Yet those very jokes indicate the power of the metaphor. Highways are something that people in industrialized countries know, are comfortable with, even love, and whose value they recognize. Americans understand highways as things that the federal government pays for and that bring them food, goods, vacations, reunions, and even produce their own culture, from Jack Kerouac's 1957 novel, *On the Road* to Ridley Scott's 1991 film *Thelma and Louise.* Europeans might see data networks as the counterpart to the autobahns and autostradas that link the diverse components of the European Union. At its best, cyberspace could do all of this, so the highway metaphor is optimistic and appropriate.

Other spatial and geographical metaphors abound: gateway, forum, room, Electronic Mall, dungeon, library, tour. One *New York Times* article ran a good thousand words on the subject of the popularization of cyberspace, with almost every paragraph containing a metaphor drawn from real estate or homesteading. And several of the major online services—CompuServe, America Online, eWorld—use globes as icons in their front-end software, as if claiming to be substitutes for the 4-billion-year-old planet we know so well.

Now some of these online services are taking geography a step further, using geographical interfaces to let users explore their resources. A geographical interface is essentially a GUI (graphical user interface, pronounced "gooey") writ large. Whereas the GUI, popularized in 1984 by the Macintosh computer, tries to make a computer screen resemble an office where a user can find his "desktop," "folders," and "trash," a geographical interface (GeoGUI?) makes the screen into a city (or forest, or ocean), where many users can move between buildings, rooms, and, one supposes, a landfill.

The designers of some new online environments, such as Apple's eWorld, General Magic's Magic Cap, and the ImagiNation Network, have begun adding geographical objects to their system. Logging onto one of these systems, the user sees a view of the "Town Square," or "Downtown." He just clicks on a shop, a post office, or a casino and suddenly he is ready to do whatever transactions are appropriate. And since he learned what to expect from a post office (if not a casino) at age five, his years of experience in the real world are all the training he needs.

The GeoGUIs in use today are quite shallow, often only one layer deep. Click on the post office, for example, and you are likely to be confronted not with a deeper geography (the interior of a post office, complete with counters, P.O. boxes, stamp machines, and so forth) but with a conventional text-based or GUI menu whose elements could be arbitrarily rearranged without changing their meaning. And the towns themselves aren't towns at all, for only one person can be

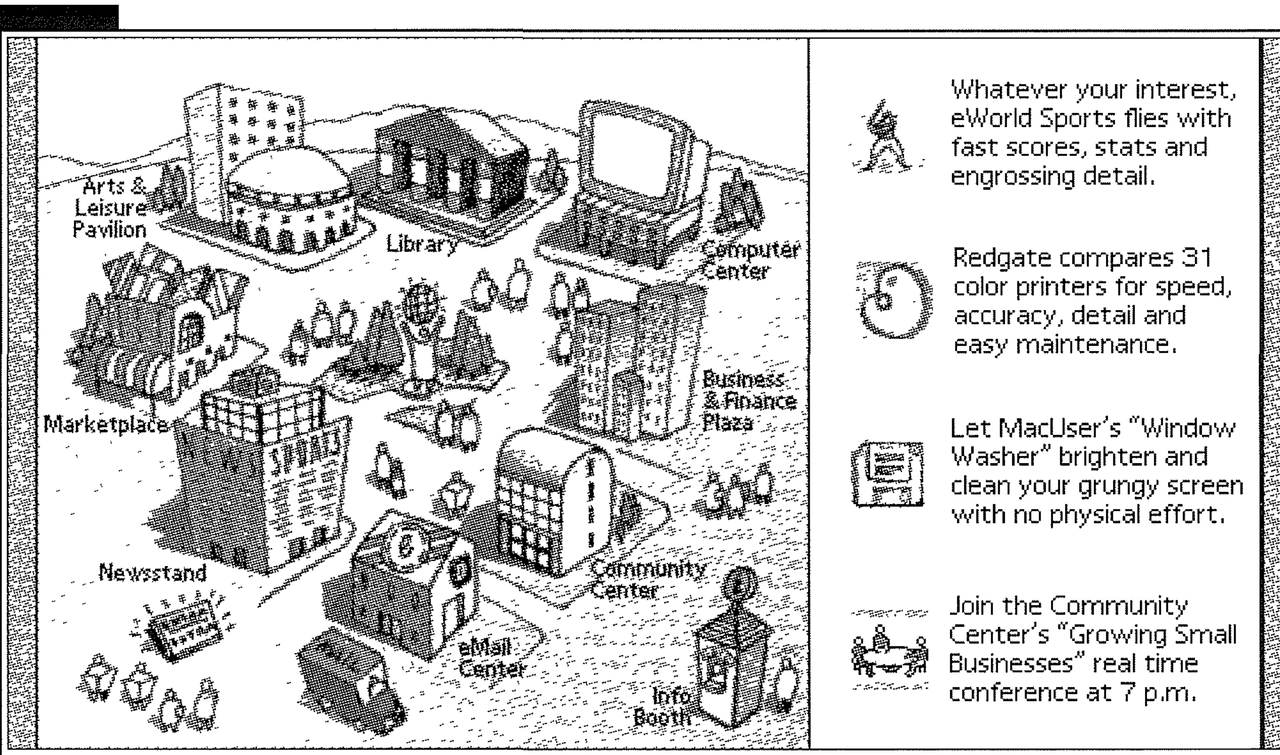


Figure 1: eWorld Top Screen. Apple's new online service, eWorld, uses a picture of a "town square" to orient users. But those figures milling around are just for show. In a truly geographic interface, each figure would represent another user, who could be engaged in conversation, ogled, or ignored.

there at a time. (Each Magic Cap user gets to build her own Downtown, so it would be impossible for two users to inhabit the same Downtown at once without getting into a shouting match over whether a building is there or not.) But it is easy to imagine these early interfaces becoming more and more complex and encompassing—first adding more layers, then going to 3D, then improving virtual reality until an e-mail message is something that one can hold, something to be posted with a stamp whose virtual mucilage leaves a sour taste on the tongue. No more cryptic commands to memorize. No more vain attempts to craft menus and pictures out of typographical characters. Just space, as we have always known it, with tasks accomplished by speaking, walking, and touching.

Programmers are also considering ways to make the Internet more geographical. Mark P. McCahill, project leader of the team that produced gopher, one of the most popular software tools for finding information on the Internet, and colleagues have proposed a "3-D Gopher" system to work with more powerful computers. Gopher now uses text based menus, though there are front-ends available which add icons as well. The 3-D Gopher proposal, presented in April 1994, argues that a more geographical approach will make cyberspace more welcoming, since it will allow the display of more data (such as abstracts of articles, links between files, and the popularity of some databases) while drawing on the knowledge that users have acquired through years of experience in the real world. "We have spent our lives learning to recognize spatial cues: what entrances look like, what a bulletin board is, where you are likely to find a you-are-here map, and so on." Why not apply that knowledge to cyberspace?

The interface McCahill et al. propose, still in the very early planning stages, would transform today's gopher servers (e.g., the card catalog at a university library) into circular "neighborhoods." Descending into a neighborhood, one would be able to view several representations of files at once, learning at a glance something of their contents, their relevance to one's search, how many other people had used them, and other information.

Going from one neighborhood to another would be like being the passenger in an airplane. One would glimpse the origin and destination neighborhoods from above, but in between one would see only "an anonymous looking grid." Because neighborhoods would have no fixed relation to one another (one can hop quite easily from gopher to gopher), there would be no real geography beyond the local level.

> *While the 3D gopher is still in the visionary stage, one particular corner of cyberspace—the world of MUDs—has used geography for over a decade.*

While the 3D gopher is still in the visionary stage, one particular corner of cyberspace has been somewhat geographically organized for over a decade. First created around 1980, MUDs (variously expanded as multi-user dimensions or multi-user dungeons) are network games that allow many players to control "characters," who can hunt for treasure, fight, build, and solve puzzles. What sets MUDs apart from the regular computer games one buys in the store is that players from all over the world can interact simultaneously—talking to each other, fighting alongside or against one another, even simulating sex. Though MUDs have only text interfaces—the user sees only a string of ASCII characters running across her screen—the game is organized geographically, with a series of "rooms," which can be anything from taverns to streets to forests to space stations. MOOs (MUDs, Object-Oriented) have "objects" that characters can move from one room to another.

In many MUDs, the attraction of socializing outweighs that of playing games, so the MUD becomes mainly a site for conversation. In this respect, they resemble the chat rooms of some online services and the "Internet Relay Chat" service of the Internet. Users of these services often spend hours at the keyboard, engaged in real-time conversation with total strangers or familiar voices, known only by their often cryptic user names.

Many MUDders and chatters long for a technology that would eliminate all that typing. A virtual-reality environment would allow them to don fantastic bodies made of whatever human and animal parts strike them, to visit each other in virtual houses that resemble French chateaux or Thai pagodas, to hit when they want to hit and to kiss when they want to kiss. Experiments have already been made adding graphics and sound to MUDs, and clearly there is a vast potential market for a multi-user, VR-GeoGUI.

The perils of geography

The great advantages, then, of VR-GeoGUIs are that they are intuitive and fun. But while it is very attractive at first glance, geography has its drawbacks as well.

First, geography can be very expensive. Virtual reality requires architects to design how the structures should appear and what physical laws—optics, gravity, sound, etc.—should operate. Then computer programmers must translate the architects' vision into thousands of lines of code. This costs money. While most institutions—governments, libraries, universities—can spare some change to scan their seal onto a World-Wide-Web server or put some

Mozart onto the voice-mail hold message, it's not clear how much they will be willing to invest in flashy, inviting virtual lobbies. Major university and national libraries certainly have gorgeous main buildings, but for the most part a library is clearly a library and not a gilded, marble-encrusted bank.

Virtual reality also consumes bandwidth. Chip Morningstar and F. Randall Farmer, designers of Lucasfilm's Habitat (essentially a visual MUD using somewhat cartoonish graphics) have written, "Communications bandwidth is a scarce resource... when communications technology advances to the point where we all have multigigabaud fiber-optic connections into our homes, computational technology will have advanced to match." This phenomenon haunts Mosaic, the graphical browser for the the World Wide Web. Journalists often become wildly enthusiastic about Mosaic's ability to display color graphics and even photographs along with text. But it takes a long time, even on a high-speed line with a state-of-the-art modem, to download a color picture. And on many servers, graphics have been used only for ornament, so that rather than organizing the space they merely slow down one's search to the point where older technology, like a 2400 bps modem and a text-only front-end, is more efficient.

NO MATTER HOW ASTOUNDING THE THROUGHPUT, SERIOUS RESEARCHERS AND PEOPLE IN A HURRY WILL FIND BETTER WAYS TO USE IT THAN WATCHING ALL THE OTHER DENIZENS OF CYBERSPACE WHIZ BY IN THEIR VIRTUAL BODIES.

Such strains on one's patience would only increase in a shared, public cyberspace where the presence of other users was also displayed graphically. No matter how astounding the throughput, serious researchers and people in a hurry will find better ways to use it (faster transmission, higher fidelity music, higher resolution photographs, more frames per second) than watching all the other denizens of cyberspace whiz by in their virtual bodies. The 3-D gopher team hopes to lessen the strain on bandwidth by having the user's computer and its software generate images, rather than having those images transmitted from the network. But many of the advantages they claim for a 3-D cyberspace (such as allowing organizations to customize their databases with pictures and sound) can only be achieved if these bulky elements *are* sent over the network.

And geographical interfaces are, by their nature, time intensive. Current interfaces, like gopher, Mosaic, and most commercial online service software, allow users to jump from site to site. In the middle of a gopher search, for example, one can hop from a gopher at a university in Germany to one in New Zealand to one in Costa Rica without having to go back to some top screen or master page. This hopping can be quite disorienting, and it is easy to lose track of where one found an interesting archive. But while eliminating the ability to jump from any site to any other and replacing it with a system of streets or landmarks would improve one's sense of place, it would also slow down a search terribly. If getting where I need to go in cyberspace, to pick up a product review or download a new font, requires me to cruise down some virtual boulevard, ask directions, make a left, descend into a neighborhood, and find an address, then I may as well get on my bicycle and go to the real library.

MUD players have some experience with this problem. Most MUDs allow any room to be connected to any other room, providing the builder of each room is willing. Moreover, users can usually "teleport" from one room to another, skipping all the distance in between. The result is that familiar principles, like the shortest distance between two points being a straight line, collapse, along with all the two- and three-dimensional geography we know. Jennifer Smith, a seasoned MUD veteran, recalls an experiment with making cyberspace resemble real-world geography:

> Islandia—a TinyMUD which ran from roughly February 1990 until May 1990—tried the "strictly topological" model, for the first time. A strict gridwork of streets was laid out, and people were not allowed to build silly things like a complete jungle in the space that was no larger than a city block. It didn't work. First thing that happened was that people complained that if they were trying to be realistic, that teleporting should be turned off. So it was. That was the big mistake; people then started complaining that it took too long to walk anywhere (each "mile" was five rooms or so long). Despite "Stepstones"—exits that would "jump" you from corner to corner, skipping the rooms in between—it still took too long to walk anywhere, and they'd more or less destroyed their original reason for denying teleportation. In the end, it was decided that only under very good circumstances can you get away with enforcing rigid "real-world" topology, and that for the sake of sanity, it ought not to be so rigidly defined.

MUDders, then, have decided that the convenience of teleporting outweighs the comfort of familiar geography. And they generally have accounts that are free or paid by the month. On a system that charged by the minute (as do most commercial services and some Internet providers), any geographical conceit that forced the user to spend time trudging from place to place would be doubly unwelcome.

All of these costs are especially significant given the Internet's present dependence on the willingness of university and corporation computer departments to donate some extra disk space and computing capacity to relatively frivolous uses like recipe databases and MUDs. With requirements of design, bandwidth, and time, a VR-GeoGUI environment would put a much greater strain on these institutions' generosity.

Perhaps money will not be such an issue. Electronics do have a way of becoming very cheap after a few years. Nonprofit institutions could set up shop in some sort of mass-produced, pre-fab virtual quonset huts, and perhaps everyone could own a computer powerful enough to run a small VR-MUD, along with a fiber-optic hookup as thick as a tree-trunk. But even if virtual geography were dirt cheap to set up and use, territoriality is a grave threat.

From birdsongs to border wars, territory has always gone hand in hand with conflict. Being an intangible mass of binary data, a virtual geography will escape some of the traditional causes of envy and strife: water, soil, gold, strategic mountain passes and harbors. But it would unavoidably import one of the chief principles of geography, that some locations are more desirable than others.

What makes one cyberplace better than others? The same thing that puts office towers downtown: centrality and agglomeration. In the nineteenth century city, centrality meant proximity to the transportation hub: the railroad terminal or the ferry pier. In cyberspace, it means proximity to wherever or whatever it is that the user enters—the top screen, the "town square," or the gateway. Agglomeration is the force that makes dozens of carpet stores cluster on a single street in Istanbul. If several similar shops huddle together, they will draw more customers than each could on its own. A user cruising around cyberspace will go where the action is, and any institution in the boondocks will suffer.

These principles will hold true no matter how things are arranged. Gibson describes the basic layout of Cyberspace as "a transparent 3D chessboard extending to infinity," reminiscent of both an urban grid like Manhattan or a rural grid like the sections of the American Midwest. Other authors, architects, and thinkers on the subject have also taken a grid as their starting point, showing that ideas of planning present in America since the eighteenth century die hard. But while a grid has much to recommend it, it will not solve all the problems of cyberspatial planning. Despite the apparent equality of all squares in a grid, some squares are bound to be more equal than others.

There is no perfect way to allocate lots in a geographical cyberspace. Cyberspace could be settled by the pioneers, the first to write the software that structures the world. This is, to a degree, what happened after the University of Minnesota released "gopher," one of the most popular tools

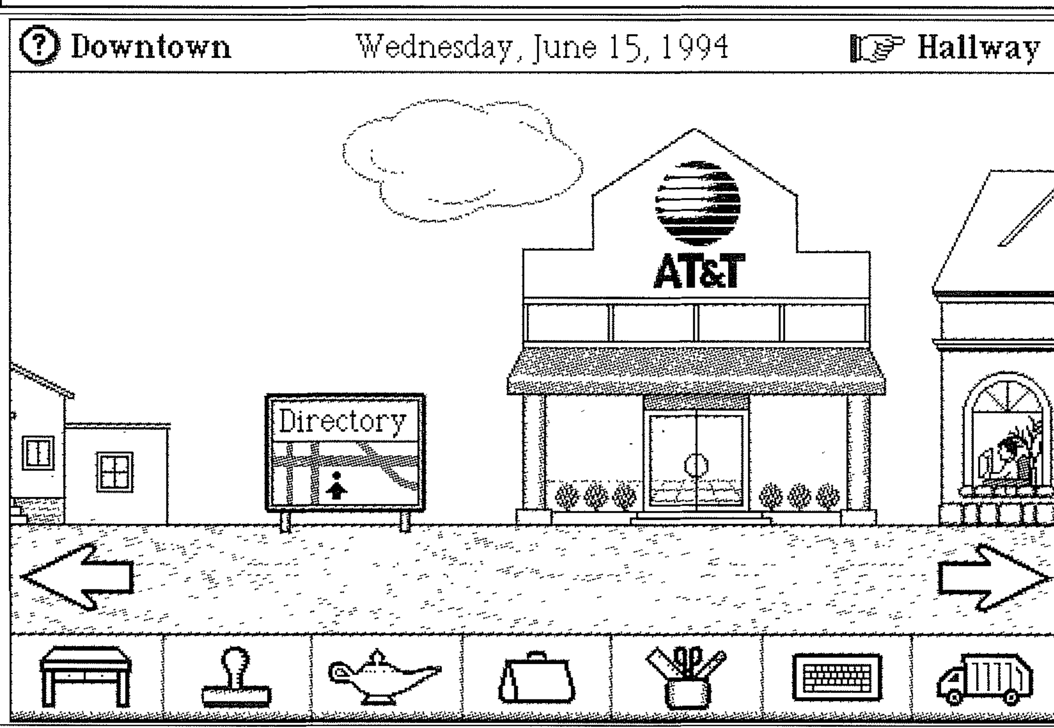


Figure 2: Magic Cap Downtown. Magic Cap's "Downtown," still a fairly primitive geography, nonetheless illustrates a potential problem with all downtowns: they can become dominated by corporations, not people.

to navigate the Internet. Because they had invented the protocol, the gopher team had a great deal of say in determining how "gopherspace," the sum of all the world's gophers, would be organized. It is worth noting that only after universities and other institutions all over the world had moved into gopherspace did the University of Minnesota float the idea of charging royalties for gopher, i.e., exacting rent from its tenants. The plan was defeated when outraged programmers threatened to release public domain versions of gopher, but that tactic might not work with a more complex, virtual or geographical interface—harder to imitate and better protected by copyright or patent.

Perhaps governments will assign the lots. Alexander the Great, William the Conqueror, and Abraham Lincoln all had experience parceling out newly subdued territory. Even today, governments are allocating, lotterying, and auctioning slices of the radio spectrum. Government control might frighten the more ardent civil libertarians who enjoy the present anarchic state of the Internet, and one country's government will have limited authority to control a network already global. But such a scenario is far less scary than the prospect of a corporation creating a working standard for cyberspace and inviting others to join up. A pioneering corporation could police cyberspace like a retirement village or an elite resort, punishing offenders and booting out the riffraff without any form of due process. And it could portion out the best spots by auction. After all, since some forgotten Sumerian staked out a cool spot just uphill from the river's floodplain, people have been arranged in space according to wealth.

Yet, worst of all would be an Internet-like cyberspace without central planning—letting a UN Agency set the standards and then letting everyone build (first come, first served) to create a sprawling, tangled maze like a thousand or ten thousand medieval cities piled on top of one another. "French wine? Well, this is the European Wine Center, where people come to discuss German, Italian, Spanish, and Bulgarian wine. But if you want French wine, why, that's over in the Cuisine Section of the French Pavilion way the heck over in Virtual World's Fair. To get there, you have to bear sort of around, well, to the right, and through a few things... it's hard to explain. There used to be a highway that would take you right to it, but then this pair of lawyers from Phoenix built their office right on top of the road, and no one has been able to make them budge."

The conquest of geography

So maybe the answer is to do away with territoriality by doing away with territory, using automated software agents instead. After all, isn't communications supposed to free us from geography? This is the principle behind the popularity of cellular phones, services that will activate a pocket pager with stock market news, and pay phones that will keep ringing a busy line so you don't have to stand by the phone, dialing over and over again.

The most recent flowering of this drive toward automation is Telescript, an intelligent agent program released by General Magic. Though produced by the same company, TeleScript is the opposite of Downtown. The idea is that a user can program his agent to go shopping, sort through his messages, negotiate with colleagues, and research information all without the user's supervision. Properly developed, this technology could make cyberspace not a place to be visited with a head-mounted display, but a place to send one's agent to do one's bidding with a few voice commands. Why push your way through the tangled bazaar of cyberspace when you can relax in the sunshine and have the rummaging done for you?

Intelligent agents resolve many of the problems raised by geographical interfaces. In terms of cost, agents are to VR what unmanned space probes are to the space shuttle.

Think of voice mail systems, for instance. Going through a geographical interface is like having to listen to all the menu choices each time you call, while using an agent is like bypassing the menu dialing the extension of the right person. Only with a good agent, you will never need to listen to the menu because the agent will find out who that person is for you.

Intelligent agents resolve many of the problems raised by geographical interfaces. In terms of cost, agents are to VR what unmanned space probes are to the space shuttle. Just as the space probe Voyager 2, now somewhere past Neptune, does not need oxygen or food or water or much in the way of temperature control, an intelligent agent could dispense with all the bells and whistles—the lights, signposts, and horizons—of a geographical cyberspace. Cyberspace would be data, just plain data, and to humans it would appear invisible. The science fiction version of this is the computers in Star Trek; ask them a question, and they tell you the answer, with no fuss about how they found it.

Let's say you wanted to retrieve a file from a computer at the Massachusetts Institute of Technology (MIT). Today, if you try using standard Internet tools, you are likely to get a message saying that there are only 50 slots open for file transfers (ftp) by people not affiliated with MIT, and that they are all taken, even late at night on a weekend. This situation is only going to get worse, with the number of Internet users growing exponentially and MIT unlikely to devote more resources to total strangers. With a virtual reality cyberspace, it would be worse still, having to wait on a virtual line, browsing back issues of the alumni magazine or hearing a loop of MIT football songs (if there are such things), while people ahead of you rummaged slowly through the files.

With an agent-based cyberspace, however, you could simply dispatch an agent to the site and if it had to wait until 3 a.m. to get access, no problem. Moreover, because agents can operate far faster than humans (limited by the mechanics of reading, digesting, and typing), so the queue would be much shorter in the first place.

As for hierarchy, agents don't notice it, or at least they make it disappear. Today, any computerized library catalog can quickly assemble a list of books by Isaac Asimov, no matter how scattered they are across the subject classification system. A fully realized computer catalog, or agent search, could just as easily arrange materials by publisher, illustrator, language, date, popularity, or medium, allowing a user to pull up a list of 1980s action movies with gross revenues over $50 million, for example, and then to download clips from those films. It is the user who defines what information is important, eliminating battles over rival hierarchies.

Agents do have their problems. By sending an agent straight for a precise chunk of information, a user skips the browsing stage of research and thus misses some opportunities to stumble across a related document, the sort that might cause a flash of inspiration and suggest a new approach to one's project. Agents could be annoying if they were allowed to directly contact human beings, like those nasty computer voices that telephone during dinner. In a worst-case scenario, agents could combine everything that is hateful about impersonal communication, from junk mail to answering machines that your friends never check. And no matter how cute and obsequious the little cartoon agent appears as he prepares to do your bidding, using intelligent agents is not going to be as much fun as the psychedelic experience of virtual reality.

A Two-Lane Information Highway

Since both geoGUIs and intelligent agents have their pluses and minuses, there may well be room for both of them on the Information Highway. The massive and growing network of computers could handle two forms of traffic, one designed for real-time browsing and another for automated exploration by software. A user would find each service useful depending on her needs of the moment. And a corpora-

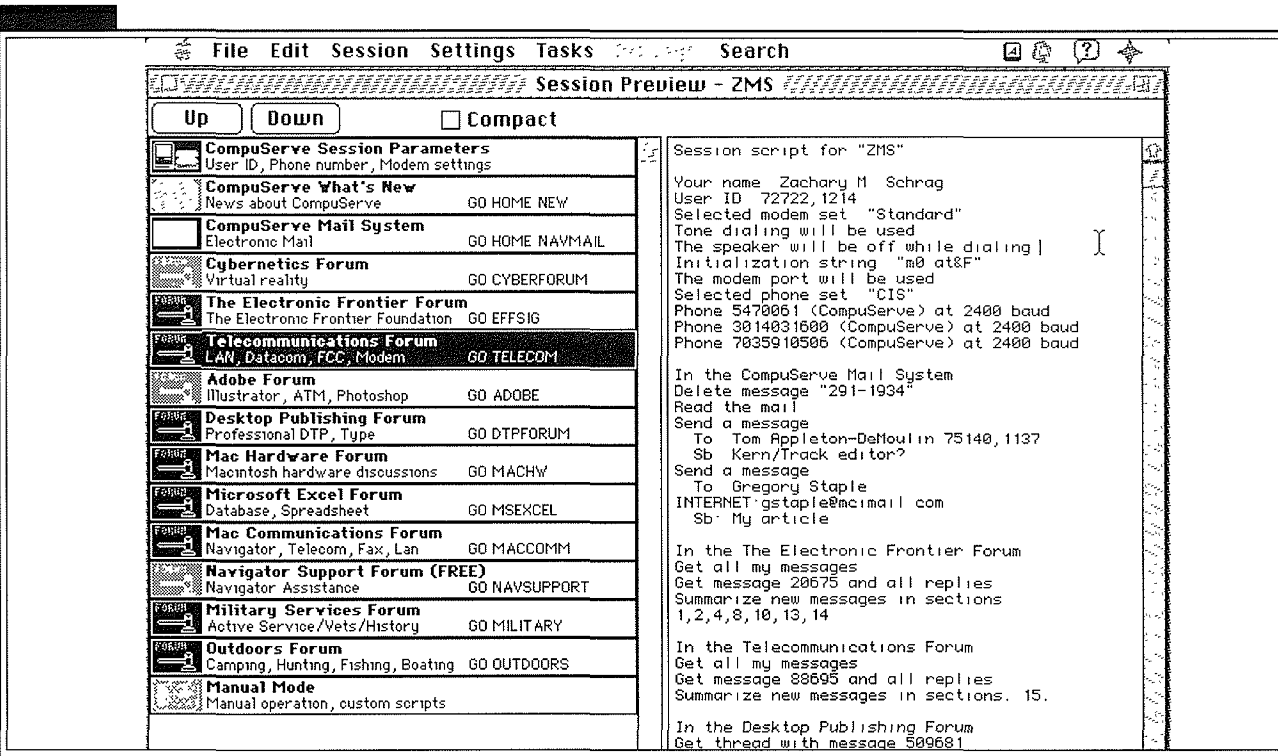


Figure 3: The CompuServe Navigator. Set up a list of tasks for the program, then go for a cup of coffee. By the time you come back, the computer will have logged on, performed all its tasks, and logged off again, leaving you time to read your messages offline, free of connect charges.

tion might use both services at once, just as today companies advertise the same products in print, by broadcast, and by direct mail.

The possibilities of a two-track cyberspace are illustrated by the two types of front-end programs available for CompuServe Information Service, the oldest of the major commercial online services. (Other online services allow similar choices, and off-line mail readers like Eudora offer some of the same possibilities to Internet users.) One can, if one desires, log on directly to CompuServe, typing one's name and password in each time, and using a number of three-letter commands to access different functions of the system. It is relatively slow, and takes a lot of typing. So most CompuServe members bypass the tedious command-line interface by using a front-end. This is a piece of software that presents an easier set of menus or icons, and then translates the user's button clicking into the commands that CompuServe understands.

The most popular front-end is CompuServe Information Manager (CIM), which CompuServe more or less gives away (it costs $10 to download, but comes with a $10 usage credit). CIM is a GUI, with icons representing categories of information, like travel or computers, and functions, like reading one's mail. Though CIM is not geographical, it is fairly close to the eWorld interface, so it is easy to imagine the icons being replaced with buildings. Already, some VR enthusiasts are at work on VISCIS, a virtual reality interface something along the lines of the 3-D Gopher proposal. The advantages of these systems is that they allow easy browsing, encouraging users to explore new areas of CompuServe while warning them when they are about to enter a more expensive service. Everything is very up-front, and could even be more so with a 3-dimensional display.

Alternatively, CompuServe subscribers can use an "offline" front-ends, like TapCIS and Navigator, which function more like agents. Before logging on, a CompuServe user tells the program what it is he wants, whether he wants it to check the mail, check forum messages, erase old messages, send messages, or download files. Then he sets his computer running, and it logs in and performs all the tasks, much faster than a human operator could, thus saving connect charges. They can even be set to run late at night, when connect charges are reduced. And the programs can remember settings from one session to another, so that the user can just punch in his favorite forums once and the program will get lists of new messages with only a few keystrokes or mouseclicks.

The fact that CompuServe itself sells both CIM and Navigator suggests that both products, and their descendants, have a future. It all depends on what you want out

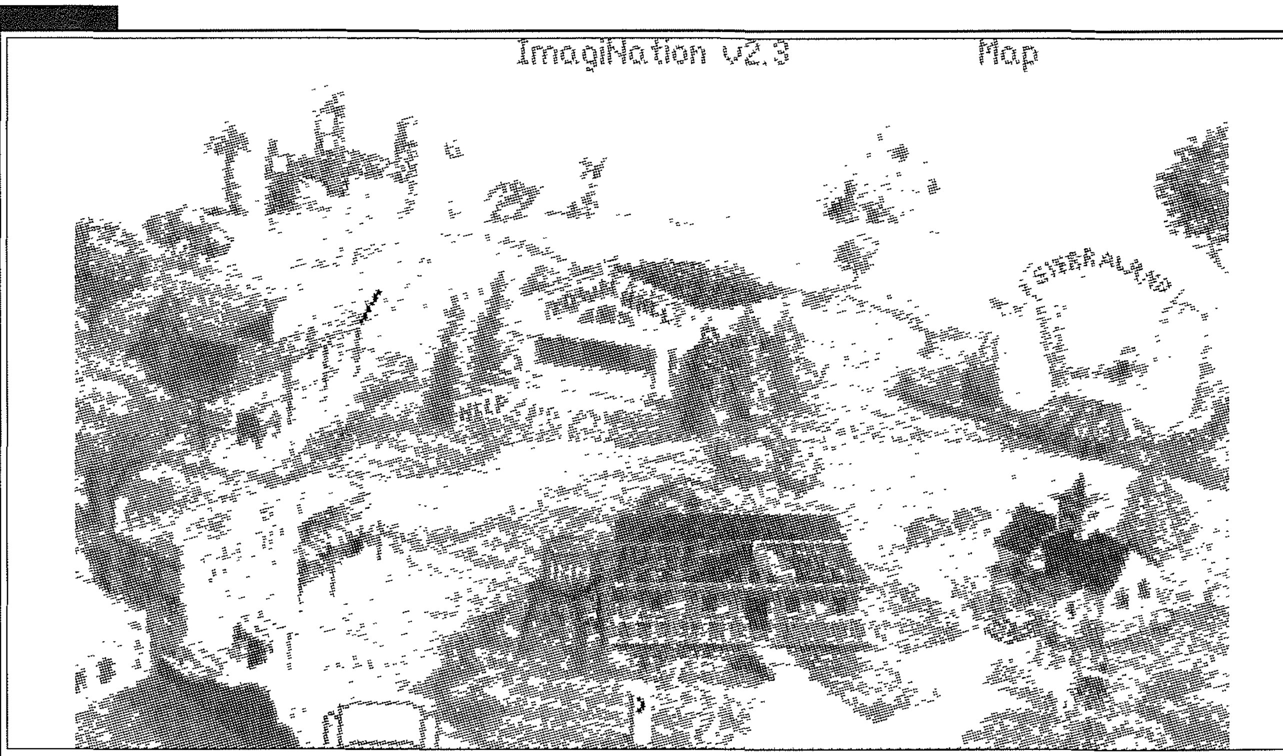


Figure 4: The ImagiNation Network: There is no question that much of the impetus toward geographic interfaces comes from a love of computer games and their special effects. Geographic interfaces and games go together like grassy fields and soccer balls; after the first screen, you can just hike on up the mountain to begin your adventure.

of cyberspace: slow wandering where the fun lies in the chase as much as in the kill, or quick raids for specific facts.

A geographical/VR cybermall would be a fine place to chat with new people, admire the newest sportscar in the showroom, and play spectacular realtime games against human opponents. A joyful place, full of glitz and fireworks, it would provide its commercial tenants a steady stream of customers, who would buy tangible goods, like mail-order clothing, or services that could be transmitted on the network itself: movies, games, and entrance to virtual discotheques and theme parks. Financed by entrance fees, the sale of advertising, and rent charged to the merchants, it would also be a place where money talks.

But it would not be much of a place for research, or for a non-profit or government institution to disseminate free information cheaply. The 3-D Gopher proposal frankly admits that "eventually we would like to allow... a real Las Vegas-style user experience." I have been to Las Vegas, and I don't remember seeing a public library. I am sure there is one, but what I noticed were the flashing electric lights and artificial volcanos of the casinos. A geographical cyberspace would likely turn out the same way, with money-making ventures prominent and noisy, and non-profit enterprises barely visible. The Las Vegas Strip is a fine place for gambling, gluttony, voyeurism, and big-name singers, but scholarly research (other than anthropology) is best done elsewhere.

A Vegas-like geographical cyberspace would not preclude the existence of another cyberspace, one dominated by software agents. This would be a very different place, more like the New York Public Library than Caesar's Palace. People would not log onto it in real time, but would program their agents to perform tasks for them as quickly as possible. This agentspace would be a place for serious research—where scientists could exchange ideas, citizens could register to vote, and victims of a new illness could hunt down medical information and form support networks. It would also be a place to shop, but for things that are no fun to shop for, like toner cartridges and mortgages. And instead of meeting strangers there, one would send quick messages to friends, who could read them at leisure. And because this "place" would not be a place at all, but an invisible network with no fixed hierarchy, where the order of the searches would be defined by the user, this cyberspace would be far more democratic.

It would not be the first time that a communications technology has succeeded in more than one guise. Conceived as a means of two-way communication, the radio achieved its most widespread use as a way to broadcast music, news, and other programs to millions of receivers. But it has never lost its original function, and airplanes, police forces, and armies, not to mention trucks, taxi cabs, and ham enthusiasts, still depend on two-way transmission. If the radio, a single technology, could blossom as two radically different social phenomena, so could cyberspace. If designers give some sober consideration to how computer networks are being used, and what interfaces will best suit the purposes of each type of user, two very complementary cyberspaces could grow side by side.

For More Information...

For a thorough examination of the possibilities of using virtual reality to construct computer network interfaces, see *Cyberspace: First Steps,* edited by Michael Benedikt (Cambridge, Mass.: MIT Press, 1991). Benedikt, an architect, has drawn together contributors from the fields of design, computer science, literature, and elsewhere to dream about making cyberpunk science fiction into a reality. Carried away with the glittering opportunities, the writers sometimes forget to take into account real-world limitations, such as cost and crowding. Nevertheless, their thoughtful essays raise many of the issues that will be confronted as computer networks truly enter everyday life. "NCSA Mosaic and the World WIde Web: Global Hypermedia Protocols for the Internet," by Bruce R. Schatz and Joseph B. Hardin, *Science,* vol. 265, 12 August 1994, provides a very thorough discussion of the capabilities of Mosaic and the World WIde Web and examines the reasons behind their extraordinary popularity.

For information on some of the specific services mentioned in this article, please contact:

CompuServe: CompuServe World Headquarters; 5000 Arlington Centre Boulevard; P.O. Box 20212; Columbus, OH 43220. Tel. (614) 457-8600

***e*World:** Apple Computer, Inc., 20525 Mariani Avenue; Cupertino, CA 95014. Tel. (408) 996-1010.

The ImagiNation Network: The ImagiNation Network; 41486 Old Barn Way; P.O. Box 1550; Oakhurst, CA 93644. Tel. (209) 642-0700. See also Elliot Gold's article on page 3.

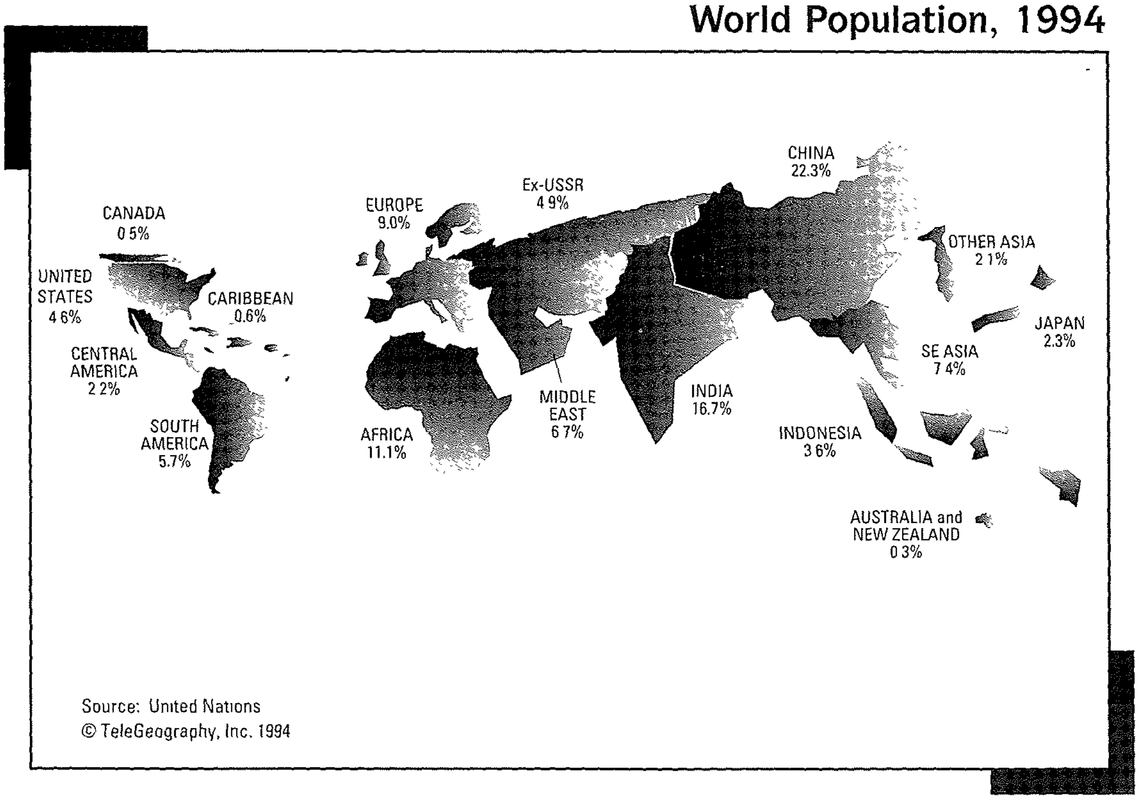
Magic Cap and Telescript: General Magic, Inc., 2465 Latham Street; Mountain View, CA 94040. Tel. (415) 261-3860.

Mosaic: Mosaic can be downloaded from the ftp server ftp.ncsa.uiuc.edu. For information, write mosaic@ncsa.uiuc.edu.

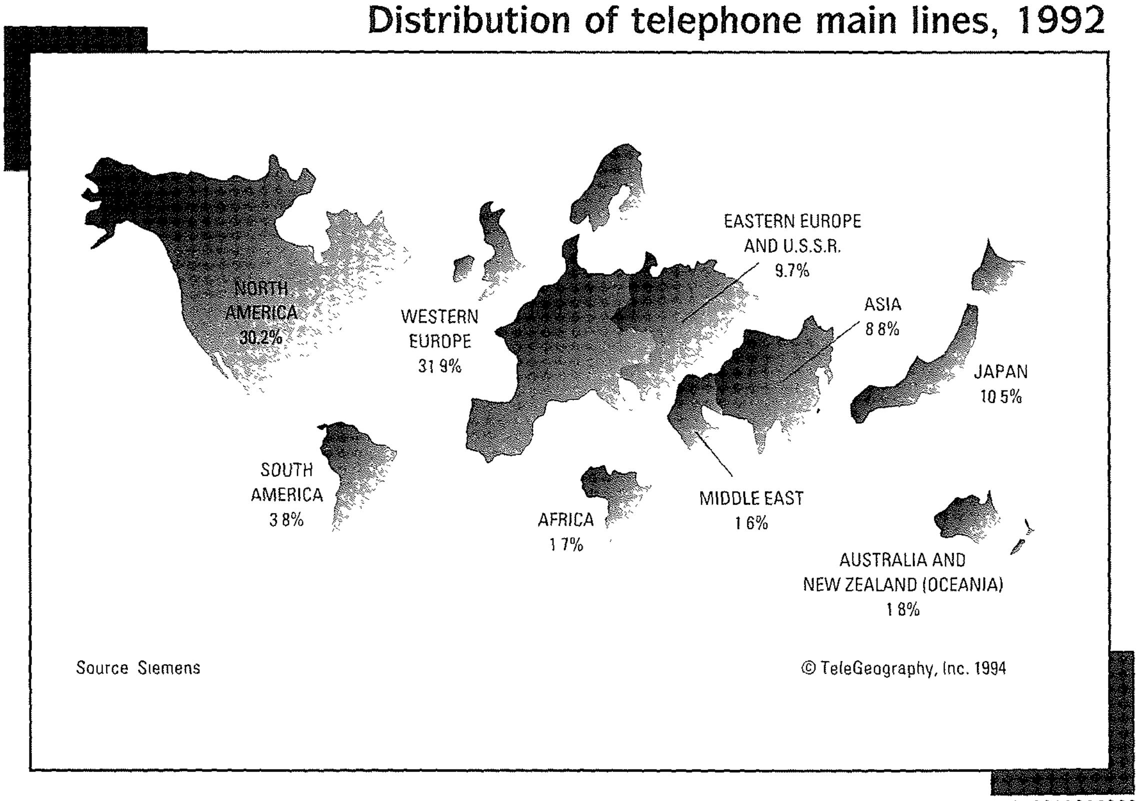
Maps

CARTOGRAMS

World Population, 1994



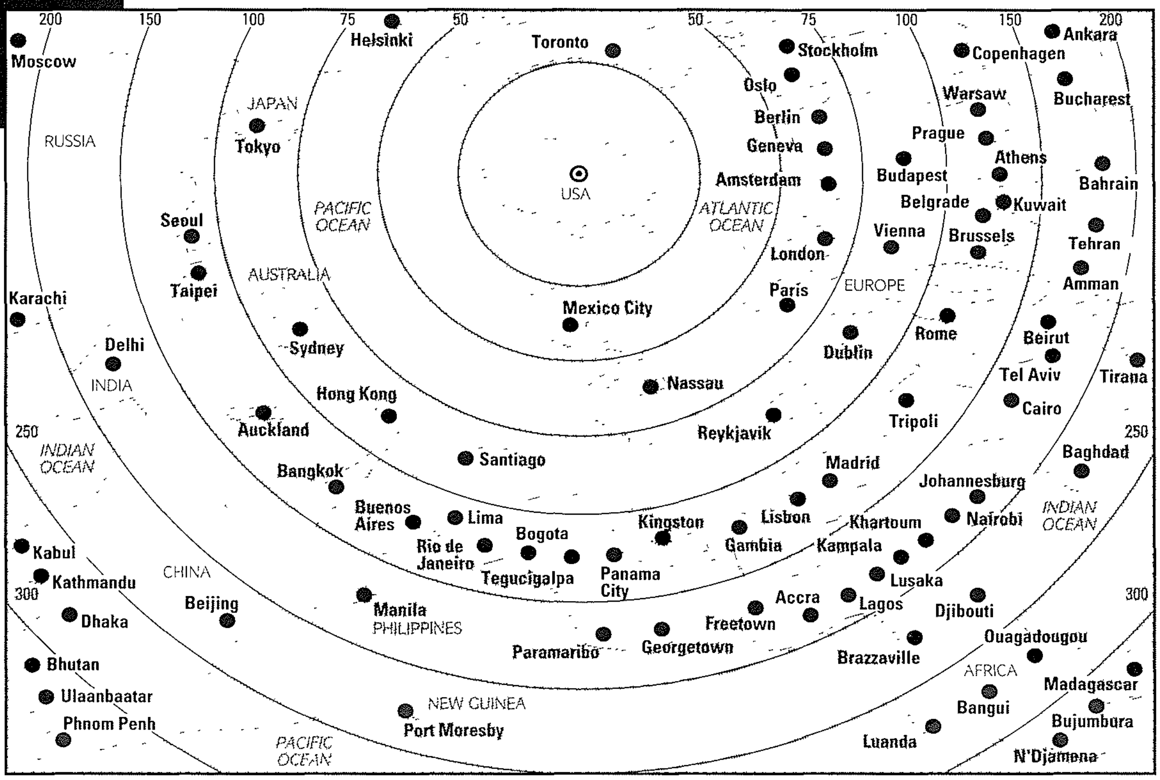
Distribution of telephone main lines, 1992



Tariff Maps

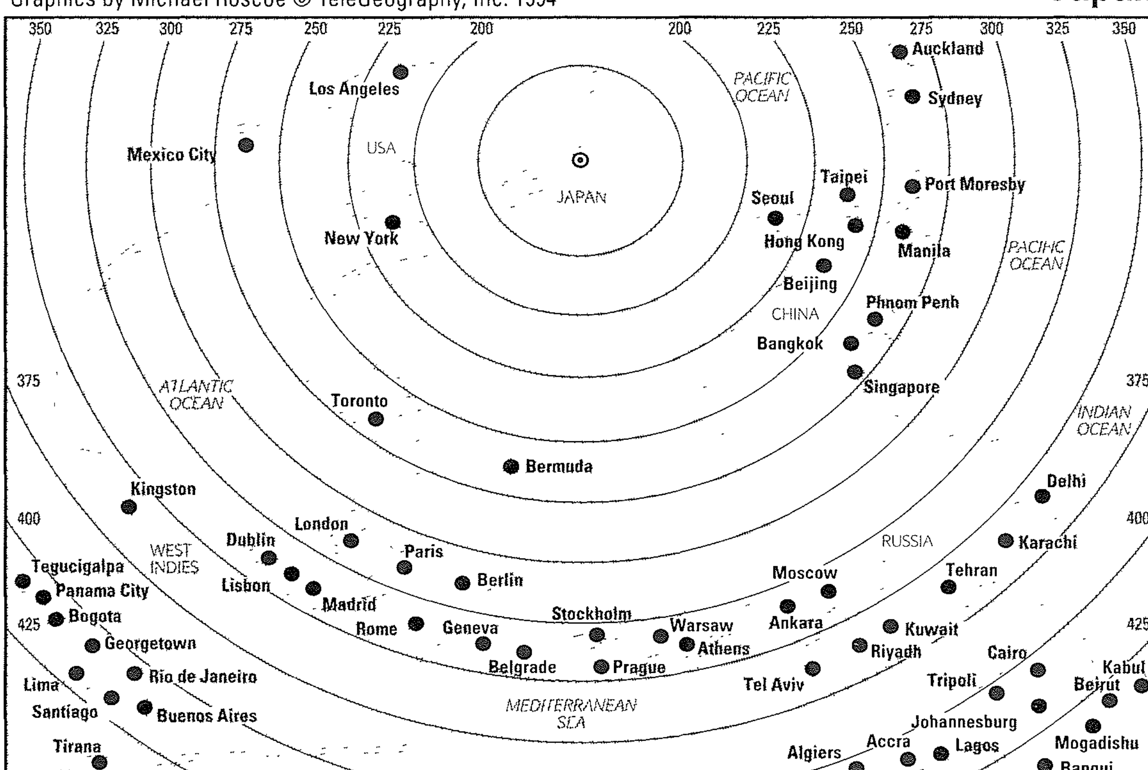
The Geography of International Telephone Charges

United States



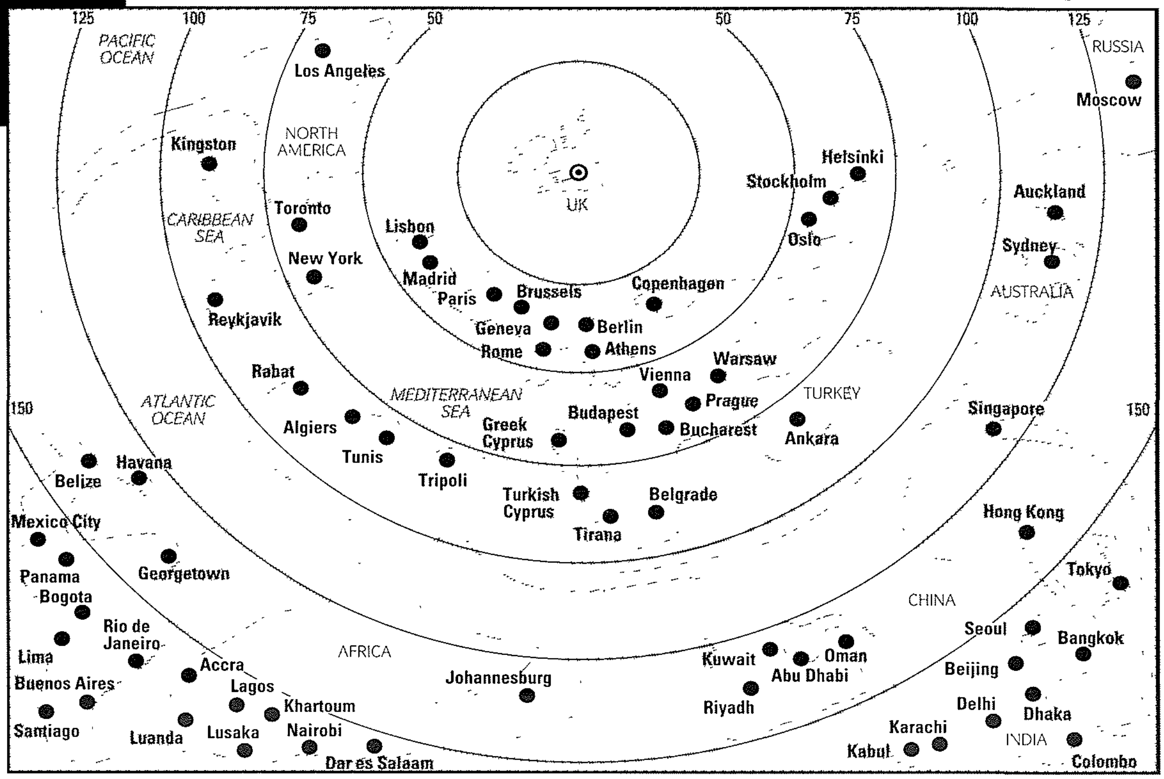
Graphics by Michael Roscoe © TeleGeography, Inc. 1994

Japan



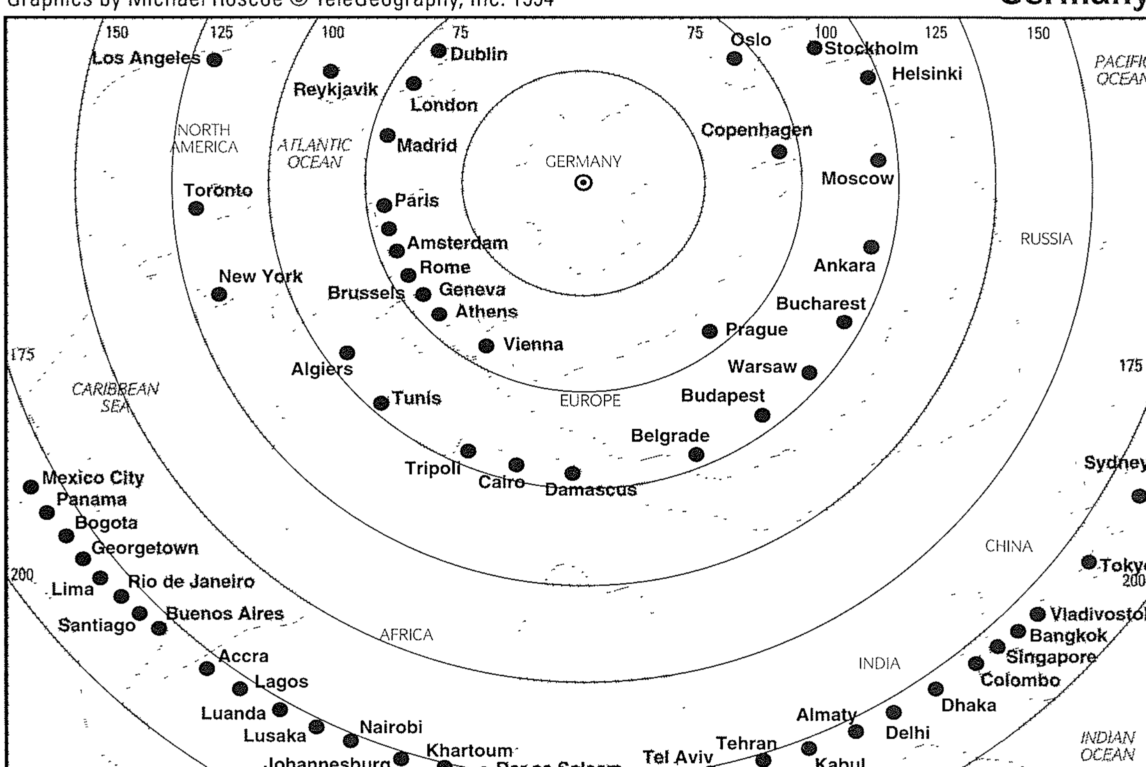
These four maps show the cost of making a telephone call from the country in the center of the map to the rest of the world. Countries are arranged according to the cost per minute of a three-minute, daytime, direct-dialed international call made from the center country. The scale of the concentric circles (isobars) is stated in U.S. cents per minute. A city which costs $1.40 per minute to call would appear between the $1.25 and $1.50 isobars. Call charges based upon June 1994 MCI (USA), KDD (Japan), BT (U.K.), and DBP Telekom (Germany) tariffs and June 1994 exchange rates.

United Kingdom

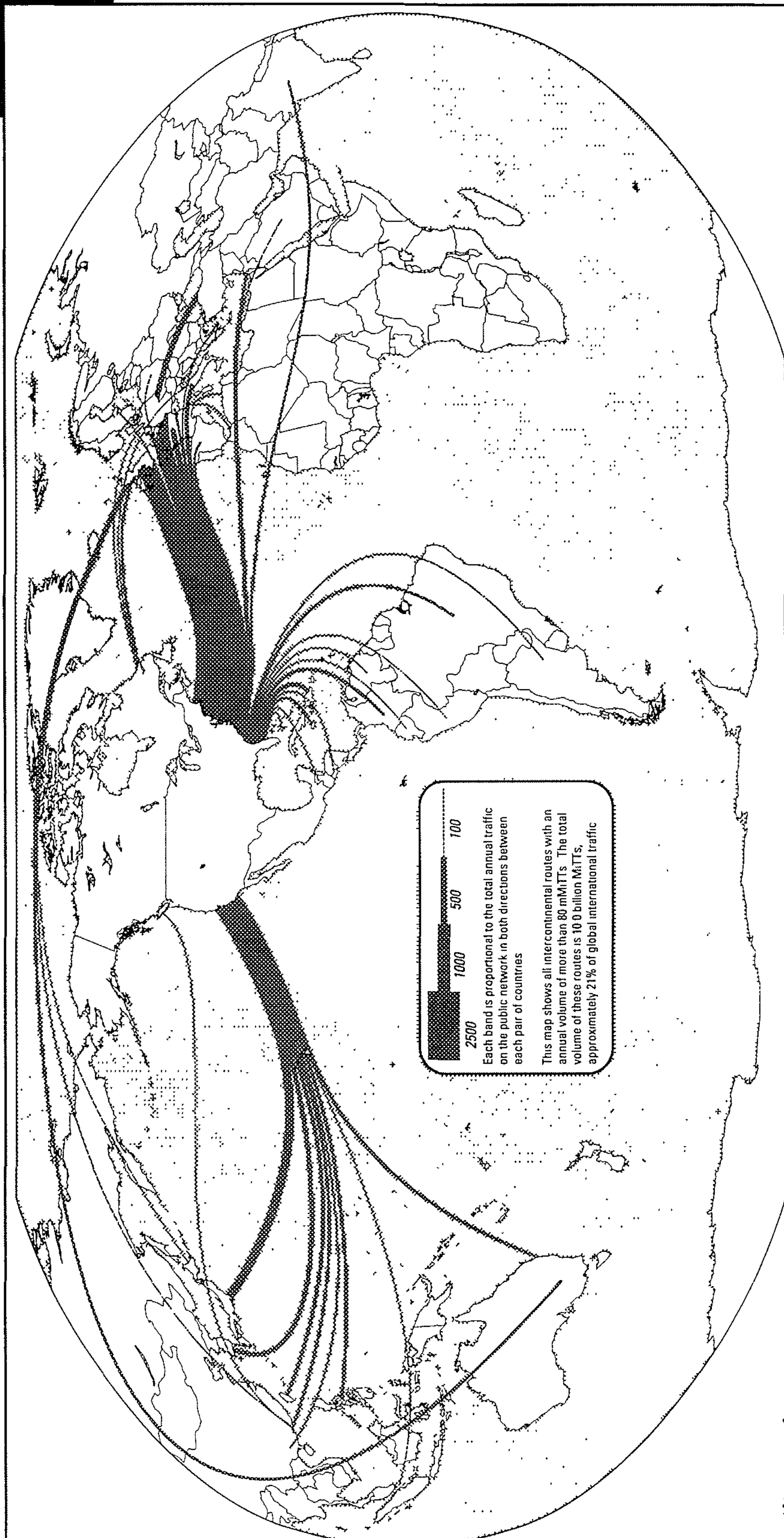


Graphics by Michael Roscoe © TeleGeography, Inc. 1994

Germany



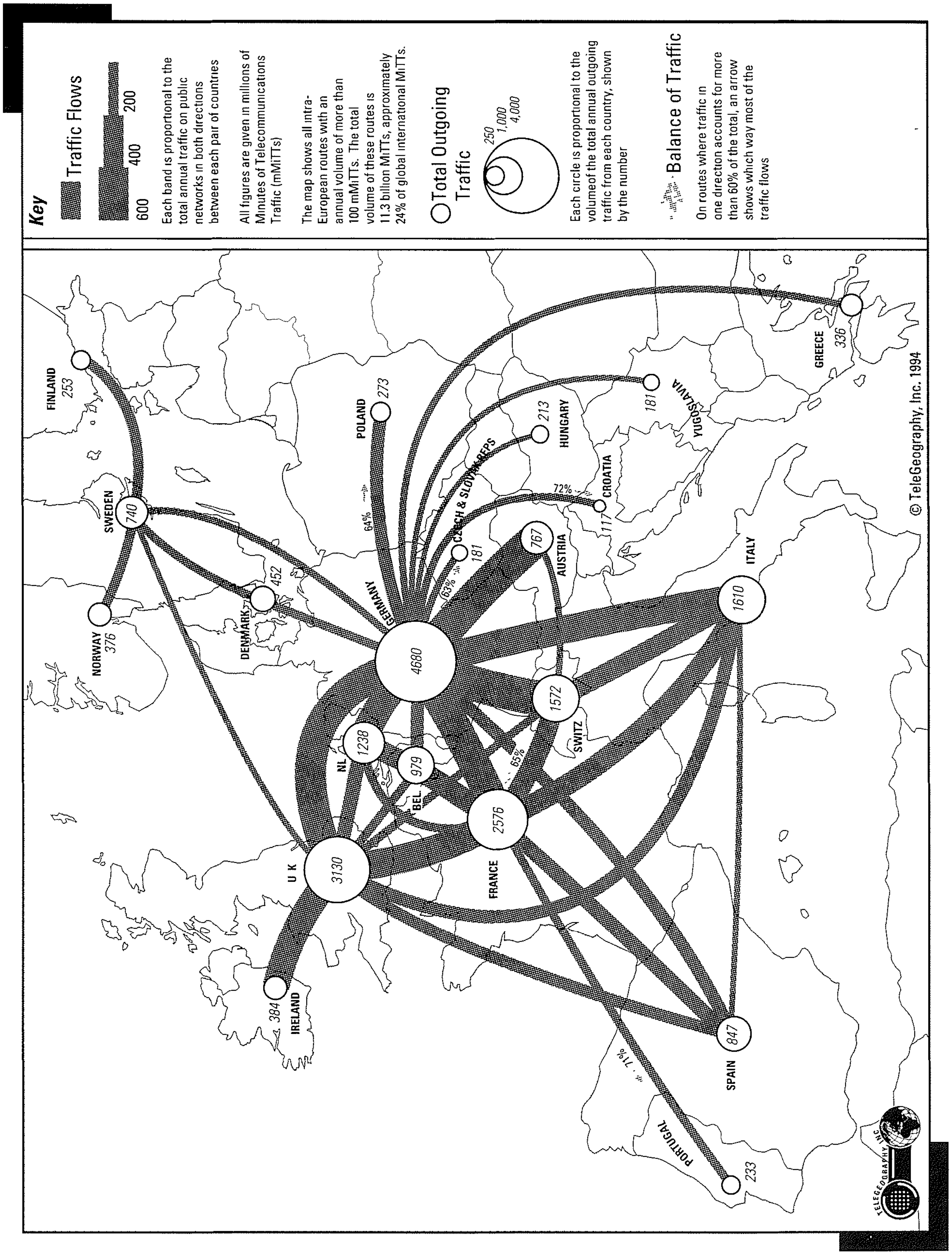
INTERCONTINENTAL TELECOMMUNICATIONS FLOWS, 1993



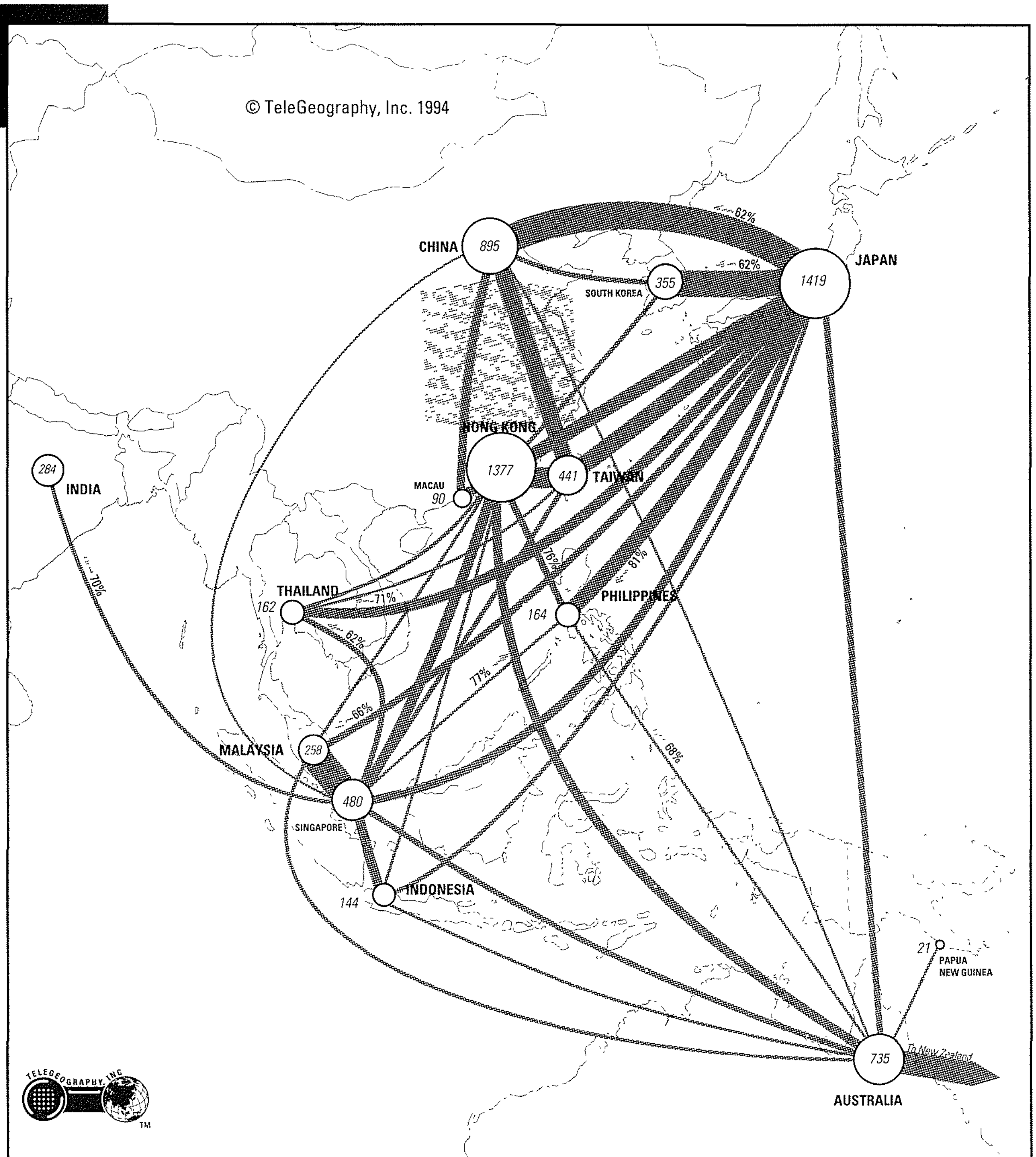
USA/U.K.	1299.7	USA/Colombia	252.0	USA/Switzerland	170.4	USA/Guatemala	107.9	USA/Singapore	94.0
USA/Germany	835.6	USA/Australia	244.3	Algeria/France	156.0	USA/Ireland	107.1	Italy/Canada	88.7
USA/Japan	685.0	USA/Hong Kong	232.2	USA/Spain	154.9	Hong Kong/Canada	105.1	USA/Bahamas	84.9
USA/France	425.3	Canada/U.K.	219.0	USA/China	149.6	USA/Peru	104.3	Japan/U.K.	82.0
Germany/Turkey	424.6	USA/Brazil	218.3	France/Morocco	126.0	USA/Greece	100.8		
USA/Korea	338.7	Australia/U.K.	218.0	USA/Sweden	115.5	USA/Venezuela	98.6		
USA/Italy	328.3	USA/Israel	215.8	USA/El Salvador	114.8	USA/Ecuador	98.5		
USA/Domin Rep.	310.9	USA/India	189.6	USA/Argentina	111.4	Germany/Canada	98.0		
USA/Taiwan	272.8	USA/Netherlands	184.0	USA/Belgium	110.5	USA/Saudi Arabia	97.3		
USA/Philippines	255.0	USA/Jamaica	182.2	USA/Poland	110.3	Hong Kong/U.K.	96.1		

Data in millions of MiTTs. The country with more outgoing traffic on each route is listed first.

EUROPEAN TELECOMMUNICATIONS FLOWS, 1993



East Asian Telecommunications Flows, 1993



Key

All figures are given in millions of *Minutes of Telecommunications* Traffic (mMiTTs), for the public telephone network

The map shows all intra-Asian routes with an annual volume of more than 20 mMiTTs The total volume of these routes is 3 6 billion MiTTs, approximately 8% of all global international traffic

Traffic Flows

200 100 50

Each band is proportional to the total annual traffic on the public telephone network in both directions between each pair of countries

Balance of Traffic

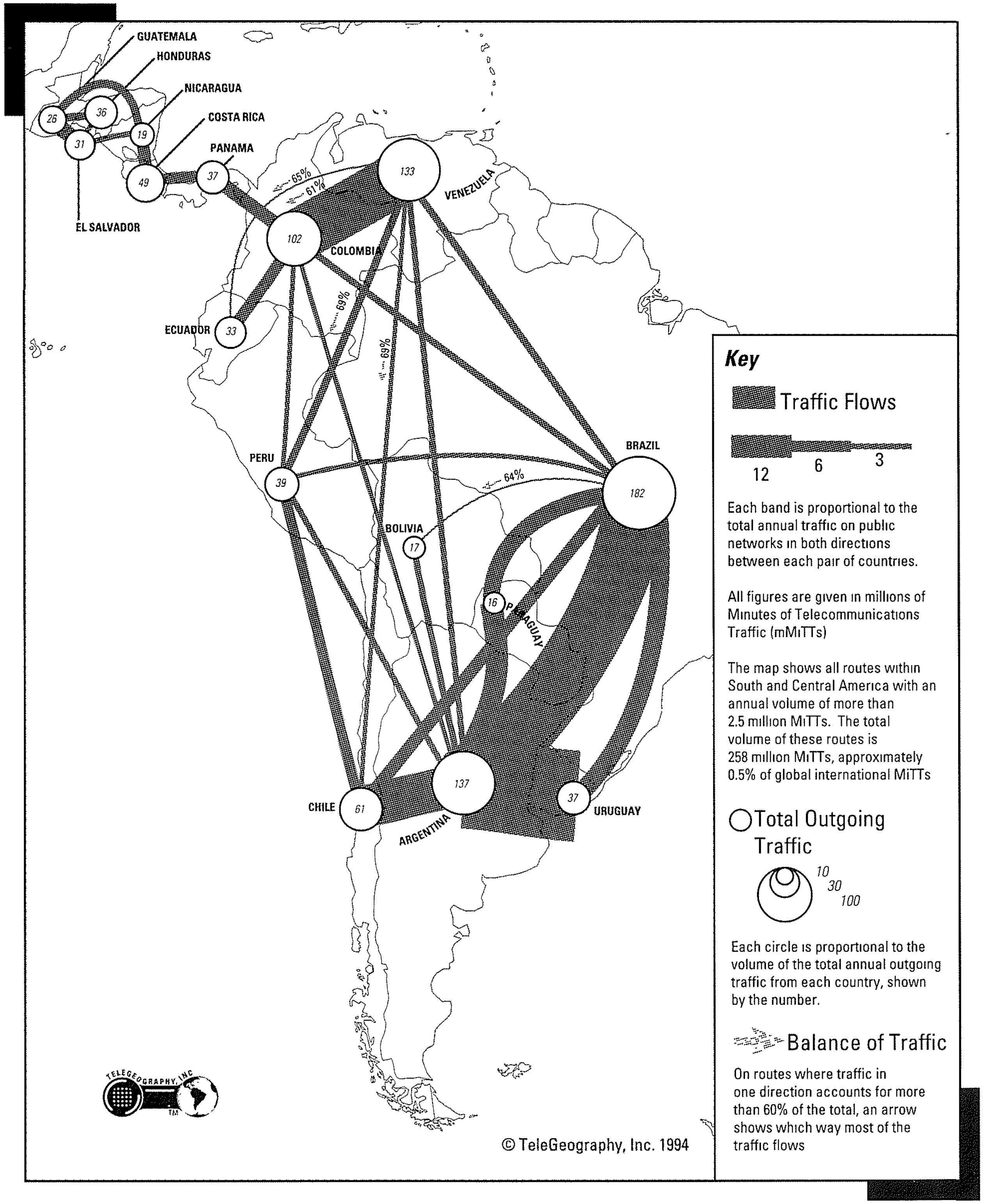
On routes where traffic in one direction accounts for more than 60% of the total, an arrow shows the direction most of the traffic flows

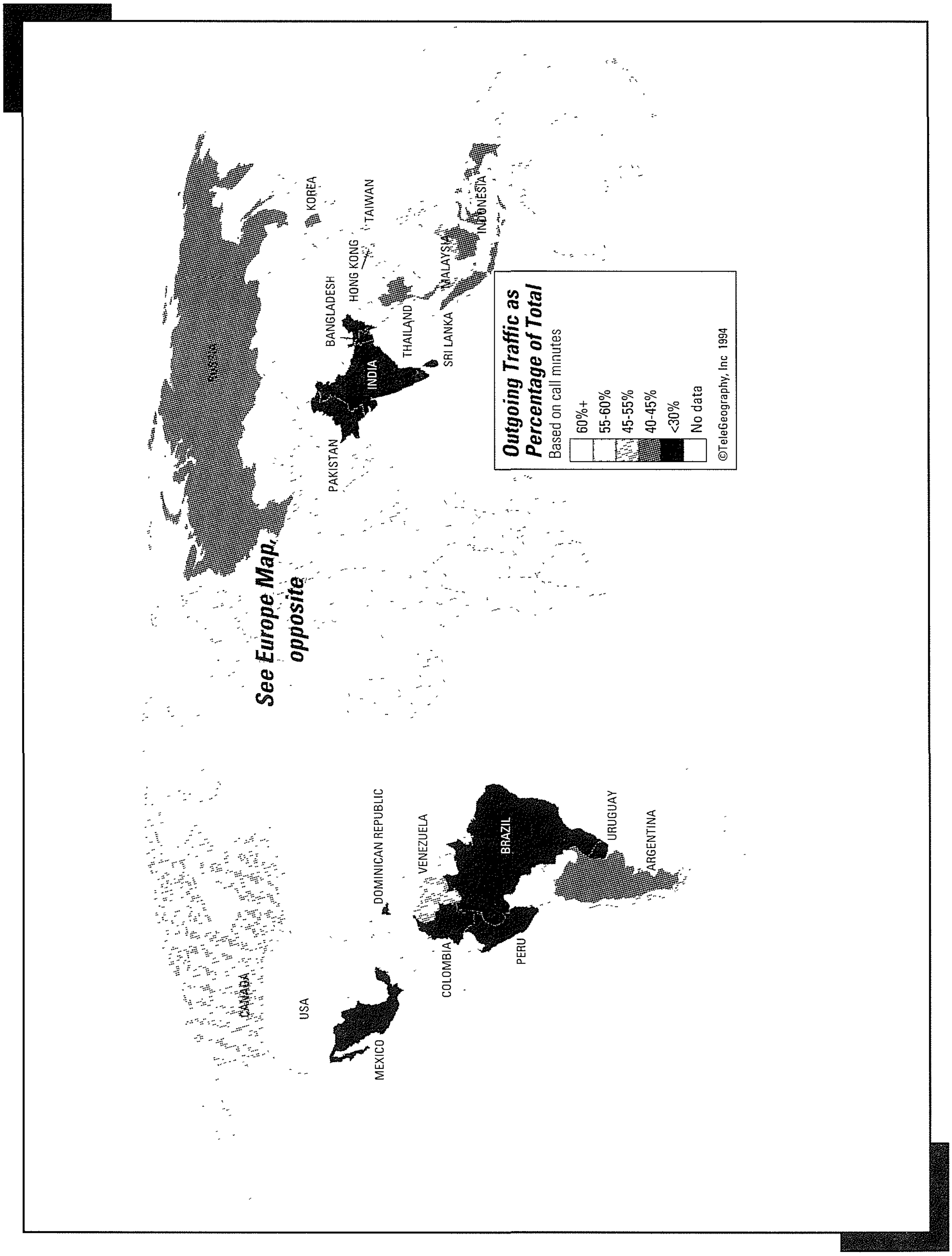
Total Outgoing Traffic

250
500
1,000

The area of each circle is proportional to the volume of the total annual outgoing traffic from each country, shown as a number

SOUTH AMERICAN TELECOMMUNICATIONS FLOWS, 1993




RUSSIA
KOREA
TAIWAN
HONG KONG
BANGLADESH
INDIA
PAKISTAN
THAILAND
SRI LANKA
MALAYSIA
INDONESIA
See Europe Map, opposite
CANADA
USA
MEXICO
DOMINICAN REPUBLIC
VENEZUELA
COLOMBIA
PERU
BRAZIL
URUGUAY
ARGENTINA
Outgoing Traffic as Percentage of Total
Based on call minutes
60%+
55-60%
45-55%
40-45%
<30%
No data
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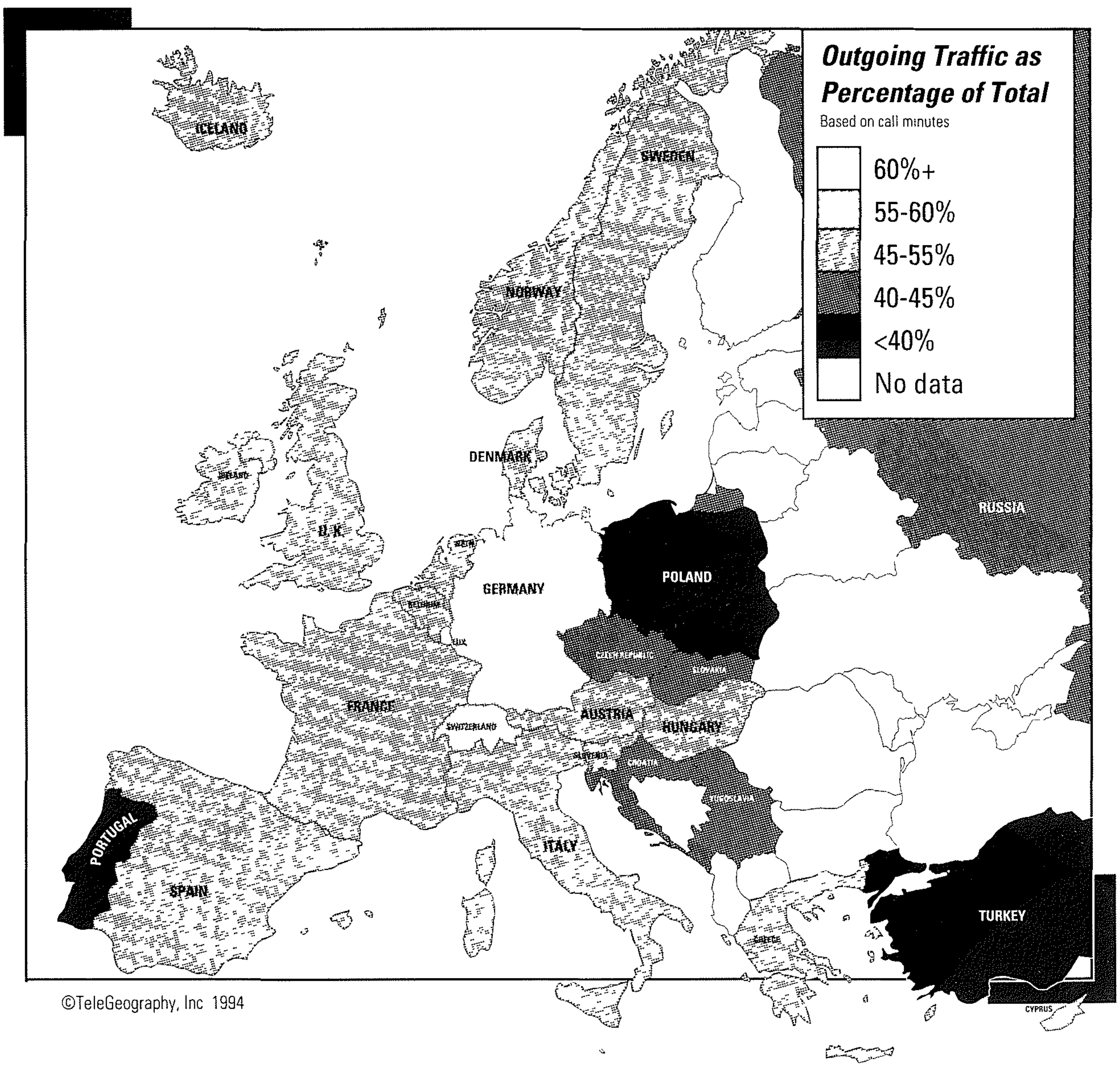
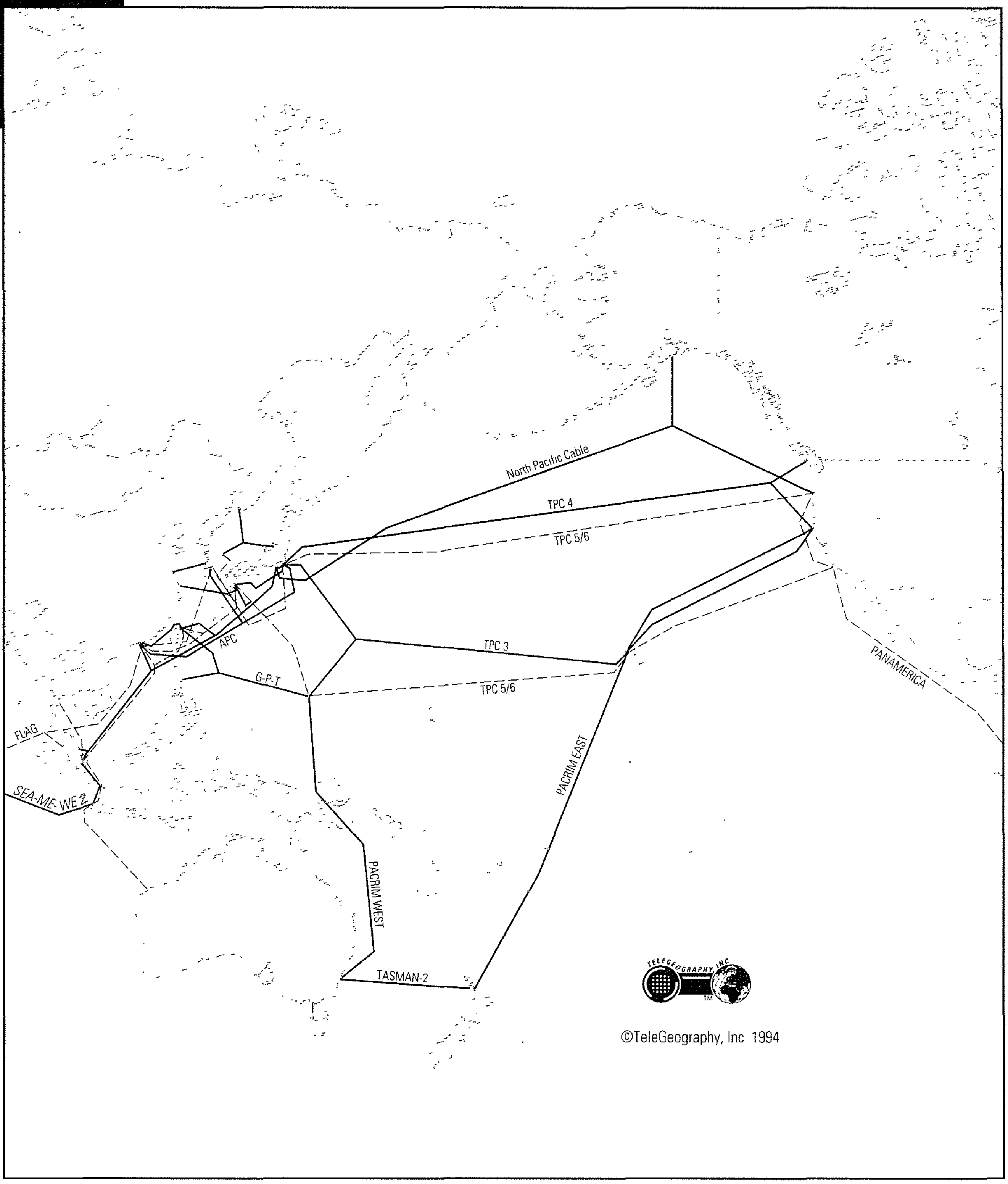
TRAFFIC BALANCES, 1993

These maps show the balance of international switched telephone circuit traffic in 1993. Countries with more than 50% outgoing traffic generally had a traffic deficit, sending out more traffic than they received. In some cases, such as the U.S., the actual traffic deficit is less than it appears here because the data is based on the billing point of calls, not the physical point of origin. (See Methodology, pp. 148-149.) By and large, however, countries with a traffic deficit also had a settlements or trade in services deficit because carriers in such countries paid out more to terminating country carriers than they received for landing inbound traffic. Countries with the lowest percentage of outbound traffic (e.g., Poland, Turkey, Pakistan, Uruguay, the Dominican Republic) likely profited most from the traffic imbalance in the past year.

For each country's precise outgoing and incoming traffic and its surplus or deficit, see pages 164-167.




North Pacific Cable
TPC 4
TPC 5/6
APC
G-P-T
TPC 3
TPC 5/6
PANAMERICA
FLAG
SEA-ME-WE 2
PACRIM EAST
PACRIM WEST
TASMAN-2
TELEGEOGRAPHY INC
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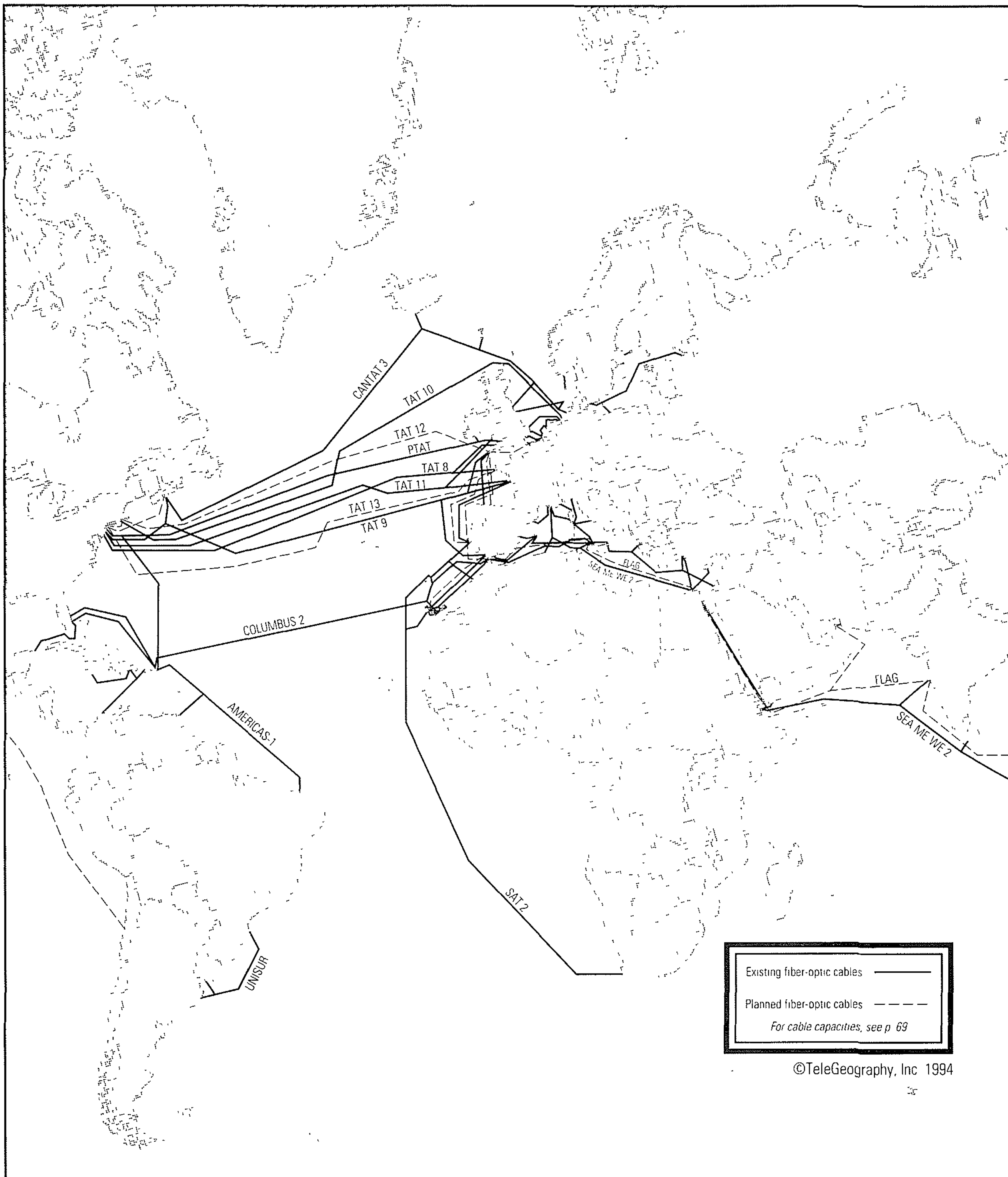
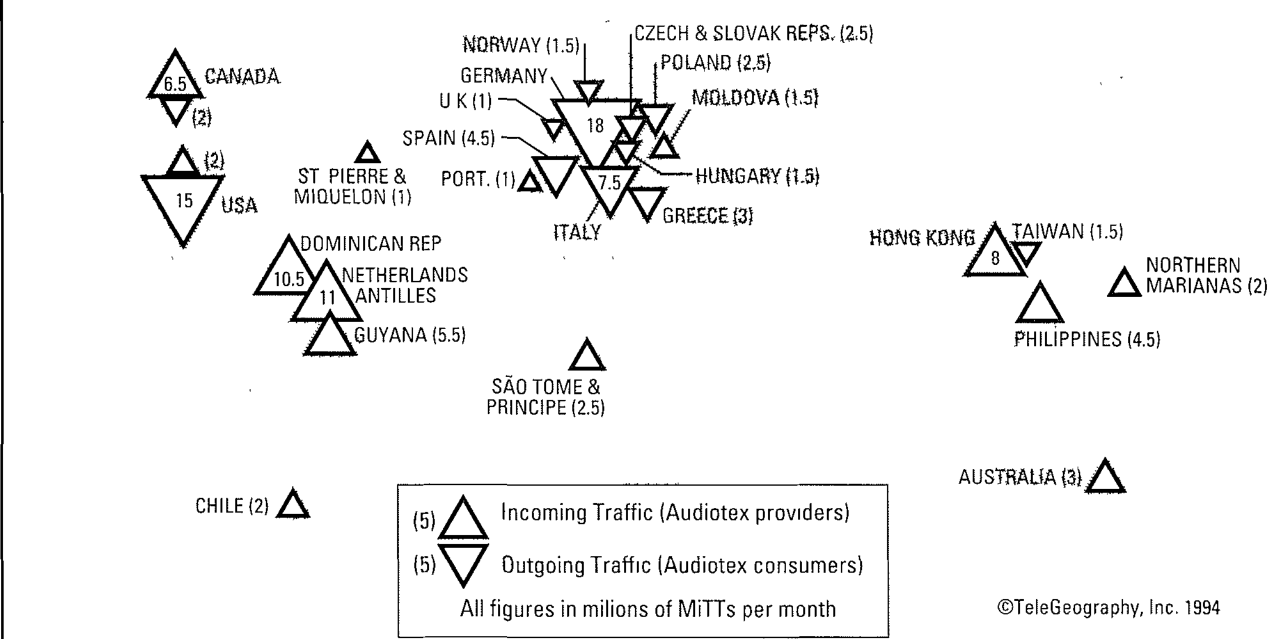
MAJOR SUBMARINE CABLES



MEN (MOSTLY) CALLING! INTERNATIONAL PHONE SEX

Major Providers and Consumers of Adult Audiotex, 1994



Since 1990, stricter national regulation of "adult" audiotex and live, sexually oriented call-in services has led many phone sex businesses to study telegeography. By relocating a sex-talk business in a relatively distant country (e.g., Guyana), the services may stimulate millions of additional incoming calls (e.g., from Germany) and substantial foreign settlements. The host carrier typically shares these settlements (paid by the originating carrier) with the audiotex entrepreneur. The higher the local settlement charge, the better off the audiotex service is likely to be. (See chart). Offshore phone sex services thus do not need to bill their customers directly and also bypass local obscenity laws.

Although not all international audiotex services are pornographic, international phone-sex calls now total over 65 million minutes a month—1.5% of all international traffic. The largest participants are mapped above. However, some of the termination countries may not actually host as many sex-talk services as the map suggests. Some services use the termination country primarily as a collection vehicle for inward traffic which is then rerouted (by private line) to an unidentified third country or in some cases back to the country from which most of the incoming calls originate.

Sources: Industry interviews; 3 Net Communications (London); *Voice International*

		Settlement Rate per minute (US$)	
Country	**Country Code**	U.S (6/94)	W Europe (est.)
Australia	61	.38	.40-.50
Canada (B.C. and Ontario)	1-604/416	.14	.40-.60
Chile	56	.60	.70-1.00
Dominican Republic	1-809	.55	.60-.80
Guyana	592	.85	.60-.70
Hong Kong	852	.50	.60-.70
Moldova	373	1.25	.40-.70
Netherlands Antilles	597	.38	.60-.80
Northern Marianas (Saipan)	670	.75	.80-1.00
Philippines	63	.84/.64*	.75-1.00
Portugal	351	.65/.35*	.40-.60
São Tome	239	n.a.	.75-1.00
St. Pierre and Miquelon	508	.53	.60-.80
United States (NY, Calif.)	1-212/415/213	--	.35-.80

*Peak/Off-Peak

The settlement rate is the payment made by the orginating carrier to the terminating carrier. This payment is typically split with the audiotex service bureau.

Audiotex Traffic Growth

Year	Annual MiTT (millions)
1991	100-150
1992	200-250
1993	500-600
1994	750-850

Tables

Table 1: Capacity and Cost per Voice Path of Selected Trans-Oceanic Cable Systems, 1956-2000

	Year in Service	Cable System	Cost (US$) per voice path	Capacity (voice paths)
Trans-Atlantic	1956	TAT-1*	557,000	89
	1965	TAT-4*	365,000	138
	1970	TAT-5*	49,000	1,440
	1983	TAT-7*	23,000	8,400
	1988	TAT-8	9,000	37,800
	1989	PTAT	6,000	85,000
	1991	TAT-9	5,500	75,600
	1993	TAT-10	4,000	75,600
	1994	CANTAT-3	1,000	302,000
	1996-97	TAT-12/13	1,000	600,000
Trans-Pacific	1957	Hawaii 1*	378,000	91
	1964	TPC-1*	406,000	167
	1974	Hawaii 2*	41,000	1,690
	1975	TPC-2*	73,000	1,690
	1988	TPC-3	16,000	37,800
	1991	North Pacific Cable	5,000	85,000
	1992	TPC-4	5,500	75,600
	1996	TPC-5/6	2,000	605,000
Japan/Saudi Arabia/U.K.	1997	FLAG	1,500	605,000

* No longer in service.

Notes: Costs are capital and construction costs only, stated in US$ to the nearest $500, unadjusted for inflation. Current technology permits approximately 5 virtual voice paths to be derived from a digital channel operating at 64,000 bits per second (64 kbit/s). Fiber optic cables are expected to have a useful life of at least 25 years. Table reports average cost per voice path for cables with multiple landing points. For example, the TAT-9 system connects the U.S. and Canada with the U.K., France and Spain. The average U.S.-U.K. cost per voice path is approximately $4000. Reserve capacity of cables is generally excluded.

Source: FCC and carriers.

Table 2: Cable and Satellite Capacity on Trans-Atlantic and Trans-Pacific Routes, 1986-2000

	Trans-Atlantic (North America-Europe) Voice Paths		*Trans-Pacific (North America-East Asia) Voice Paths*	
Year	**Cable**	**Satellite**	**Cable**	**Satellite**
1986	22,000	78,000	2,000	39,000
1987	22,000	78,000	37,800	39,000
1988	60,000	78,000	37,800	39,000
1989	145,000	93,000	37,800	39,000
1990	145,000	283,000	37,800	39,000
1991	221,000	283,000	114,200	27,000
1992	296,600	496,000	190,500	27,000
1993	372,200	620,800	264,000	83,300
1994	664,000	620,800	264,000	234,000
1995	1,264,000	710,800	264,000	234,000
1996	1,264,000	710,800	864,600	234,000
1997-2000*	1,264,000	737,500	1,464,600	424,500

*minimum available

Notes: Estimates of cable voice paths assume that 5 virtual voice paths can be derived from one 64 kbit/s digital circuit; cable estimates do not include circuits held in reserve for cable/satellite restoration services. Estimates of trans-Atlantic capacity exclude proposed PTAT-2 cable in 1997-2000 timeframe. Estimates of trans Pacific cable circuits are based on capacity from North America to Japan via Hawaii or Guam and exclude proposed SE-ME-WE-3, CANPAC-1, and Trans-Siberian Link (TSL) cables, all scheduled for 1996-97 timeframe.

Estimates of satellite voice paths are based on Intelsat satellites only prior to 1993; satellite estimates exclude one Intelsat satellite in each region held in reserve. Estimates also assume one voice path per channel until 1989 deployment of Intelsat VI series with 24,000 channels or 120,000 voice paths using Digital Code Multiplication Equipment (DCME). The Intelsat VII series, deployed in 1992, has a nominal capacity of 18,000 channels or 90,000 voice paths using DCME. For 1993-2000 time period, estimates assume full capacity of the following non-Intelsat systems is available: **Trans-Atlantic** PAS-1; PAS-3, Orion-1 and TDRS-4; **Trans-Pacific** PAS-2; Rimsat/Express (2 satellites) and TDRS-174. In the near term, some additional telecommunications circuits are likely to be available from Intersputnik, Hispansat and, after 1997, from the Iridium, Globalstar, and Inmarsat proposed mobile satellite systems. Currently, non-Intelsat satellites are limited to 1250 64 kbit/s circuits per satellite for public switched telephony. This limit is expected to be raised to 8000 64 kbit/s circuits in 1995 and phased out by 1998. Additionally, the capacity of the following "national" satellite systems may provide some trans-Pacific telecommunications service: Optus (Australia), Palapa Pacific (Indonesia), and, in the North Pacific, Aurora (U.S.).

Regional capacity estimates do not necessarily imply that full capacity is available to satisfy demand on any given bilateral route.

Source: FCC and carriers.

Table 3: The Top 40 International Carriers, 1988-93

Rank	Company	Country	1993	1992	Change 92-93	1991	1988
			Outgoing Traffic (millions of MiTTs)				
1.	AT&T (a,b)	United States	7129	6984	2.1%	6557	4778
2.	DBP Telekom (c)	Germany	4680	4087	14.5%	3605	2479
3.	MCI (a,b)	United States	2839	2083	36.3%	1600	262
4.	France Telecom (a)	France	2576	2449	5.2%	2295	1570
5.	BT (d)	United Kingdom	2310	2188	5.6%	2105	1654
6.	Telecom Italia (f)	Italy	1610	1473	9.3%	1220	n.a.
7.	Swiss PTT	Switzerland	1572	1551	1.4%	1429	1014
8.	Stentor (b,g)	Canada	1430	1520	-5.9%	1425	1054
9.	Hongkong Telecom (d,e)	Hong Kong	1377	1137	21.1%	913	441
10.	Netherlands PTT (a)	Netherlands	1238	1134	9.2%	1018	706
11.	Sprint (a,b)	United States	1175	940	25.0%	723	131
12.	Belgacom (a)	Belgium	979	911	7.5%	823	561
13.	KDD (d)	Japan	944	893	5.7%	850	529
14.	China MPT (e)	China	895	635	40.9%	440	170
15.	Telefonica	Spain	847	804	5.3%	719	330
16.	Mercury (d)	United Kingdom	820	661	24.1%	493	75
17.	Teleglobe (a)	Canada	808	722	11.9%	647	358
18.	Austrian PTT (a)	Austria	767	713	7.6%	642	401
19.	Telia AB (h)	Sweden	685	691	-0.9%	672	485
20.	Telstra (i)	Australia	640	659	-2.9%	610	415
21.	Telmex (a)	Mexico	625	684	-8.6%	500	211
22.	Singapore Telecom (d,j)	Singapore	480	412	16.5%	344	142
23.	TeleDanmark	Denmark	452	425	6.4%	395	296
24.	Saudi Com. Ministry	Saudi Arabia	448	465	-3.7%	411	288
25.	DGT Taiwan (a)	Taiwan	441	369	19.5%	255	143
26.	Telecom Eireann (d,k)	Ireland	384	297	29.4%	273	202
27.	Norwegian Telecom	Norway	376	349	7.8%	309	246
28.	Etisalat	U.A.E.	342	299	14.2%	262	177
29.	OTE (a)	Greece	336	299	12.5%	245	179
30.	Videsh Sanchar (d,l)	India	284	260	9.4%	186	91
31.	Telekomunikacja Polska	Poland	273	213	28.2%	125	28
32.	Korea Telecom	Rep. of Korea	265	245	8.2%	229	104
33.	Turkish PTT	Turkey	265	227	16.7%	198	118
34.	Telekom Malaysia	Malaysia	258	217	19.2%	176	95
35.	Telkom South Africa	South Africa	255	222	14.9%	203	125
36.	Telecom Finland	Finland	253	235	7.7%	215	149
37.	IDC (d)	Japan	239	197	21.3%	154	0
38.	ITJ (d)	Japan	228	193	18.1%	156	0
39.	HTC	Hungary	213	184	16.0%	151	62
40.	Rostelecom	Russia	201	176	14.4%	n.a.	n.a.

MiTT is Minutes of Telecommunications Traffic. Data are for public voice circuits only rounded to the nearest million MiTT.

a. 1993 traffic based on billing point of call, not originating point.
b. Data for North American carriers include continental traffic.
c. For DBP Telekom, all data include outgoing traffic from the former East Germany.
d. Data are for the Fiscal Year (April 1993 to March 1994). HKT and Mercury are majority owned by Cable & Wireless (U.K.).
e. Includes Hong Kong-China traffic.
f. Combined totals for Iritel and Italcable. Prior to 1994, Iritel (formerly ASST) handled intra-continental traffic only, and Italcable carried overseas traffic .
g. Stentor was formerly Telecom Canada; Stentor traffic is for U.S. only of which approximately 70% is originated by Bell Canada.
h. Telia AB was formerly Televerket.
i. Telstra was formerly AOTC.
j. Singapore Telecom data include traffic to Malaysia (except local border traffic).
k. Telecom Eireann data include traffic to the U.K
l Videsh Sanchar data excludes traffic to Pakistan.

Table 4a: Market Share of Competing International Carriers, 1986-94

Percentage of Outgoing MiTT

Country/Carrier	1986	1987	1988	1989	1990	1991	1992	1993
United States								
AT&T	94.3	93.0	89.1	83.3	78.4	74.8	70.3	62.2
MCI	4.0	4.7	7.0	10.2	14.6	17.8	21.2	24.8
Sprint	1.6	2.3	3.5	5.8	6.4	6.3	7.3	10.3
IDB							n.a.	0.6
U.K. (F.Y.)								
BT	99.8	98.5	95.5	91.0	86.0	81.0	76.8	72.4
Mercury	0.2	1.5	4.5	9.0	14.0	19.0	23.2	25.8
IPL Resellers								1.8
Japan (F.Y.)								
KDD				93.3	88.0	73.3	69.7	66.9
IDC				3.7	6.5	13.3	15.3	16.9
ITJ				3.0	5.5	13.4	15.0	16.2
New Zealand (F.Y.)								
TNZ					92.0	82.0	80.0	78.4
ClearCom					8.0	18.0	20.0	21.6
Korea, Republic of								
Korea Telecom							79.9	74.5
Dacom							20.1	25.5
Chile								
Entel Chile							80.0	55.0
Chilesat							20.0	20.0
VTR Telecom							<1.0	<5.0
Philippines								
PLDT							91.6	84.2
Philippine Global Com.							8.4	15.8
Eastern Telecom							n.a.	n.a.
Sweden								
Telia AB								92.6
Tele-2								7.4
Australia								
Telstra							98.0	87.0
Optus							2.0	13.0
Canada (Canada-U.S. route only)								
Stentor								85.7
Unitel								2.2
Resellers								12.1

Notes: MiTT is Minutes of Telecommunications Traffic. Data based on international outgoing traffic for the public switched network only. Unless stated, data exclude traffic and market share of carriers reselling international private line services (IPL resellers). Market shares are for the full year, beginning in the first year of competition. Market shares for U.S. carriers prior to 1993 exclude resellers and traffic to Canada and Mexico; minor U.S. carriers are not listed. For U.K. carriers traffic to Ireland is excluded. For the Philippines, market share data exclude Eastern Telecom. For Chile and the Philippines, start-up carriers are listed in Table 4b, opposite. Chilean shares to not add up to 100% because Chilesat reportedly acted as an international gateway in 1993. This gateway handled an additional 20% of outbound traffic originated by CTC, the largest local exchange company, prior to the establishment of CTC Mundo.

Table 4b: Other Competing International Carriers

Additional facilities-based international telephone carriers have also been authorized in the following markets, but were not operational or had limited international traffic as of 1 July 1994:

Chile

- * Entel Chile
- T.D.I. (affiliate of BellAtlantic, U.S.)
- CIDCOM Larga Distancia (100% owned by BellSouth, U.S.)
- CTC Mundo

Dominican Republic

- * CODATEL
- Tricom

Finland

- * Telecom Finland
- Telivo (owned by Finnish state electric company, Imatran Voima)
- Finnet International (owned by regional Finnish telephone companies)
- Arlands Mobil Telefon Ltd.

Indonesia

- * PT Indosat
- PT Satelindo

Israel

- * Bezeq
- DARCOM Communications Ltd.

Malaysia

- * Telekom Malaysia
- Technology Resource Industries (TRI)

Philippines

- * PLDT
- Isla Communications, Inc. (30% owned by Shinawatra group, Thailand)
- Smart Communications, Inc.
- Capital Wireless Inc. (20% owned by Korea Telecom)
- Globe Telecom (38% owned by Singapore Telecom)
- International Communication Corp.

Russia

- * Intertelecom
- Aerocom Ltd.
- Astelit
- Baltic Communication
- Comstar Telecom
- Leningrad Trunk Line
- Nakhodka Telecom
- Sakhalin Island
- Tatin Com
- Teleport-TP
- Vostoktelecom

* Former monopoly operator in the market.

Table 5: International Carriers:

Company	Share symbol	Principal Exchange	Share price 8/31/94		EPS (lc)	PER (x)
AT&T	U:T - T.N	New York	55.25	US$	3.45	16.0
BCE (a)	C:B - B.TO	Toronto	48.13	C$	2.75	17.5
Bezeq (b)	N/A - BEZQ.TA	Tel Aviv	5.05	NIS	0.08	31.5
BT	BT - BT.L	London	391.00	£	29.00	13.5
C&W (c)	CABL - CW.L	London	473.00	£	22.30	21.2
CPRM	MVNB - MARN.IN	Lisbon	5,050.00	Esc	287.00	17.6
CTC	U:CTC - CTCpa.SN	Santiago	2,210.00	P	117.77	18.8
Dacom	KO:DAC - 84310.KS	Seoul	83,900 00	Won	1,728.00	48.6
Entel (Chile)	CH:ENT - ENT.SN	Santiago	5,220.00	P	366.78	14.2
GTE (d)	U:GTE - GTE.N	New York	31.75	US$	2.20	14.4
Globe Telecom ('A' share)	PH:GLA - N/A	Manila	28.00	P	-0.57	-49.1
Hong Kong Telecom	K:TELE - 0008.HK	Hong Kong	16.90	HK$	0.65	26.0
IDB Comm	IDBX - IDBX.O	New York	9.50	US$	0.43	22.1
KDD	J:LZ@N - 9431.T	Tokyo	11.70	Y 000	243.68	0.0
Matav (Hungary) (e)	Not listed	N/A	2,200.00	Ft		N/A
MCI	MCIC - MCIC.O	New York	24.56	US$	1.30	18.9
OTE (Greece) (f)	Not listed	N/A		Drs		N/A
PLDT	PH:PLD - N/A	Manila	1,755.00	P	101.50	17 3
PTT Netherlands (KPN)	H:KPN - KPN.AS	Amsterdam	53.90	Fl	4.20	12.8
Singapore Telecom	T:TELC - TELE.SI	Singapore	3.46	S$	8.00	0.4
Sprint	U:FON - FON.N	New York	39.63	US$	1.99	19.9
Tele Danmark	N:TELE - TLDa.CO	Copenhagen	135.00	DKK	119.20	1.1
Telebras ('PN' share)	BR:TL4 - TEL.SA	São Paulo	57.69	US$/000 shares	1.52	38.0
Telecom Argentina (g)	AG:TEC - TEC2.BA	Buenos Aires	7.23	P	0.20	37.1
Telecom Corp of New Zealand	Z:TELN - TEL.NZ	Wellington	5.20	NZ$	27.60	0.2
Telecom Italia (h)	I.SIP - TELE.MI	Milan	4,560.00	Lit	182.00	25.1
Telefonica de Argentina	AG:TEA - TEA2.BA	Buenos Aires	7.30	P	0.25	29.3
Telefonica de Espana	E:TEF - TEF.MC	Madrid	1,840.00	Pta	93.00	19.8
Teleglobe	745251 - TLO.TO	Toronto	18.63	C$	1 20	15.5
Telekom Malaysia	L:TKOM - TLMM.KL	Kuala Lumpur	21.40	RM	0.55	38.9
Telmex ('L' share)	MX:TML - TMXL.MX	Mexico City	10.80	NP	0.85	12.7
VSNL	ID.VSN - N/A	Bombay	1,100.00	Rp	15.00	73.3

Share symbol is Datastream mnemonic and Reuter code where available.
lc = local currency
N/A = Not Applicable. n.a. = not available.

a. BCE is the parent of Bell Canada, which serves the U.S. It also holds a 30% interest in TeleGlobe.
b. Bezeq's stock prices are listed as of 6/30/94 and 6/30/93
c. C&W's principal international carriers are Hong Kong Telecom, 58%-owned, and Mercury Communications (U.K.), 80%,-owned.
d. GTE provides international service through its wholly owned U.S. subsidiary Hawaiian Telephone Co. GTE also owns CODATEL in the Dominican Republic, 50% of BCTel and Quebec Telephone and 20% of CANTV (Venezuela).
e. Matav price is for the 'grey' market for c.5% of stock
f. OTE: latest estimate for proceeds of IPO equal to Drs250-400bn (US$1.065 - 1.672bn).
g. Telecom Argentina revenue figures correspond to first two quarters of FY ending 9/94.
h. Telecom Italia has resulted from the amalgamation of SIP, Iritel, Italcable and Telespazio on 18/8/94. The share price is that of SIP before that date.

Stock Prices and Market Capitalization

Share price (lc) 8/31/93	% ch on 8/31/93 lc	US$	International Service Revenues US$m	% of total revenue	Number of shares (m)	Mkt. cap. (US$bn)	Exchange rate 8/31/94	Capitalization (US$bn)	Cap. as % total mkt.
62.88	-12.1	-12.1	5,206	7.8	1,352.40	74.72	1.00	4070	1.8%
43.25	11.3	6.2	n.a.	n.a.	305.35	10.74	1.37	259	4.1%
6.31	-20.0	-25.4	468	34.2	720.52	1.20	3.06	45	2.7%
428.00	-8.6	-5.8	2,925	14.3	6,207.00	37.21	1.53	1129	3.3%
431.00	9.7	9.7	3,463	48.5	2,185.00	15.84	1.53	1129	1.4%
5,550.00	-9.0	-1.2	204	62.1	15.60	0.49	160.50	15	3.3%
1,823.00	21.2	n/a	135	14.8	859.02	4.55	417.24	55	8.3%
90,000.00	-6.8	n/a	220	54.3	7.80	0.82	800.75	162	0.5%
5,740.00	-9.1	n/a	146	58.5	92.60	1.16	417.24	55	2.1%
36.63	-13.3	-13.3	2,277	14.3	944.90	30.00	1.00	4070	0.7%
22.00	27.3	31.0	N/A	N/A	93.50	0.10	26.45	38	0.3%
12.40	36.3	34.6	1,958	62.8	11,153.00	24.39	7.73	273	8.9%
15.80	-39.9	-39.9	138	44.4	74.03	0.70	1.00	4070	0.0%
12.80	-8.6	-4.9	2,196	91.2	64.30	7.55	99.67	3766	0.2%
	N/A		N/A	N/A	N/A	2.7 E	108.16	1.7	N/M
28.00	-12.3	-12.3	2,003	16.8	540.20	13.27	1.00	4070	0.3%
	N/A		n.a.	n.a.	n.a.	n.a.	239.20	8.7	N/A
1,200.00	46.3	54.4	519	67.0	52.40	3.48	26.45	38	9.1%
N/A	N/A	N/A	1,296	14.8	460.47	14.01	1.77	248	5.6%
N/A	N/A	N/A	917	49.9	5,200.00	12.00	1.50	124	9.7%
37.00	7.1	7.1	764	6.7	341.00	13.51	1.00	4070	0.3%
170.00	-20.6	-12.2	508	18.0	6.77	0.15	6.24	43	0.3%
35.00	64.8	n/a	575	11.2	285,024.00	16.44	1.00	147	11.2%
3.81	89.8	89.2	90	10.8	984.40	7.12	1.00	45	15.8%
4.75	9.5	22.2	273	18.0	1,889.60	5.91	1.66	25	23.7%
3,605.00	26.5	29.3	n.a.	n.a.	8,177.00	23.43	1591.75	170	13.8%
4.27	71	69.8	214	12.0	1,178.80	8.61	1.00	45	19.1%
1,635.00	13	13.0	1,013	10.2	927.00	13.02	131.03	123	10.6%
16.38	14	10.7	290	68.7	56.80	0.77	1.37	259	0.3%
16.50	30	30.0	188	12.2	1,980.40	16.61	2.55	152	10.9%
8.24	31	18.9	1,435	19.7	10,603.20	33.89	3.38	192	17.6%
1,250.00	-12	n/a	214	91.0	80.00	2.81	31.37	150	1.9%

International Service Revenue figures include all international services traffic (telephone, data, private line, etc.) but does not include equipment sales or sales of foreign affiliates unless stated. Data for North American carriers is net of settlements with foreign carriers.

Source: Baring Securities, Datastream, company reports, Reuters, Financial Times.

This table was compiled with the assistance of Baring Securities, Ltd; 1 America Square, London EC3 N2L7, Tel. +44-71-522-6000, Fax +44-71-702-0008. The table is provided for information purposes only and under no circumstances should be considered as an offer to sell or as a solicitation of any offer to buy.

Table 6: Internet Statistics

The Internet Society

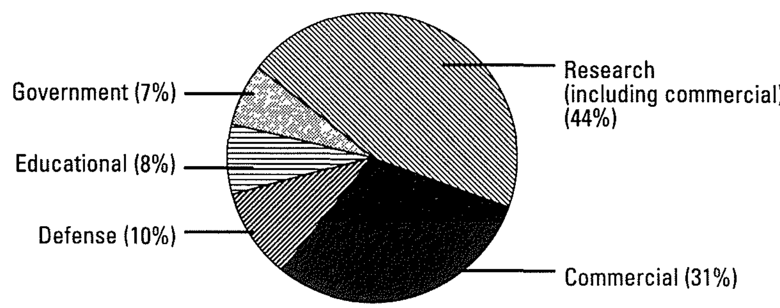
The data on the following four pages were supplied by the Internet Society:

- The global international organization for open systems internetworking and the Internet.
- A common mechanism for standards making, operational administration and coordination, research coordination and education, global cooperation among national, regional, and other international bodies.
- An international means for sharing information and encouraging development of internet-related infrastructure and use around the world.

Members consist of individuals and organizations—commercial, governmental, and non-profit. For more information, contact the Internet Society; Suite 270; 12020 Sunrise Valley Drive; Reston, VA 22091 USA. <isoc@isoc.org> Tel: +1-703-648-9888. Fax: +1-703-648-9887.

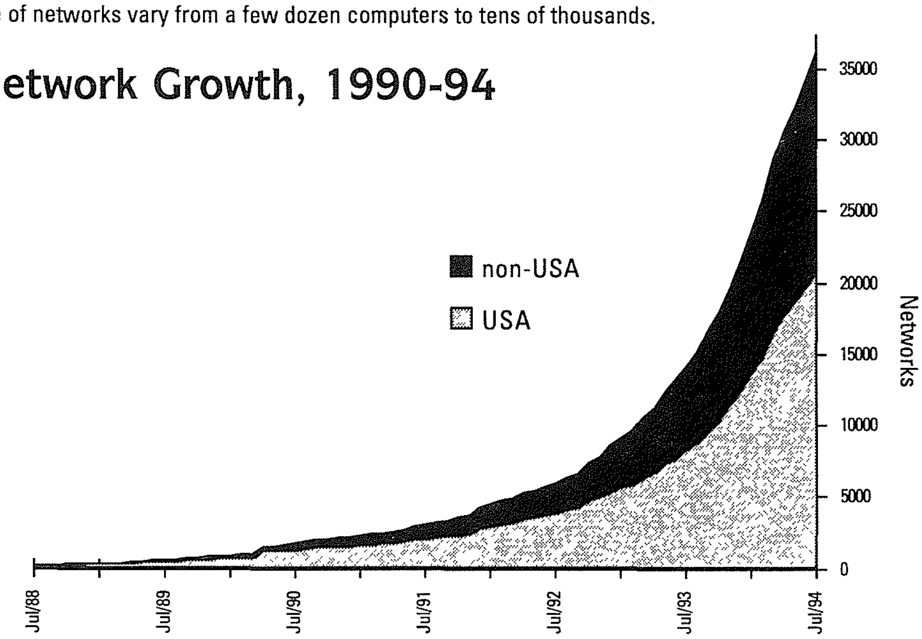
Internet Networks

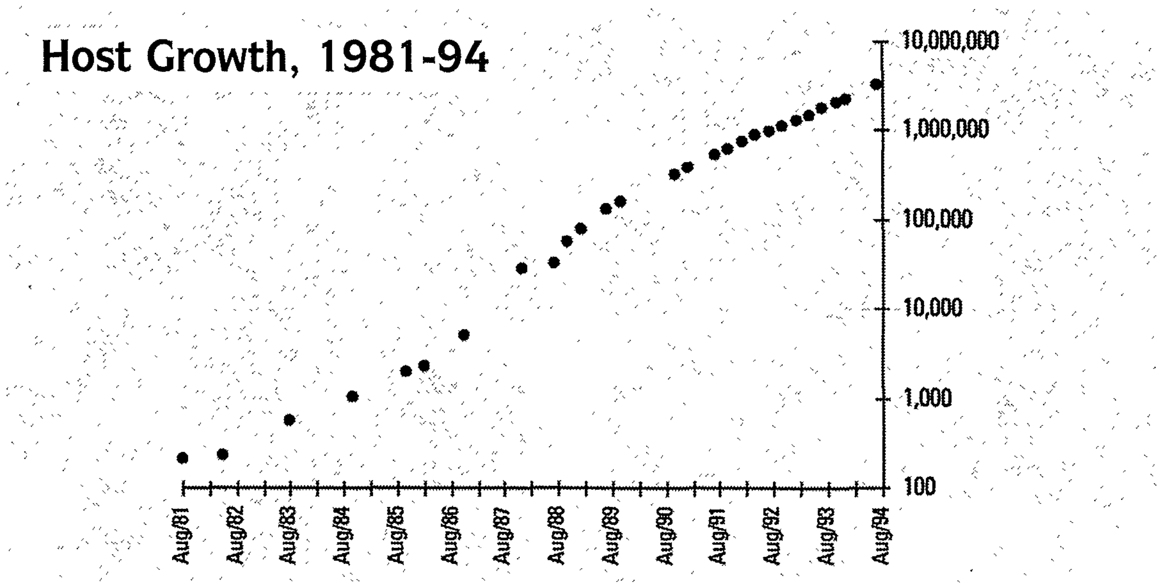
July 1993



An internet network consists of one or more Wide Area Networks (WANs) or Local Area Networks (LANs) capable of supporting the connection of almost any kind of computer, which is called a host. The size of networks vary from a few dozen computers to tens of thousands.

Network Growth, 1990-94





Host growth

An Internet host is a term used for a computer of any kind attached to the Internet capable of supporting the TCP/IP protocol and possessing a unique global address.

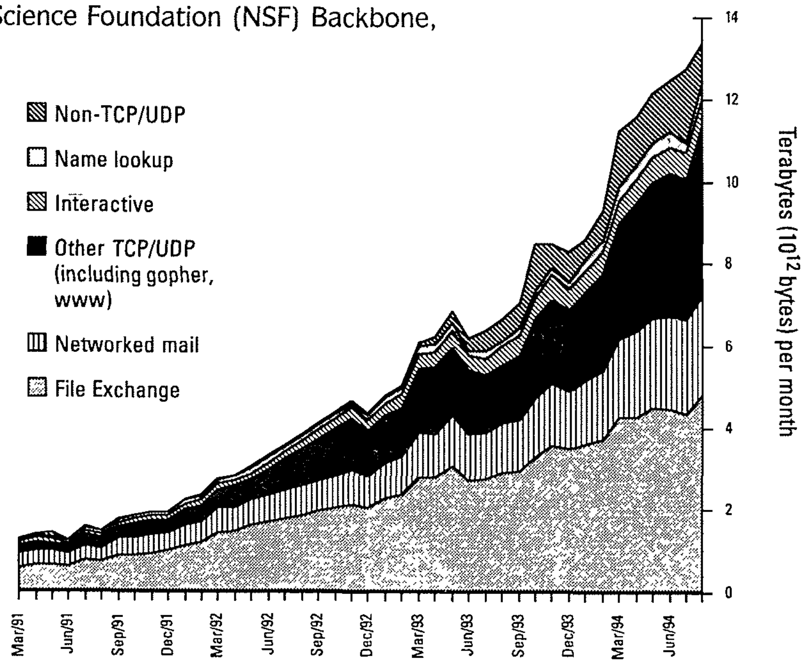
	Nov/92	Mar/93	Aug/94
Argentina	n.a.	1	248
Australia	287	346	1780
Brazil	n.a.	68	5896
Chile	n.a.	9	3703
Colombia	n.a.	0	144
Czech Republic	80	93	304
Finland	72	98	421
France	384	457	1648
Germany	377	516	1512
Hong Kong	9	9	62
Indonesia	0	0	49
Italy	203	233	435
Japan	206	216	1564
Korea, Rep. of	37	38	348
Mexico	n.a.	23	5164
Netherlands	107	127	291
New Zealand	58	60	334
Peru	n.a.	0	42
Russia	n.a.	n.a.	259
Singapore	28	28	67
Spain	44	68	246
Sweden	87	111	260
Switzerland	70	81	289
Taiwan	95	165	376
Thailand	2	12	73
United Kingdom	308	368	1449
Uruguay	n.a.	0	101
Venezuela	n.a.	6	399

Traffic Growth, 1991-94

Traffic on the U.S. National Science Foundation (NSF) Backbone, by category of service

The NSF Backbone Network is the most heavily used, large-scale Internet interconnection facility in the world. In early 1995, the traffic will be transferred to commercial public Internet backbones, and the NSFNet will be decommissioned.

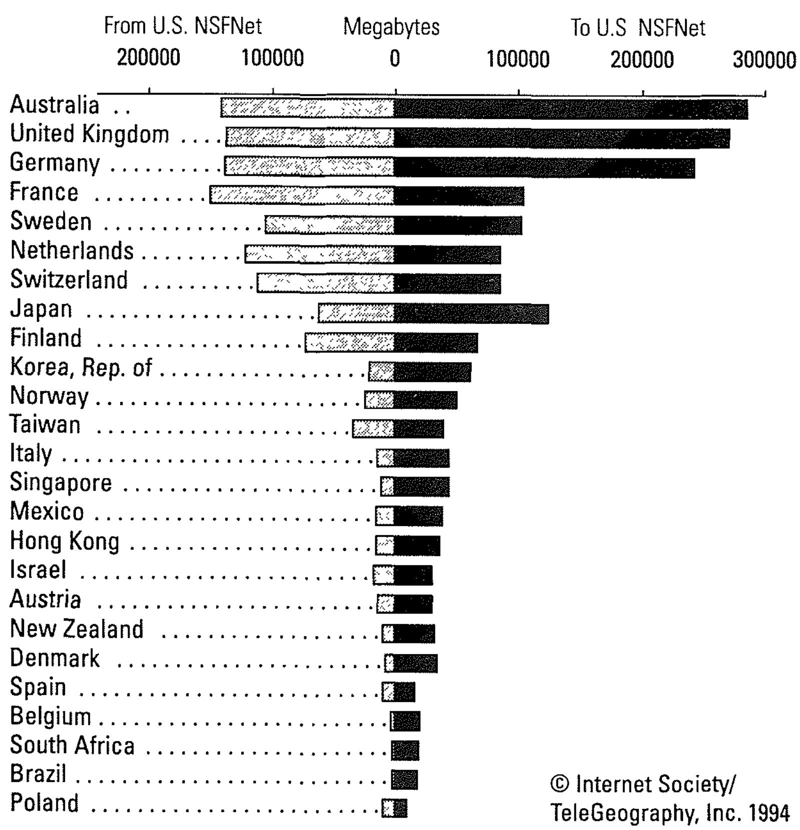
TCP/UDP are basic Internet standards that allow up to 128,000 different network applications and services to be provided over the Internet. Non-TCP/UDP standards are for special network services and Open Systems Interconnection.



United States International Traffic

Traffic to and from the NSFNet Backbone, August 1994

This graph shows inbound and outbound traffic from 25 of the top 27 countries to the NSFNet backbone. The top two countries, the United States and Canada, are excluded for reasons of scale. For those figures and others, see page 79.
Traffic to and from CERN (the European Center for Nuclear Research), the largest European backbone, as of March 1993 is detailed in *TeleGeography 1993*.



Internet Networks and Traffic by Country, 1991-94

	Networks			Inbound Traffic to NSFNet			Outbound Traffic from NSFNet		
	Aug 94	Jun 93	Sep 91	Aug 94	Jun 93	Sep 91	Aug 94	Jun 93	Sep 91
United States	12900	5576	1758	13501.9	6057.3	1034.4	12371.0	5446.0	1108.0
Canada	1028	429	144	402.5	116.7	48.0	799.4	277.4	34.1
Australia	482	189	96	141.8	59.3	22.6	285.8	93.8	11.0
United Kingdom	748	420	44	137.7	69.8	12.6	272.0	169.4	4.2
Germany	822	443	144	138.5	47.5	19.3	244.1	112.3	8.1
France	780	453	95	150.4	89.8	8.8	105.7	80.7	5.5
Sweden	164	87	25	106.0	32.2	8.9	103.3	39.3	7.4
Netherlands	207	131	52	122 8	52 2	10.7	85.9	48 9	5.4
Switzerland	172	87	35	112.3	40.9	9.4	85.5	45.2	7.7
Japan	696	257	73	62.9	19.5	4.6	125.2	41.8	2.2
Finland	231	102	12	73.6	50.8	4.2	67.5	27.2	9.9
Korea, Rep. of	117	35	9	21.6	4.3	3.9	62.3	17.7	0.6
Norway	138	52	8	25.3	15.9	4.6	51.2	23.7	2.5
Taiwan	171	78	0	34.5	33.2	0	40.7	40.6	0.0
Italy	266	169	30	14.8	13.5	5.5	44.5	47.7	4.8
Singapore	41	16	2	12.2	3.4	2.4	44.5	19.0	0.3
Mexico	65	34	5	16.4	5.9	2.4	38.9	52.3	1.5
Hong Kong	28	8	1	15.9	1.7	0.3	36.6	14.0	0.0
Israel	123	48	16	18.4	6.7	5.6	30.9	17.5	1.9
Austria	153	84	14	14.7	9.1	3.9	30.9	23.1	1.0
New Zealand	163	50	15	10.6	2.0	1.5	33.0	9.6	0.0
Denmark	24	8	3	8.1	7.2	2.8	35.1	13.6	1.1
Spain	94	39	7	11.0	2.4	0.9	16.0	23.1	0.4
Belgium	57	14	n.a.	3.9	1.2	n.a.	20.7	7.2	n.a.
South Africa	141	42	0	3.6	1.7	0	19.8	9.7	0.0
Brazil	108	52	8	3.5	1.9	0.2	18.7	17.5	1.9
Poland	75	45	n.a.	10.7	0.8	n.a.	10.2	3.1	n.a.
Chile	51	14	1	5.1	3.4	0.1	15.5	7.5	0.1
Czech Republic	105	51	n.a.	9.5	1.1	n.a.	10.4	4.2	n.a.
Russia	180	n.a.	n.a.	2.6	n.a.	n.a.	11.7	n.a.	n.a.
Ireland	77	24	n.a.	3.3	0.8	n.a.	9.0	4.4	n.a.
Turkey	45	9	n.a.	2.2	n.a.	n.a.	8.8	n.a.	n.a.
Thailand	38	13	n.a.	1.8	1.4	n.a.	9.2	1.5	n.a.
Greece	38	11	n.a.	3.2	0.6	n.a.	7.4	3.7	n.a.
Hungary	107	20	n.a.	2.0	0.5	n.a.	6.4	3.2	n.a.
Slovakia	27	13	n.a.	4.4	0.5	n.a.	3.4	1.5	n.a.
China	4	n.a.	n.a.	1.7	n.a.	n.a.	4.7	n.a.	n.a.
Kuwait	4	1	n.a.	0.7	0.0	n.a.	5.5	0.3	n.a.
Portugal	70	35	n.a.	1.4	1.0	n.a.	4.6	3.6	n.a.
Puerto Rico	6	n.a.	n.a.	1.8	n.a.	n.a.	4.1	n.a.	n.a.
India	7	3	n.a.	1.2	1.4	n.a.	4.0	1.5	n.a.
Malaysia	6	3	n.a.	0.7	0.1	n.a.	4.6	0.4	n.a.
Slovenia	31	n.a.	n.a.	1.4	n.a.	n.a.	3.7	n.a.	n.a.
Iceland	30	13	n.a.	0.9	0.4	n.a.	3.6	1.4	n.a.
Costa Rica	5	2	n.a.	0.5	0.0	n.a.	3.7	1.1	n.a.

Countries listed in descending order of total traffic to and from the NSFNet. Traffic data in gigabytes (10^9 bytes) per month.

Table 7: The Top 50 International Routes, 1993

	Countries	MiTT each way	Total MiTT
1.	USA/Canada	2493.1/1602.3	4095.4
2.	USA/Mexico	1398.8/456.1	1854.9
3.	USA/United Kingdom	799.8/499.9	1299.7
4.	Hong Kong/China	688.4/535.0	1223.4
5.	USA/Germany	572.4/263.2	835.6
6.	Switzerland/Germany	363.0/340.0	703.0
7.	Germany/Austria	368.0/322.2	690.2
8.	USA/Japan	397.2/287.8	685.0
9.	Germany/France	348.0/285.0	633.0
10.	Germany/United Kingdom	343.0/281.0	624.0
11.	Germany/Netherlands	290.0/284.8	574.8
12.	United Kingdom/France	287.0/285.0	572.0
13.	Germany/Italy	320.0/239.8	559.8
14.	United Kingdom/Ireland	266.0/207.1	473.1
15.	Belgium/France	234.9/201.0	435.9
16.	Germany/Turkey	330.0/97.6	427.6
17.	USA/France	263.6/161.7	425.3
18.	Italy/France	212.2/212.0	424.2
19.	Switzerland/France	271.0/143.0	414.0
20.	Netherlands/Belgium	206.4/202.2	408.6
21.	Switzerland/Italy	232.0/162.8	394.8
22.	USA/Korea, Rep. of	237.3/101.4	338.7
23.	USA/Italy	229.6/98.7	328.3
24.	USA/Dominican Republic	253.3/57.6	310.9
25.	France/Spain	155.0/143.0	298.0
26.	Netherlands/United Kingdom	155.4/131.0	286.4
27.	USA/Taiwan	184.3/88.5	272.8
28.	United Kingdom/Italy	139.0/124.5	263.5
29.	Germany/Belgium	132.0/127.6	259.6
30.	Germany/Spain	137.0/121.2	258.2
31.	Germany/Poland	164.0/93.2	257.2
32.	USA/Philippines	219.1/35.9	255.0
33.	USA/Colombia	200.2/51.8	252.0
34.	USA/Australia	126.1/118.2	244.3
35.	Australia/New Zealand	124.0/117.0	241.0
36.	Spain/United Kingdom	123.6/115.0	238.6
37.	Singapore/Malaysia	121.0/116.0	237.0
38.	USA/Hong Kong	142.8/89.4	232.2
39.	Japan/Korea	139.8/89.4	229.2
40.	Japan/China	138.3/85.0	223.3
41.	Canada/United Kingdom	123.0/96.0	219.0
42.	USA/Brazil	171.4/46.9	218.3
43.	Australia/United Kingdom	117.0/101.0	218.0
44.	USA/Israel	162.6/53.2	215.8
45.	Sweden/Finland	105.0/98.0	203.0
46.	Sweden/Norway	102.0/92.4	194.4
47.	USA/India	134.1/55.5	189.6
48.	USA/Netherlands	107.3/76.7	184.0
49.	USA/Jamaica	144.8/37.4	182.2
50.	Germany/Denmark	90.6/86.5	177.1

All data in millions of minutes of telecommunications traffic (MiTT). The country which generates more traffic on each route is listed first. The routes listed above total 24.8 billion mintues, 52% of all international traffic. For routes to and from the United States, calls are measured by point of billing in both directions. See Methodology, page 149.

Americas

International Traffic

Argentina

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	29.4	21.5%
2. Uruguay	26.1	19.1%
3. Brazil	14.2	10.4%
4. Chile	11.6	8.5%
5. Spain	8.9	6.5%
6. Italy	7.6	5.6%
7. Paraguay	6.7	4.9%
8. Peru	3.4	2.5%
9. France	3.0	2.2%
10. Germany	2.8	2.0%
11. Bolivia	2.7	2.0%
12. United Kingdom	2.3	1.7%
13. Mexico	2.3	1.7%
14. Colombia	1.5	1.1%
15. Venezuela	1.4	1.0%
16. Switzerland	1.4	1.0%
17. Canada	1.3	0.9%
18. Israel	1.1	0.8%
19. Netherlands	0.7	0.5%
20. Ecuador	0.6	0.5%
Other	7.9	5.8%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	132.5	159.7	192.3
Outgoing	89.4	124.3	137.1
Surplus (Deficit)	43.1	35.4	55.4
Total Volume	221.9	284.1	329.4

Note: Surplus/deficit and total volume data may appear inconsistent by ±0.2 due to rounding.

Brazil

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	63.9	35.0%
2. Argentina	20.2	11.1%
3. Italy	9.4	5.2%
4. Germany	8.9	4.9%
5. Portugal	8.1	4.4%
6. France	6.2	3.4%
7. United Kingdom	6.1	3.3%
8. Uruguay	5.2	2.9%
9. Japan	4.5	2.5%
10. Spain	4.4	2.4%
11. Paraguay	4.4	2.4%
12. Chile	4.1	2.2%
13. Switzerland	3.7	2.0%
14. Sweden	2.9	1.6%
15. Canada	2.8	1.5%
16. Mexico	2.4	1 3%
17. Venezuela	2.0	1.1%
18. Netherlands	1.9	1.0%
19. Bolivia	1.8	1.0%
20. Colombia	1.8	1 0%
Other	17.7	9 7%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	261.6	330.6	373.8
Outgoing	171.2	169.9	182.4
Surplus (Deficit)	90.4	160.7	191.4
Total Volume	432.8	500.5	556.2

Note: Data based on billing point of traffic.

Canada

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	1669	67.4%
2. United Kingdom	132	5.3%
3. Hong Kong	51	2.1%
4. France	45	1.8%
5. Germany	43	1.7%
6. Italy	35	1.4%
7. Australia	22	0.9%
8. Jamaica	20	0.8%
9. India	19	0.8%
10. Japan	18	0.7%
11. Philippines	18	0.7%
12. Netherlands	15	0.6%
13. Mexico	14	0.6%
14. Portugal	13	0.5%
15. Switzerland	12	0.5%
Other	351	14.2%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	398.2	441.2	503
Outgoing	647.3	722.3	808
Surplus (Deficit)	(249.1)	(281.1)	(305)
Total Volume	1045.5	1163.5	1311

Notes: Incoming and outgoing totals are for Teleglobe only and exclude all Canada-U.S. traffic. Teleglobe data based on billing point of traffic. U.S. route traffic includes IPL resellers. Route data are rounded to the nearest million minutes.

Chile

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	17.0	27.9%
2. Argentina	11.0	18.0%
3. Brazil	3.0	4.9%
4. Spain	3.0	4.9%
5. Peru	2.5	4.1%
6. Germany	2.1	3.4%
7. Canada	1.6	2.6%
8. United Kingdom	1.5	2.5%
9. France	1.5	2.5%
10. Bolivia	1.3	2.1%
11. Italy	1.4	2.3%
12. Mexico	1.2	2.0%
13. Venezuela	1.0	1.6%
14. Colombia	0.9	1.5%
15. Uruguay	0.8	1.3%
Other	11.2	18.4%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	61.8	85.6	N.A.
Outgoing	49.0	55.0	61.0
Surplus (Deficit)	12.8	30.6	N.A.
Total Volume	110.8	140.6	N.A.

Notes: Data are rounded to the nearest million minutes for routes above 3 million minutes. Data include Entel Chile, ChileSat, and VTR only.

Colombia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	51.0	49.8%
2. Venezuela	11.1	10.8%
3. Panama	4.3	4.2%
4. Ecuador	4.3	4.2%
5. Spain	3.1	3.1%
6. Mexico	3.1	3.0%
7. United Kingdom	2.1	2.1%
8. Germany	1.9	1.9%
9. Italy	1.9	1.8%
10. Brazil	1.8	1.8%
11. Peru	1.7	1.7%
12. France	1.7	1.7%
13. Argentina	1.6	1.5%
14. Canada	1.2	1.2%
15. Costa Rica	1.1	1.1%
16. Chile	1.1	1.1%
17. Puerto Rico	0.8	0.7%
18. Switzerland	0.7	0.7%
19. Japan	0.6	0.6%
20. Netherlands	0.6	0.6%
Other	6.7	6.5%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	203.4	238.0	278.7
Outgoing	83.6	94.5	102.4
Surplus (Deficit)	115.8	143.5	176.3
Total Volume	287.0	332.5	381.1

Note: Data based on billing point of traffic.

Cuba

Largest Telecommunications Routes, 1992

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	6.6	59.7%
2. Mexico	0.9	8.3%
3. Spain	0.9	8.0%
4. Canada	0.6	5.6%
5. Italy	0.4	3.9%
6. Venezuela	0.3	2.4%
7. Panama	0.2	1.8%
8. Argentina	0.2	1.4%
9. Dominica	0.1	1.3%
10. Dominican Republic	0.1	1.2%
11. Brazil	0.1	1.0%
12. Chile	0.1	1.0%
13. Colombia	0.1	0.8%
14. Ecuador	0.1	0.7%
15. Nicaragua	0.0	0.4%
Other	0.3	2.6%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	18.6	N.A.
Outgoing	12.0	12.4	N.A.
Surplus (Deficit)	N.A.	6.2	N.A.
Total Volume	N.A.	31.0	N.A.

Ecuador

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	18.1	54.6%
2. Colombia	4.2	12.6%
3. Chile	1.0	3.1%
4. Peru	1.0	3.1%
5. Venezuela	1.0	3.0%
6. Brazil	0.8	2.4%
7. Argentina	0.7	2 1%
8. Spain	0.7	2.1%
9. Panama	0.6	1.9%
10. Germany	0.6	1.7%
11. Mexico	0.5	1.6%
12. Italy	0.5	1.5%
13. Canada	0.5	1.5%
14. France	0.4	1.1%
15. United Kingdom	0.4	1 1%
16. Costa Rica	0.3	0.8%
17. Switzerland	0.2	0.7%
18. Japan	0.2	0.6%
19. Bolivia	0.2	0 5%
20. Netherlands	0.2	0.5%
Other	1.2	3.7%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	78.9	87.4	101.4
Outgoing	23.6	28.6	33.1
Surplus (Deficit)	55.3	58.8	68.3
Total Volume	102.5	116.0	134.5

Mexico

Largest Telecommunications Routes, 1993

	Destination	MiTT	Percentage of Outgoing Traffic
1.	United States	542.1	86.7%
2.	Canada	11.1	1.8%
3.	Spain	8.4	1.3%
4.	France	6.3	1.0%
5.	United Kingdom	4.8	0 8%
6.	Germany	4.5	0.7%
7.	Colombia	4.4	0.7%
8.	Cuba	3.8	0.6%
9.	Italy	3.5	0.6%
10.	Argentina	3.2	0.5%
11.	Guatemala	3.1	0.5%
12.	Brazil	2.7	0.4%
13.	Costa Rica	2.0	0.3%
14.	Peru	1.9	0.3%
15.	Japan	1.8	0.3%
16.	Chile	1.7	0.3%
17.	El Salvador	1.7	0 3%
18.	Switzerland	1.6	0.3%
19.	Venezuela	1.6	0.3%
20.	Panama	1.5	0.2%
	Other	13.5	2.2%

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National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	N.A.	1115.0	1370.6
Outgoing	500.2	683.5	625.4
Surplus (Deficit)	N.A.	431.5	745.2
Total Volume	N.A.	1798.5	1996.0

Note: Data based on billing point of traffic.

Peru

Largest Telecommunications Routes, 1993

	Destination	MiTT	Percentage of Outgoing Traffic
1.	United States	15.8	40.5%
2.	Chile	3.2	8.2%
3.	Spain	2.7	6.9%
4.	Argentina	2.4	6.2%
5.	Venezuela	1.5	3 8%
6.	Italy	1.5	3.8%
7.	Brazil	1.5	3.8%
8.	Colombia	1.3	3.3%
9.	Bolivia	1.0	2.6%
10.	Mexico	0.9	2.3%
11.	Japan	0.9	2.3%
12.	Ecuador	0.8	2.1%
13.	Germany	0.8	2.1%
14.	Canada	0.7	1.8%
15.	United Kingdom	0.7	1.8%
16.	France	0.7	1.8%
17.	Panama	0.4	1.0%
18.	Switzerland	0.4	1.0%
19.	Costa Rica	0.2	0 5%
20.	Netherlands	0.2	0.5%
	Other	1.4	3.6%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	105.9	128.1	152.4
Outgoing	29.3	32.1	39.0
Surplus (Deficit)	76.6	96.0	113.4
Total Volume	135.2	160.2	191.4

United States (Outgoing)

Largest Telecommunications Routes, 1993

Destination	MiTT 1992	MiTT 1993	Percentage of Outgoing Traffic 1993
1. Canada	2226.4	2493.1	21.8%
2. Mexico	1277.2	1398.8	12.2%
3. United Kingdom	733.4	799.8	7.0%
4. Germany	562.9	572.4	5.0%
5. Japan	363	397.2	3.5%
6. France	239.8	263.6	2.3%
7. Dominican Republic	249.4	253.3	2.1%
8. Korea, Rep. of	206.4	237.3	2.0%
9. Italy	207.2	229.6	1 9%
10. Philippines	195.2	219.1	2 2%
11. Colombia	172.4	200.2	1.7%
12. Taiwan	162.5	184.3	1.6%
13. Brazil	144.7	171.4	1.5%
14. Israel	137.6	162.6	1.4%
15. Jamaica	124.3	144.5	1.3%
16. Hong Kong	113.9	142.8	1 2%
17. India	97.8	134.1	1.2%
18. Australia	113.2	126.1	1.1%
19. Netherlands	92.7	107.3	0.9%
20. El Salvador	99.9	107.0	0 9%
Other		3116.7	27.2%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	2829.8	3149.4	3284.4
Outgoing	5984.5	6670.4	7500.3
Surplus (Deficit)	(3154.7)	(3521.0)	(4125.9)
Total Volume	8814.3	9819.8	10784.7

Notes: Incoming and outgoing traffic totals exclude Canada and Mexico traffic and traffic from non-Continental U.S. territories (Puerto Rico, Virgin Islands, and Guam). Route-by-route data also exclude these territories. Canada traffic excludes IPL resellers. All data based on the billing point of the traffic. See Methodology.

United States (Incoming)

Largest Telecommunications Routes, 1993

	Origin	MiTT 1992	MiTT 1993	Percentage of Incoming Traffic 1993
1.	Canada	1512.1	1602.3	29.7%
2.	United Kingdom	501.1	499.9	9.3%
3.	Mexico	608.6	456.1	8.5%
4.	Japan	277.9	287.8	5.3%
5.	Germany	235.7	263.2	4.9%
6.	France	156.6	161.7	3.0%
7.	Australia	103.6	118.2	2.2%
8.	Korea, Rep. of	95.4	101.4	1.9%
9.	Italy	117.9	98.7	1.8%
10.	Hong Kong	82.3	89.4	1.7%
11.	Taiwan	82.2	88.5	1.6%
12.	Netherlands	66.7	76.7	1.4%
13.	Switzerland	66	66.0	1.2%
14.	Dominican Rep.	50.2	57.6	1.1%
15.	India	60.1	55.5	1.0%
16.	Sweden	53.4	53.5	1.0%
17.	Israel	48.1	53.2	1.0%
18.	Colombia	50.6	51.8	1.0%
19.	Brazil	49.3	46.9	0.9%
20.	Venezuela	53	45.6	0.8%
	Other		1118.8	20.7%

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USA: Other Correspondents

Other Telecommunications Routes, 1993

Country	Outgoing MiTT 1992	Outgoing MiTT 1993	Incoming MiTT 1992	Incoming MiTT 1993
Argentina	66.8	84.8	25.7	26.6
Austria	33.9	37.4	23.3	21.7
Bangladesh	17.7	20.1	1.5	1.9
Belgium	63.6	75.3	32.9	35.2
Bulgaria	4.6	5.7	1.1	1.3
Chile	38.3	49.7	16.2	17.8
China	68.4	110.1	25.4	41.1
Croatia	n.a.	10.5	n.a.	3.4
Cuba	21.1	8.4	3.6	3.3
Cyprus	9.6	6.3	3.9	3.8
Czech and Slovak Republics	16.2	14.9	10.8	8.4
Denmark	32.3	36.4	22.0	23.6
Ecuador	73.3	86.4	11.6	12.1
El Salvador	99.9	107.0	8.5	7.8
Finland	17.2	19.1	14.6	15.9
Greece	70.0	75.5	25.7	25.3
Guatemala	88.0	93.8	18.5	14.1
Hungary	17.6	20.4	12.9	14.0
Iceland	6.9	7.3	5.5	6.4
Indonesia	37.5	44.8	12.8	17.5
Ireland	66.8	75.7	27.6	31.4
Jamaica	124.4	144.8	42.4	37.4
Luxembourg	5.4	6.6	4.2	4.7
Macau	1.5	1.7	0.8	1.0
Malaysia	28.7	32.7	10.2	12.7
New Zealand	21.3	24.7	16.1	19.2
Norway	32.6	34.7	26.0	28.3
Pakistan	64.2	68.7	7.2	7.5
Peru	80.1	89.6	12.5	14.7
Philippines	195.2	219.1	22.3	35.9
Poland	73.9	81.6	25.0	28.7
Portugal	35.1	47.1	9.6	10.4
Russia	n.a.	45.6	n.a.	12.8
Saudi Arabia	61.5	67.6	29.9	29.7
Singapore	47.1	56.6	34.0	37.4
Slovenia	n.a.	2.1	n.a.	0.0
South Africa	29.1	36.3	18.7	20.8
Spain	105.6	109.5	53.1	45.4
Sri Lanka	5.4	6.1	1.2	1.7
Sweden	57.4	62.0	53.4	53.5
Switzerland	93.5	104.4	65.3	66.0
Thailand	53.1	62.8	15.7	18.8
Turkey	37.6	40.1	16.0	16.8
United Arab Emirates	22.9	27.9	16.1	17.4
Uruguay	13.6	15.1	2.2	3.1
Venezuela	76.0	87.9	53.0	45.6
Yugoslavia	n.a.	18.7	n.a.	1.1

Note: All data based on the billing point of the traffic. See Methodology.

Uruguay

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Argentina	22.3	59.7%
2. Brazil	4.7	12.7%
3. United States	3.1	8.2%
4. Spain	1.1	2.9%
5. Chile	0.9	2.4%
6. Paraguay	0.6	1.7%
7. Italy	0.6	1.5%
8. France	0.4	1.0%
9. Germany	0.4	1.0%
10. United Kingdom	0.3	0.8%
11. Mexico	0.3	0.7%
12. Canada	0.2	0.7%
13. Israel	0.2	0.7%
14. Venezuela	0.2	0.6%
15. Switzerland	0.2	0.6%
16. Peru	0.1	0.4%
17. Colombia	0.1	0.4%
18. Australia	0.1	0.3%
19. Ecuador	0.1	0.3%
20. Netherlands	0.1	0.3%
Other	1.3	3.4%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	48.0	53.0	58.0
Outgoing	29.3	30.2	37.4
Surplus (Deficit)	18.7	22.8	20.6
Total Volume	77.3	83.2	95.4

Note: Data based on billing point of traffic.

Venezuela

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	55.9	42.0%
2. Colombia	17.1	12.8%
3. Spain	8.0	6.0%
4. Italy	6.9	5 1%
5. Dominican Republic	3.7	2.8%
6. Mexico	3.5	2.6%
7. Peru	3.3	2.5%
8. Canada	2.6	2.0%
9. Portugal	2.4	1 8%
10. Brazil	2.3	1.7%
11. Chile	2.2	1.6%
12. France	2.2	1 6%
13. Germany	2.1	1.6%
14. Argentina	2.0	1.5%
15. Ecuador	1.8	1.4%
16. United Kingdom	1.8	1.3%
17. Netherlands Antilles	1.5	1 2%
18. Puerto Rico	1.3	1.0%
19. Panama	1.2	0.9%
20. Switzerland	1.0	0.7%
Other	10.5	7.9%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	103.9	128.6	148.3
Outgoing	91.7	115.5	133.3
Surplus (Deficit)	12.2	13.1	15.0
Total Volume	195.6	244.1	281.6

Note: Data based on billing point of traffic.

Europe

International Traffic

Austria

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	322.2	42.0%
2. Switzerland	58.4	7.6%
3. Italy	39.3	5.1%
4. Yugoslavia	30.8	4.0%
5. Hungary	26.5	3.4%
6. Turkey	23.9	3.1%
7. United States	23.7	3.1%
8. United Kingdom	23.3	3.0%
9. Croatia	21.2	2.8%
10. France	20.2	2.6%
11. Poland	18.2	2.4%
12. Netherlands	18.1	2.4%
13. Czech Republic	14.1	1.8%
14. Slovenia	13.3	1.7%
15. Slovak Republic	9.7	1.3%
16. Belgium	8.1	1.1%
17. Romania	7.8	1.0%
18. Russia	7.3	0.9%
19. Sweden	7.1	0.9%
20. Spain	6.5	0.8%
Other	68.0	8.9%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	636.9	692.3	751.0
Outgoing	641.9	713.4	767.4
Surplus (Deficit)	(5.0)	(21.1)	(16.4)
Total Volume	1278.8	1405.7	1518.4

Note: Data based on billing point of traffic.

Belgium

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. France	234.9	24.0%
2. Netherlands	202.2	20.6%
3. Germany	127.6	13.0%
4. United Kingdom	87.2	8.9%
5. Italy	50.7	5.2%
6. Luxembourg	35.7	3.6%
7. United States	35.4	3.6%
8. Spain	28.6	2.9%
9. Switzerland	24.4	2.5%
10. Sweden	11.8	1.2%
11. Portugal	10.1	1.0%
12. Greece	9.8	1.0%
13. Turkey	9.2	0.9%
14. Denmark	9.0	0.9%
15. Austria	7.8	0.8%
16. Morocco	7.8	0.8%
17. Ireland	5.5	0.6%
18. Canada	4.8	0.5%
19. Norway	4.4	0.5%
20. Israel	3.8	0.4%
Other	68.7	7.0%

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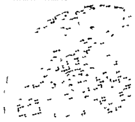
National Traffic Balance

MiTT	1991	1992	1993
Incoming	845.0	952.7	1025.3
Outgoing	822.7	911.1	979.4
Surplus (Deficit)	22.3	41.6	45.9
Total Volume	1667.7	1863.8	2004.7

Note: Data based on billing point of traffic.



Bulgaria

Largest Telecommunications Routes, 1992

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	13.6	16.8%
2. Turkey	10.3	12.7%
3. Greece	8.8	10.9%
4. Yugoslavia	4.6	5.7%
5. Italy	4.2	5.2%
6. Austria	3.4	4.2%
7. France	3.2	4.0%
8. United Kingdom	3.1	3.8%
9. Switzerland	1.6	2.0%
10. Cyprus	1.5	1.9%
11. Czech & Slovak Reps.	1.4	1.7%
12. Poland	1.2	1.5%
13. Netherlands	1.1	1.4%
14. Sweden	1.0	1.2%
15. Belgium	1.0	1.2%
16. Hungary	0.8	1.0%
Other	20.2	24.6%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	N.A.
Outgoing	73	81	91
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Note: Route data exclude Romania and Russia.

Croatia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	41.0	35.0%
2. Austria	13.2	11.2%
3. Italy	11.6	9.9%
4. Slovenia	6.8	5 8%
5. Switzerland	6.1	5.2%
6. United Kingdom	4.7	4.0%
7. France	4.5	3.8%
8. United States	3.4	2.9%
9. Netherlands	2.6	2.3%
10. Macedonia	2.1	1.8%
11. Canada	1.7	1.5%
12. Sweden	1.6	1.4%
13. Spain	1.6	1.4%
14. Hungary	1.6	1.4%
15. Denmark	1.5	1.3%
16. Czech & Slovak Reps.	1.4	1.2%
17. Russia	1.2	1.0%
18. Belgium	1.2	1.0%
19. Australia	1.1	1.0%
20. Norway	0.6	0.5%
21. Other	7.7	6.6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	156.7	189.1	170.3
Outgoing	93.4	104.7	117.2
Surplus (Deficit)	63.3	84.4	53.0
Total Volume	250.1	293.8	287.4

Czech and Slovak Reps.

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	52.8	29.1%
2. Austria	21.4	11.8%
3. Italy	10.0	5.5%
4. United Kingdom	9.9	5.4%
5. United States	8.8	4.9%
6. France	7.1	3.9%
7. Poland	6.9	3.8%
8. Russia	6.7	3.7%
9. Switzerland	6.4	3.5%
10. Hungary	6.2	3.4%
11. Netherlands	5.2	2.8%
12. Canada	4.8	2.6%
13. Belgium	3.1	1.7%
14. Ukraine	3.1	1.7%
15. Yugoslavia	3.0	1.7%
16. Hong Kong	2.9	1.6%
17. Croatia	2.1	1.2%
18. Spain	2.1	1.2%
19. Sweden	2.1	1.2%
Other	17.0	9.4%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	179.5	236.0	253.2
Outgoing	128.1	178.0	181.4
Surplus (Deficit)	51.4	58.0	71.8
Total Volume	307.6	414.0	434.6

Note: Though the Czech and Slovak Republics have been independent countries since January 1, 1993, separate traffic data has only been calculated since September 1, 1993. The above data reflect combined traffic from both countries and do not include traffic from the two countries to each other.

Denmark

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	86.5	19.1%
2. Sweden	75.8	16.8%
3. United Kingdom	49.0	10.8%
4. Norway	46.5	10.3%
5. United States	22.3	4.9%
6. France	20.2	4.5%
7. Netherlands	17.8	3.9%
8. Italy	11.3	2.5%
9. Switzerland	10.3	2.3%
10. Belgium	9.2	2.0%
11. Spain	9.0	2.0%
12. Finland	8.9	2.0%
13. Faroe Islands	8.1	1.8%
14. Poland	7.5	1.6%
15. Turkey	4.8	1.1%
16. Greenland	4.2	0.9%
17. Austria	4.1	0.9%
18. Iceland	3.1	0.7%
19. Canada	3.0	0.7%
20. Greece	2.8	0.6%
Other	47.9	10.6%

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National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	397.2	425.2	460.0
Outgoing	394.5	424.5	452.3
Surplus (Deficit)	2.7	0.7	7.6
Total Volume	791.7	849.7	912.3

Note: Surplus/deficit and total volume data may appear inconsistent by ±0.1 due to rounding.

Finland

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Sweden	98	38.7%
2. Germany	23	9.1%
3. Russia	20	7.9%
4. United States	16	6.3%
5. United Kingdom	15	5.9%
6. Denmark	9	3 6%
7. Norway	9	3 6%
8. France	7	2.8%
9. Netherlands	6	2 4%
10. Switzerland	5	2.0%
11. Italy	5	2.0%
12. Spain	5	2.0%
Other	35	13.8%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	N.A.
Outgoing	215	235	253
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Note: Data are rounded to the nearest million minutes for Telecom Finland only. Traffic to Estonia is excluded.

France

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	285.0	11.1%
2. United Kingdom	285.0	11.1%
3. Italy	212.0	8.2%
4. Belgium	201.0	7.8%
5. Spain	155.0	6.0%
6. United States	153.0	5.9%
7. Switzerland	143.0	5.6%
8. Portugal	119.0	4.6%
9. Netherlands	81.0	3.1%
10. Morocco	71.0	2.8%
11. Algeria	56.0	2.2%
12. Tunisia	34.0	1.3%
13. Canada	32.0	1.2%
14. Turkey	29.0	1.1%
15. Sweden	22.0	0.9%
16. Poland	20.0	0.8%
17. Denmark	19.0	0.7%
18. Austria	18.0	0.7%
19. Greece	18.0	0.7%
20. Luxembourg	18.0	0.7%
Other	605.0	23.5%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	2355	2540	2710
Outgoing	2295	2449	2576
Surplus (Deficit)	60	91	64
Total Volume	4650	4989	5356

Note: Data based on billing point of traffic.

Germany

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	425	9.1%
2. Austria	368	7.9%
3. France	348	7.4%
4. United Kingdom	343	7.3%
5. Switzerland	340	7.3%
6. Turkey	327	7.0%
7. Italy	320	6.8%
8. Netherlands	290	6.2%
9. Poland	164	3.5%
10. Spain	137	2.9%
11. Belgium	132	2.8%
12. Croatia	107	2.3%
13. Greece	105	2.2%
14. Denmark	91	1.9%
15. Czech & Slovak Reps.	90	1.9%
16. Sweden	66	1.4%
17. Yugoslavia	65	1.4%
18. Hungary	55	1.2%
19. Canada	49	1.0%
20. Russia	48	1.0%
Other	810	17.3%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	2900	3100	3707.8
Outgoing	3605	4087	4679.6
Surplus (Deficit)	(705)	(987)	(971.8)
Total Volume	6505	7187	8387.4

Notes: Incoming totals for 1991 and 1992 are rounded to the nearest 100 million minutes. Other data for those years are rounded to the nearest million minutes. Data for 1993 include 159 million MiTT of foreign-billed Country Direct traffic, of which 145 million MiTT were on the United States route.

Greece

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	68.1	20.3%
2. United Kingdom	45.7	13.6%
3. Italy	30.7	9.1%
4. United States	23.8	7.1%
5. France	19.2	5.7%
6. Cyprus	13.6	4.1%
7. Canada	9.8	2.9%
8. Australia	9.4	2.8%
9. Belgium	9.1	2.7%
10. Netherlands	9.0	2.7%
11. Switzerland	8.7	2.6%
12. Bulgaria	7.5	2.2%
13. Albania	6.9	2.1%
14. Romania	5.7	1.7%
15. Russia	5.5	1.6%
16. Yugoslavia	5.5	1.6%
17. Turkey	5.3	1.6%
18. Austria	5.1	1.5%
19. Sweden	5.1	1 5%
20. Poland	4.0	1.2%
Other	38.5	11.5%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	320.1	359.7	406.1
Outgoing	245.0	298.9	336.2
Surplus (Deficit)	75.1	60.8	70.0
Total Volume	565.1	658.5	742.3

Note: Surplus/deficit and total volume data may appear inconsistent by ±0.1 due to rounding. Data based on billing point of traffic.

Hungary

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	51.0	23.9%
2. Austria	26.8	12.6%
3. United States	12.8	6.0%
4. Italy	11.6	5.4%
5. Romania	10.5	4.9%
6. United Kingdom	9.0	4.2%
7. France	7.0	3.3%
8. Russia	6.9	3.2%
9. Switzerland	6.7	3.1%
10. Czech & Slovak Reps.	5.4	2.5%
11. Netherlands	5.3	2.5%
12. Yugoslavia	4.9	2.3%
13. Canada	4.1	1.9%
14. Sweden	3.9	1.8%
15. Ukraine	3.7	1.7%
16. Belgium	3.4	1.6%
17. Hong Kong	2.7	1.2%
18. Croatia	2.6	1.2%
19. Poland	2.4	1.1%
20. Other	32.7	15.3%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	137.4	150.5	192.8
Outgoing	150.6	183.8	213.2
Surplus (Deficit)	(13.2)	(33.3)	(20.4)
Total Volume	288.0	334.3	406.0

Iceland

Largest Telecommunications Routes, 1993

	Destination	MiTT	Percentage of Outgoing Traffic
1.	United States	6.4	26.4%
2.	Denmark	3.3	13.6%
3.	Sweden	2.6	11.0%
4.	United Kingdom	2.6	10.6%
5.	Norway	2.0	8.4%
6.	Germany	1.8	7.6%
7.	France	0.7	3.0%
8.	Netherlands	0.7	2.8%
9.	Faroe Islands	0.6	2.4%
10.	Spain	0.3	1.4%
11.	Italy	0.3	1.3%
12.	Belgium	0.3	1.2%
13.	Finland	0.3	1.1%
14.	Switzerland	0.2	1.0%
15.	Luxembourg	0.2	0.7%
16.	Austria	0.1	0.6%
17.	USSR (former)	0.1	0.4%
18.	Portugal	0.1	0.4%
19.	Poland	0.1	0.4%
20.	Ireland	0.1	0.3%
	Other	1.4	5.7%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	20.8	21.7	23.4
Outgoing	20.8	22.1	24.1
Surplus (Deficit)	0.0	(0.4)	(0.7)
Total Volume	41.6	43.8	47.5

Note: Data based on billing point of traffic.

Ireland

Largest Telecommunications Routes, FY 1993/94

Destination	MiTT	Percentage of Outgoing Traffic
1. United Kingdom	207.1	53.9%
2. Northern Ireland	68.1	17.8%
3. United States	37.0	9.6%
4. Germany	13.3	3.5%
5. France	10.9	2.8%
6. Netherlands	6.2	1.6%
7. Spain	5.0	1.3%
8. Italy	4.7	1.2%
9. Belgium	4.0	1.0%
10. Canada	3.8	1.0%
11. Australia	3.2	0.8%
12. Switzerland	2.4	0.6%
13. Sweden	1.9	0.5%
14. Denmark	1.9	0.5%
15. Japan	0.9	0.2%
16. Austria	0.8	0.2%
17. Norway	0.7	0.2%
18. Hong Kong	0.7	0.2%
19. South Africa	0.6	0.2%
20. Portugal	0.6	0.2%
Other	10.2	2.7%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	FY 1991/92	FY 1992/93	FY 1993/94
Incoming	140.4	383.0	423.0
Outgoing	83.4	296.6	383.9
Surplus (Deficit)	57.0	86.4	39.0
Total Volume	223.8	679.6	806.9

Notes: FY ends on 31 March. Traffic balances for FY 1991/92 exclude the United Kingdom. Surplus/deficit and total volume data may appear inconsistent by ±0.1 due to rounding.

Italy

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	239.8	14.9%
2. France	212.2	13.2%
3. Switzerland	162.8	10.1%
4. United States	154.5	9.6%
5. United Kingdom	124.5	7.7%
6. Canada	56.7	3.5%
7. Spain	55.7	3.5%
8. Belgium	43.1	2.7%
9. Austria	38.8	2.4%
10. Netherlands	29.4	1.8%
11. Morocco	27.4	1.7%
12. Greece	25.4	1.6%
13. Poland	19.5	1.2%
14. Hong Kong	19.0	1.2%
15. Tunisia	18.4	1.1%
16. Romania	17.8	1.1%
17. Slovenia	15.8	1.0%
18. Dominican Republic	14.9	0 9%
19. Brazil	14.2	0.9%
20. Russia	13.1	0.8%
Other	306.8	19.1%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	1541.0	1672.7
Outgoing	1219.5	1473.4	1609.7
Surplus (Deficit)	N.A.	67.6	63.0
Total Volume	N.A.	3014.4	3282.4

Note: Data reflect combined totals for Iritel and Italcable. Prior to 1994, Iritel (formerly ASST) handled intra-European traffic only and Italcable carried overseas traffic.

Luxembourg

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Belgium	45.3	22.8%
2. Germany	41.5	20.8%
3. France	38.6	19.4%
4. Portugal	12.7	6.4%
5. United Kingdom	11.9	6.0%
6. Italy	9.7	4.9%
7. Netherlands	7.2	3.6%
8. Switzerland	6.1	3.1%
9. United States	4.7	2.3%
10. Denmark	3.4	1.7%
11. Spain	2.9	1.5%
12. Austria	1.8	0.9%
13. Sweden	1.7	0.8%
14. Greece	1.2	0.6%
15. Ireland	0.8	0.4%
16. Japan	0.7	0.3%
17. Norway	0.6	0.3%
18. Hong Kong	0.6	0.3%
19. Canada	0.6	0.3%
20. Finland	0.5	0.3%
Other	6.8	3.4%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	102.4	107.5	131.7
Outgoing	165.3	181.0	199.3
Surplus (Deficit)	(62.9)	(73.5)	(67.6)
Total Volume	267.7	288.5	331.0

Netherlands

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	284.8	23.0%
2. Belgium	206.4	16.7%
3. United Kingdom	155.4	12.6%
4. France	93.4	7.5%
5. United States	76.6	6.2%
6. Italy	39.6	3.2%
7. Switzerland	36.7	3.0%
8. Spain	34.0	2.7%
9. Turkey	28.1	2.3%
10. Sweden	19.3	1.6%
11. Denmark	18.1	1.5%
12. Austria	17.9	1.4%
13. Canada	14.0	1.1%
14. Poland	11.2	0.9%
15. Norway	10.8	0.9%
16. Morocco	10.0	0.8%
17. Greece	10.0	0.8%
18. Portugal	9.2	0.7%
19. Suriname	9.0	0.7%
20. Ireland	8.2	0.7%
Other	145.5	11.8%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	1039.0	1163.0
Outgoing	1017.7	1133.9	1238.2
Surplus (Deficit)	N.A.	(94.9)	(75.2)
Total Volume	N.A.	2172.9	2401.2

Note: Data based on billing point of traffic.

Norway

Largest Telecommunications Routes, 1992

Destination	MiTT	Percentage of Outgoing Traffic
1. Sweden	92.4	26.5%
2. Denmark	50.4	14.5%
3. United Kingdom	45.5	13.1%
4. Germany	25.4	7.3%
5. United States	19.3	5.5%
6. France	11.7	3 4%
7. Netherlands	9.6	2.8%
8. Finland	9.5	2.7%
9. Hong Kong	7.6	2.2%
10. Spain	6.4	1.8%
11. Switzerland	5.4	1.5%
12. Italy	5.1	1.5%
13. Belgium	4.6	1.3%
14. Poland	3.8	1.1%
15. Canada	3.7	1 0%
16. Netherlands Antilles	3.4	1 0%
17. Yugoslavia	2.3	0.7%
18. Austria	2.1	0 6%
19. Turkey	2.1	0.6%
20. Iceland	1.8	0.5%
Other	37.0	10 6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	N.A.	314	322.5
Outgoing	308.5	349	376.2
Surplus (Deficit)	N.A.	(35)	(53.7)
Total Volume	N.A.	663	698.7

Poland

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	93.2	34.2%
2. United States	28.7	10.5%
3. United Kingdom	14.5	5.3%
4. France	14.3	5.2%
5. Italy	11.9	4.4%
6. Austria	10.4	3.8%
7. Sweden	9.6	3.5%
8. Ukraine	8.4	3.1%
9. Netherlands	8.2	3.0%
10. Canada	7.0	2.6%
11. Belgium	5.5	2.0%
12. Australia	5.3	1.9%
13. Denmark	4.9	1.8%
14. Czech & Slovak Reps.	4.6	1.7%
15. Switzerland	4.1	1.5%
16. Belarus	3.6	1.3%
17. Lithuania	2.5	0.9%
18. Greece	2.3	0.8%
19. Spain	2.2	0.8%
20. Norway	2.0	0.7%
Other	29.5	10.8%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	366.6	431.5
Outgoing	125.0	212.7	272.7
Surplus (Deficit)	N.A.	153.9	158.8
Total Volume	N.A.	579.3	704.2

Portugal

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. France	49.0	21.1%
2. Spain	34.6	14.9%
3. United Kingdom	25.5	11.0%
4. Germany	24.1	10.4%
5. Switzerland	12.4	5.3%
6. United States	10.3	4.4%
7. Italy	9.3	4.0%
8. Brazil	8.9	3.8%
9. Belgium	7.7	3.3%
10. Netherlands	7.4	3.2%
11. Angola	6.2	2.7%
12. Canada	4.4	1.9%
13. Sweden	2.7	1.2%
14. Luxembourg	2.4	1.0%
15. Denmark	2.1	0.9%
16. Guinea-Bissau	2.0	0.9%
17. Cape Verde	2.0	0.9%
18. Mozambique	1.9	0.8%
19. South Africa	1.9	0.8%
20. Austria	1.3	0.6%
Other	16.4	7.0%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	384.0	N.A.	438.2
Outgoing	186.1	212.0	232.6
Surplus (Deficit)	197.9	N.A.	205.6
Total Volume	570.1	N.A.	670.8

Note: Data include traffic for Telecom Portugal, which carries intra-European traffic only, and CPRM, which carries overseas traffic. CPRM had 49.3 million MiTT outbound and 84.3 million MiTT inbound in 1993. Data based on billing point of traffic.

Russia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	30.1	15.0%
2. United States	22.5	11.2%
3. China	10.7	5.3%
4. United Kingdom	8.6	4.3%
5. Finland	8.6	4.3%
6. Italy	8.5	4.2%
7. Poland	8.0	4.0%
8. France	6.7	3.3%
9. Yugoslavia	6.7	3.3%
10. Israel	6.1	3.0%
11. Bulgaria	6.1	3.0%
12. India	5.3	2.6%
13. Czech & Slovak Reps.	5.2	2.6%
14. Turkey	5.1	2.5%
15. Hungary	4.9	2.4%
16. Austria	4.1	2.0%
17. Sweden	3.5	1.7%
18. Netherlands	3.2	1.6%
19. Switzerland	3.0	1.5%
20. Spain	3.0	1.5%
Other	41.1	20.4%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	230.7	268.0
Outgoing	N.A.	175.6	201.0
Surplus (Deficit)	N.A.	55.1	67.0
Total Volume	N.A.	406.3	469.0

Note: Data do not include traffic to or from other former Soviet republics. For traffic within the Commonwealth of Independent States, see page 124.

Slovenia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	12.7	20.1%
2. Austria	9.4	14.9%
3. Italy	8.7	13.8%
4. Croatia	7.6	12.1%
5. Yugoslavia	6.3	10.0%
6. Switzerland	2.3	3 7%
7. Macedonia	1.8	2.9%
8. France	1.7	2 6%
9. United Kingdom	1.6	2.5%
10. United States	1.3	2 1%
11. Hungary	0.9	1.5%
12. Netherlands	0.8	1.3%
13. Czech & Slovak Reps.	0.8	1.2%
14. USSR (former)	0.6	1.0%
15. Sweden	0.6	1 0%
16. Australia	0.6	0 9%
17. Belgium	0.5	0.8%
18. Canada	0.3	0.5%
19. Spain	0.3	0 4%
Other	4.1	6 6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	55.8
Outgoing	34.6	46.2	62.8
Surplus (Deficit)	N.A.	N.A.	(7.0)
Total Volume	N.A.	N.A.	118.7

Note: Surplus/deficit and total volume data may appear inconsistent by ±0.1 due to rounding.

Spain

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. France	143.0	16 9%
2. United Kingdom	123.6	14.6%
3. Germany	121.2	14 3%
4. United States	70.4	8.3%
5. Italy	58.9	7 0%
6. Portugal	34.6	4 1%
7. Netherlands	32.7	3.9%
8. Switzerland	30.6	3.6%
9. Belgium	28.7	3.4%
10. Morocco	19.3	2.3%
11. Argentina	15.2	1.8%
12. Sweden	12.0	1.4%
13. Denmark	8.1	1.0%
14. Ireland	7.9	0.9%
15. Mexico	7.8	0 9%
16. Venezuela	7.8	0.9%
17. Colombia	7.5	0.9%
18. Hong Kong	6.9	0.8%
19. Austria	6.4	0.8%
20. Brazil	6.1	0.7%
Other	98.3	11.6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	736.9	847.2	908.4
Outgoing	718.7	804.5	846.9
Surplus (Deficit)	18.2	42.7	61.5
Total Volume	1455.6	1651.7	1755.3

Sweden

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Finland	105	14.2%
2. Norway	102	13.8%
3. Denmark	89	12.0%
4. Germany	77	10.4%
5. United Kingdom	66	8.9%
6. United States	55	7.4%
7. France	28	3.8%
8. Spain	18	2.4%
9. Italy	17	2.3%
10. Netherlands	16	2.2%
11. Switzerland	15	2.0%
12. Belgium	12	1.6%
13. Yugoslavia	10	1.4%
14. Austria	9	1.2%
15. Turkey	7	0.9%
16. Canada	7	0.9%
17. Other	107	14.5%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	571	595	630
Outgoing	672	691	740
Surplus (Deficit)	(101)	(96)	(110)
Total Volume	1243	1286	1370

Note: Data are rounded to the nearest million minutes for Telia and Tele-2 only.

Switzerland

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	363	23.1%
2. France	271	17.2%
3. Italy	232	14.7%
4. United Kingdom	84	5.3%
5. Austria	70	4.4%
6. United States	67	4.2%
7. Portugal	60	3.8%
8. Spain	55	3.5%
9. Netherlands	38	2.4%
10. Turkey	31	2.0%
11. Belgium	28	1.8%
12. Yugoslavia	24	1.5%
13. Sweden	16	1.0%
14. Canada	12	0.8%
Other	221	13.9%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	1124.0	1191.5	1258.7
Outgoing	1429.4	1551.0	1572.0
Surplus (Deficit)	(305.4)	(359.5)	(313.3)
Total Volume	2553.4	2742.5	2830.7

Note: Route data are rounded to the nearest million minutes.

United Kingdom

Largest Telecommunications Routes, FY 1993/94

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	530	16.9%
2. France	287	9.2%
3. Germany	281	9.0%
4. Ireland	266	8.5%
5 Italy	139	4.4%
6. Netherlands	131	4.2%
7. Spain	115	3.7%
8. Australia	101	3.2%
9. Canada	96	3.1%
10. Belgium	84	2.7%
11. Switzerland	82	2.6%
12. Sweden	52	1.7%
13. Denmark	46	1 5%
14. Greece	45	1.4%
15. India	42	1.3%
16. South Africa	41	1.3%
17. Hong Kong	41	1 3%
18. Japan	39	1.2%
19. Pakistan	38	1.2%
20. Norway	37	1 2%
Other	637	20.4%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	FY 1991/92	FY 1992/93	FY 1993/94
Incoming	2692	2789	3086
Outgoing	2598	2849	3130
Surplus (Deficit)	94	(60)	(44)
Total Volume	5290	5638	6216

Notes: Data are rounded to the nearest million minutes. Data are for BT and Mercury only; traffic of IPL resellers is excluded. IPL resellers had approximately 60 million outbound MiTT in FY 1993. See Methodology.

Yugoslavia

Largest Telecommunications Routes, 1993

	Destination	MiTT	Percentage of Outgoing Traffic
1.	Germany	51.7	28.5%
2.	Austria	21.9	12.1%
3.	Switzerland	17.0	9.4%
4.	Greece	9.6	5.3%
5.	Italy	9.3	5.1%
6.	France	8.2	4.5%
7.	Slovenia	7.2	4.0%
8.	United States	7.1	3.9%
9.	United Kingdom	5.4	3.0%
10.	Sweden	5.2	2.9%
11.	Hungary	4.7	2.6%
12.	Russia	4.1	2.3%
13.	Turkey	4.1	2.3%
14.	Bulgaria	2.7	1.5%
15.	Macedonia	2.6	1.4%
16.	Canada	2.5	1.4%
17.	Netherlands	2.1	1.2%
18.	Australia	2.0	1.1%
19.	Czech Republic	1.8	1.0%
20.	Cyprus	1.3	0.7%
	Other	11.0	6.1%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	223.5
Outgoing	106.6	142.8	181.5
Surplus (Deficit)	N.A.	N.A.	42.0
Total Volume	N.A.	N.A.	405.0

Note: Includes only traffic from present-day Yugoslavia (Serbia and Montenegro). For traffic from Croatia and Slovenia, see pages 101 and 118.

Traffic within the Commonwealth of Independent States

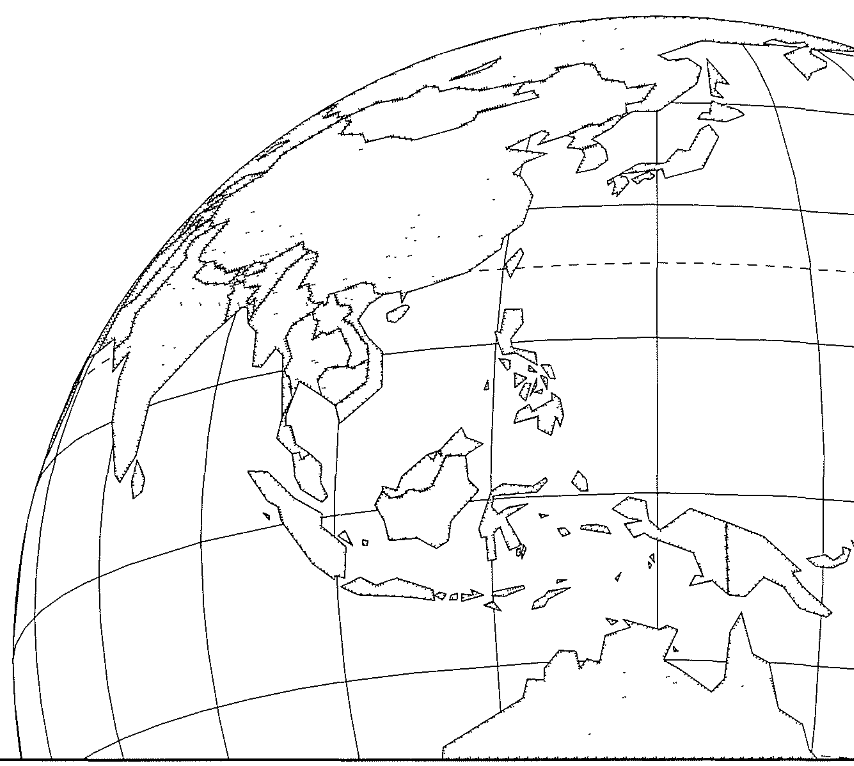
September-December 1993 (thousands of minutes)

From: / To:	Armenia	Kyrgyzstan	Moldova	Russia	Uzbekistan
Azerbaijan	1.0	63.8	72.7	8,217.0	203.3
Armenia	--	22.5	164.6	11,947.5	242.3
Belarus	438.9	111.4	965.3	22,603.5	385.6
Georgia	572.0	5.4	0.2	8,192.7	113.5
Kazakhstan	138.6	2,977.6	200.5	21,797.9	2,493.8
Kyrgyzstan	14.6	--	25.8	4,077.8	1,031.6
Moldova	98.4	18.6	--	6,514.1	78.5
Russia	11,797.1	6,296.7	8,964.8	--	13,409.9
Tajikistan	9.8	184.3	10.4	2,624.9	1,114.2
Turkmenistan	257.3	105.6	3.8	1,870.9	515.3
Ukraine	1,825.5	333.9	6,781.4	70,635.5	1,445.3
Uzbekistan	237.6	1,031.9	85.9	11,615.9	--

Source: Regional Commonwealth in the Field of Communications (RCC)

Asia, Middle East, & Africa

International Traffic



Australia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. New Zealand	124	16.6%
2. United Kingdom	120	16.1%
3. United States	119	16.0%
4. Hong Kong	32	4.3%
5. Japan	28	3.8%
6. Singapore	22	3.0%
7. Germany	19	2.6%
8. Canada	19	2.6%
9. Italy	18	2.4%
10. Malaysia	16	2.1%
11. Philippines	15	2.0%
12. Indonesia	13	1.7%
13. Greece	11	1.5%
14. Papua New Guinea	10	1.3%
15. China	10	1.3%
16. Taiwan	9	1.2%
17. France	9	1.2%
18. Thailand	9	1.2%
19. Fiji	8	1.1%
20. South Africa	7	0.9%
Other	127	17.0%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	N.A.
Outgoing	610	670	745
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Notes: Data rounded to the nearest million minutes, for Telstra and Optus only. Data include Country Direct traffic, but exclude traffic of IPL resellers. See Methodology.

Bangladesh

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. India	1.9	11.2%
2. United Kingdom	1.9	11.2%
3. United States	1.7	9.7%
4. Singapore	1.2	7.2%
5. Hong Kong	1.1	6.3%
6. Saudi Arabia	1.0	5.5%
7. Japan	0.9	5.4%
8. Korea, Rep. of	0.8	4.4%
9. Malaysia	0.7	4.2%
10. Pakistan	0.7	4.0%
11. United Arab Emirates	0.4	2.4%
12. Germany	0.4	2.2%
13. Italy	0.4	2.0%
14. Thailand	0.3	2.0%
15. China	0.3	1.7%
16. Kuwait	0.3	1.5%
17. Canada	0.2	1.4%
18. France	0.2	1.4%
19. Netherlands	0.2	1.1%
20. Australia	0.2	0.9%
Other	2.4	13.7%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	56.1.	66.8	83.9
Outgoing	10.3	14.3	17.2
Surplus (Deficit)	45.8	52.5	66.7
Total Volume	66.4	81.1	101.1

China

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Hong Kong	535	59.8%
2. Japan	85	9.5%
3. Taiwan	65	7.3%
4. United States	45	5.0%
5. Macau	30	3 4%
6. Korea, Rep. of	15	1.7%
7. Singapore	10	1.1%
8. Germany	10	1.1%
9. Australia	10	1.1%
10. Canada	10	1.1%
11. Russia	10	1.1%
12. Thailand	5	0.6%
13. France	5	0.6%
14. United Kingdom	4	0.4%
15. Italy	3	0.3%
Other	53	5.9%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	N.A.
Outgoing	440.0	635.1	895
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Note: Data are rounded to the nearest 5 million minutes. Routes below 5 million minutes are rounded to the nearest million.

Cyprus

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United Kingdom	27.6	29.5%
2. Greece	19.3	20.6%
3. United States	4.2	4.5%
4. Germany	4.0	4.3%
5. USSR (former)	3.2	3.4%
6. Lebanon	2.5	2.7%
7. France	2.3	2.5%
8. Yugoslavia	2.0	2.1%
9. Italy	2.0	2.1%
10. Israel	1.8	2.0%
11. Romania	1.7	1.9%
12. Bulgaria	1.6	1.7%
13. Egypt	1.4	1.4%
14. Switzerland	1.3	1.4%
15. Syria	1.2	1.3%
16. Sweden	1.2	1.3%
17. Canada	1.1	1.2%
18. Australia	1.1	1.1%
19. Austria	1.0	1.1%
20. Jordan	1.0	1.1%
Other	12.1	12.9%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	71.7	73.7	72.2
Outgoing	70.1	85.3	93.8
Surplus (Deficit)	1.6	(11.6)	(21.6)
Total Volume	141.8	159.0	166.0

Hong Kong

Largest Telecommunications Routes, FY 1993/94

Destination	MiTT	Percentage of Outgoing Traffic
1. China	688	50%
2. United States	96	7%
3. Taiwan	83	6%
4. Canada	55	4%
5. Japan	55	4%
6. United Kingdom	55	4%
7. Macau	41	3%
8. Singapore	41	3%
9. Australia	41	3%
10. Philippines	41	3%
Other	179	13%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	FY 1991/92	FY 1 992/93	FY 1993/94
Incoming	783.0	1009.4	1260.3
Outgoing	913.2	1136.6	1376.9
Surplus (Deficit)	(130.2)	(127.2)	(116.5)
Total Volume	1696.2	2146.0	2637.2

Note: Fiscal year ends on 31 March. Route data are rounded to the nearest million minutes. Surplus/deficit and total volume data may appear inconsistent by ±0.1 due to rounding.

India

Largest Telecommunications Routes, FY 1993/94

Destination	MiTT	Percentage of Outgoing Traffic
1. Saudi Arabia	51.9	18.3%
2. United States	51.6	18.2%
3. United Arab Emirates	31.9	11.2%
4. United Kingdom	26.5	9.3%
5. Germany	9.6	3.4%
6. Singapore	9.6	3.4%
7. Hong Kong	8.8	3.1%
8. Canada	6.6	2.3%
9. Oman	5.7	2.0%
10. Australia	5.0	1.8%
11. Japan	5.0	1.7%
12. France	4.9	1.7%
13. Qatar	4.0	1 4%
14. Italy	3.4	1.2%
15. Malaysia	2.8	1 0%
16. Bahrain	2.5	0.9%
17. Thailand	2.3	0 8%
18. Switzerland	2.3	0.8%
19. Netherlands	2.3	0 8%
20. Russia	2.1	0.8%
Other	45.3	16.0%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	FY 1991/92	FY 1 992/93	FY 1993/94
Incoming	N.A.	354.6	441.0
Outgoing	185.8	259.6	283.9
Surplus (Deficit)	N.A.	95.0	157.1
Total Volume	N.A.	614.2	724.8

Note: Outgoing totals and route data do not include India-Pakistan traffic. Fiscal year ends on 31 March.
Surplus/deficit and total volume data may appear inconsistent by ±0.1 due to rounding.

Indonesia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Singapore	35.0	24.4%
2. United States	18.1	12.6%
3. Japan	14.0	9.7%
4. Australia	11.4	7.9%
5. Hong Kong	10.3	7.2%
6. Taiwan	7.1	4.9%
7. Malaysia	6.7	4.7%
8. Korea, Rep. of	5.9	4.1%
9. United Kingdom	4.9	3.4%
10. Germany	4.4	3.1%
11. Netherlands	4.0	2.8%
12. France	2.9	2.0%
13. Philippines	2.4	1.7%
14. China	2.1	1.5%
15. Thailand	1.8	1.3%
16. Canada	1.8	1.3%
17. Italy	1.7	1.2%
18. Saudi Arabia	1.5	1.0%
19. India	1.4	1.0%
20. Switzerland	0.9	0.6%
Other	5.5	3.8%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	135.7	165.5	201.8
Outgoing	100.0	118.1	143.8
Surplus (Deficit)	35.7	47.4	58.0
Total Volume	235.7	283.6	345.6

Note: Data based on billing point of traffic. Data are for Indosat only.

Israel

Largest Telecommunications Routes, 1992

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	48.3	31.5%
2. United Kingdom	15.1	9.9%
3. France	11.8	7.7%
4. Germany	10.8	7.1%
5. USSR (former)	6.2	4.0%
6. Italy	5.6	3.7%
7. Canada	4.6	3.0%
8. Switzerland	4.5	2.9%
9. Netherlands	4.0	2.6%
10. Belgium	3.8	2.5%
11. South Africa	2.6	1.7%
12. Australia	2.4	1.6%
13. Romania	2.1	1.4%
14. Turkey	1.8	1.2%
15. Argentina	1.7	1.1%
Other	27.8	18.2%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	247.0	266.0	N.A.
Outgoing	139.4	153.1	175.5
Surplus (Deficit)	107.6	112.9	N.A.
Total Volume	386.4	419.1	N.A.

Note: Data are for Bezeq only.

Japan

Largest Telecommunications Routes, FY 1993/94

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	273.1	20.7%
2. Korea	139.8	10.6%
3. China	138.3	10.5%
4. Philippines	103.6	7.8%
5. Taiwan	79.2	6.0%
6. Thailand	59.8	4.5%
7. Brazil	51.0	3.9%
8. Hong Kong	49.2	3.7%
9. United Kingdom	43.0	3.3%
10. Iran	34.2	2.6%
11. Malaysia	33.5	2.5%
12. Singapore	33.0	2.5%
13. Australia	28.4	2.1%
14. Germany	26.2	2.0%
15. Peru	23.2	1.8%
16. Indonesia	19.2	1.5%
17. France	18.8	1.4%
18. Canada	18.2	1.4%
19. Pakistan	17.5	1.3%
20. Italy	9.4	0.7%
Other	121.5	9.2%

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National Traffic Balance

MiTT	FY 1991/92	FY 1992/93	FY 1993/94
Incoming	836.8	891.5	981.2
Outgoing	1160.5	1283.5	1411.2
Surplus (Deficit)	(323.7)	(392.0)	(429.8)
Total Volume	1997.3	2174.8	2392.4

Note: Route-by-route data include only IDD calls, while total data include operator assisted calls as well. Fiscal year ends on 31 March. Data are for KDD, ITJ, and IDC combined.

Republic of Korea

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	100.2	28.2%
2. Japan	89.4	25.2%
3. China	23.5	6.6%
4. Hong Kong	16.9	4.8%
5. Philippines	11.0	3.1%
6. Germany	9.3	2.6%
7. Canada	8.0	2.3%
8. United Kingdom	7.4	2.1%
9. Taiwan	7.3	2.1%
10. Indonesia	7.0	2.0%
11. Australia	7.0	2.0%
12. Singapore	6.5	1.8%
13. France	5.2	1.5%
14. Thailand	4.2	1.2%
Other	52.3	14.7%

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National Traffic Balance

MiTT	1991	1992	1993
Incoming	425.1	453.9	510.5
Outgoing	229.2	305.9	355.4
Surplus (Deficit)	195.9	148.0	155.1
Total Volume	654.3	759.8	865.9

Note: 1991 data are for Korea Telecom only. 1992 and 1993 data are for Korea Telecom and Dacom combined.

Macau

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Hong Kong	41.8	46.5%
2. China	38.2	42.4%
3. Portugal	2.3	2.6%
4. Taiwan	1.3	1.5%
5. Thailand	1.1	1.2%
6. United States	1.0	1.1%
7. Canada	0.7	0.8%
8. Australia	0.5	0.5%
9. Philippines	0.4	0.5%
10. Japan	0.4	0.4%
11. Singapore	0.3	0.3%
12. United Kingdom	0.3	0.3%
13. Malaysia	0.2	0.3%
14. France	0.2	0.2%
15. Korea, Rep. of	0.2	0.2%
16. Indonesia	0.1	0.1%
17. Germany	0.1	0.1%
18. Belgium	0.1	0.1%
19. Italy	0.0	0.0%
Other	0.7	0.8%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	57.1	68.6	71.3
Outgoing	63.2	76.9	89.9
Surplus (Deficit)	(6.1)	(8.3)	(18.6)
Total Volume	120.3	145.5	161.2

Malaysia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Singapore	116.0	44.9%
2. Japan	18.4	7.1%
3. Australia	14.0	5.4%
4. United States	13.9	5.4%
5. United Kingdom	13.4	5.2%
6. Hong Kong	11.6	4.5%
7. Taiwan	10.1	3.9%
8. Thailand	8.6	3.3%
9. Indonesia	8.1	3.2%
10. India	6.6	2.5%
11. Philippines	4.1	1.6%
12. China	3.5	1.4%
13. Germany	3.1	1.2%
14. Korea, Rep. of	3.1	1.2%
15. Canada	2.4	0.9%
16. Bangladesh	2.1	0.8%
17. Brunei	2.1	0.8%
18. New Zealand	1.8	0.7%
19. Pakistan	1.7	0.7%
20. France	1.7	0.7%
Other	11.8	4.6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	N.A.	249.0	304.2
Outgoing	176.2	216.5	258.1
Surplus (Deficit)	N.A.	32.5	46.1
Total Volume	N.A.	465.5	562.3

Note: Above totals do not include local Malaysia-Singapore border traffic. Data are for Telekom Malaysia only.

New Zealand

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Australia	117	53 4%
2. United Kingdom	24	11.0%
3. United States	19	8.7%
4. Hong Kong	7	3.2%
5. Japan	5	2 3%
6. Fiji	4	1.8%
7. Canada	4	1.8%
8. Western Samoa	4	1.8%
9. Singapore	3	1.4%
10. Taiwan	2	0.9%
11. Germany	2	0.9%
12. Malaysia	2	0.9%
13. Netherlands	1	0.5%
14. China	1	0 5%
15. Indonesia	1	0 5%
16. South Africa	1	0 5%
17. India	1	0 5%
18. France	1	0 5%
19. Papua New Guinea	1	0 5%
20. Cook Islands	1	0 5%
Other	18	8 2%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	N.A.
Outgoing	165	189	219
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Note: Data rounded to the nearest million minutes for Telecom New Zealand and Clear Communications Ltd. Data based on billing point of traffic.

Pakistan

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United Kingdom	8.4	14.8%
2. United States	7.7	13.5%
3. United Arab Emirates	6.1	10.7%
4. Saudi Arabia	6.0	10.6%
5. Germany	2.5	4.4%
6. India	2.0	3.5%
7. Japan	1.5	2.7%
8. Iran	1.4	2.4%
9. France	1.2	2.2%
10. Singapore	1.2	2.2%
11. Hong Kong	1.1	2.0%
12. Kuwait	1.1	2.0%
13. Canada	0.9	1.7%
14. China	0.9	1.6%
15. Netherlands	0.8	1.3%
16. Italy	0.8	1.3%
17. Switzerland	0.7	1.2%
18. Korea, Rep. of	0.6	1.0%
19. Qatar	0.5	1.0%
20. Turkey	0.5	0.9%
Other	10.7	18.9%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	305.7
Outgoing	34.3	44.2	56.5
Surplus (Deficit)	N.A.	N.A.	249.2
Total Volume	N.A.	N.A.	362.2

Philippines

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	67	40.9%
2. Japan	23	14.0%
3. Hong Kong	13	7.9%
4. Canada	9	5.5%
5. Australia	7	4.3%
6. Singapore	5	3.0%
7. Taiwan	5	3.0%
8. Korea, Rep. of	4	2.4%
9. Saudi Arabia	4	2 4%
10. United Kingdom	3	1.8%
11. Italy	2	1.2%
12. Malaysia	2	1.2%
Other	20	11.0%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	385.4	462.1	N.A.
Outgoing	128.5	135.8	164
Surplus (Deficit)	256.9	326.3	N.A.
Total Volume	513.9	597.9	N.A.

Note: Traffic to the United States includes traffic to Guam. Data rounded to the nearest million minutes and include PLDT and Philippine Global Com. only.

Saudi Arabia

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Egypt	116.9	26.1%
2. Pakistan	44.4	9.9%
3. United States	29.7	6.6%
4. United Kingdom	22.2	5.0%
5. India	22.0	4.9%
6. United Arab Emirates	21.7	4.8%
7. Kuwait	17.9	4.0%
8. Yemen	15.7	3.5%
9. Jordan	15.6	3.5%
10. Syria	14.7	3.3%
11. Bahrain	13.0	2.9%
12. Philippines	11.6	2.6%
13. Turkey	8.9	2.0%
14. Sudan	8.7	1.9%
15. France	8.6	1.9%
16. Bangladesh	8.5	1.9%
17. Morocco	7.4	1.6%
18. Lebanon	6.8	1.5%
19. Qatar	6.1	1.4%
20. Germany	5.9	1.3%
Other	41.2	9.2%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	266.7	292.1	N.A.
Outgoing	410.6	464.6	447.5
Surplus (Deficit)	(143.9)	(172.5)	N.A.
Total Volume	677.3	756.7	N.A.

Singapore

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Malaysia	121	25.6%
2. Indonesia	45	9 5%
3. Hong Kong	42	8.9%
4. United States	38	8.1%
5. Japan	36	7.6%
6. Thailand	26	5 5%
7. Australia	22	4.7%
8. Taiwan	22	4 7%
9. United Kingdom	21	4 4%
10. India	21	4.4%
11. China	18	3 8%
12. Philippines	17	3 6%
13. Germany	10	2.1%
14. Korea, Rep. of	9	1 9%
15. France	6	1 3%
16. Brunei	6	1 3%
17. Other	13	2 8%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	FY 1991/92	FY 1992/93	FY 1993/94
Incoming	N.A.	N.A.	N.A.
Outgoing	344	412	480
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Note: Data rounded to the nearest million minutes. Fiscal year ends on 31 March. Totals exclude local Malaysia-Singapore border traffic. Route-by-route data are for 1993 calendar year.

South Africa

Largest Telecommunications Routes, 1992

Destination	MiTT	Percentage of Outgoing Traffic
1. United Kingdom	37.7	17.0%
2. Namibia	27.8	12.5%
3. Zimbabwe	19.5	8.8%
4. United States	18.3	8.3%
5. Botswana	14.0	6.3%
6. Germany	10.8	4.9%
7. Swaziland	10.0	4.5%
8. Mozambique	9.5	4.3%
9. Lesotho	7.3	3.3%
10. Australia	5.5	2.5%
11. Portugal	4.4	2.0%
12. France	4.0	1.8%
13. Israel	3.8	1.7%
14. Italy	3.7	1.7%
15. Canada	3.6	1.6%
16. Switzerland	3.4	1.5%
17. Netherlands	3.3	1.5%
18. Zambia	2.9	1.3%
19. Malawi	2.2	1.0%
20. Belgium	2.1	0.9%
Other	27.9	12.6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	N.A.	250.7	N.A.
Outgoing	202.6	221.7	255
Surplus (Deficit)	N.A.	29.0	N.A.
Total Volume	N.A.	472.4	N.A.

Sri Lanka

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. India	2.2	11.3%
2. United Kingdom	2.2	11.3%
3. Singapore	1.6	8.2%
4. United States	1.5	7.7%
5. Japan	1.2	6.2%
6. Hong Kong	1.1	5.6%
7. Australia	0.9	4.6%
8. Germany	0.8	4.1%
9. Korea, Rep. of	0.6	3.1%
10. United Arab Emirates	0.6	3.1%
11. France	0.5	2.6%
12. Canada	0.5	2.6%
13. Italy	0.5	2.6%
14. Saudi Arabia	0.4	2.1%
15. Pakistan	0.3	1.5%
16. Maldives	0.3	1.5%
17. Switzerland	0.3	1.5%
18. Thailand	0.3	1.5%
19. Kuwait	0.3	1.5%
20. Malaysia	0.3	1.5%
Other	3.1	15.9%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	1991	1992	1993
Incoming	N.A.	N.A.	65.0
Outgoing	15.6	17.8.	19.5
Surplus (Deficit)	N.A.	N.A.	45.5
Total Volume	N.A.	N.A.	84.5

Taiwan

Largest Telecommunications Routes, FY 1993/94

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	89.0	20.2%
2. Hong Kong	87.3	19.8%
3. China	71.6	16.2%
4. Japan	57.1	13.0%
5. Singapore	14.7	3.3%
6. Thailand	11.4	2 6%
7. Canada	10.9	2.5%
8. Philippines	10.4	2.4%
9. Malaysia	9.4	2.1%
10. Australia	8.2	1.9%
11. Germany	7.7	1.7%
12. Indonesia	7.2	1.6%
13. Korea, Rep. of	6.3	1.4%
14. United Kingdom	6.3	1.4%
15. France	4.6	1.0%
16. Vietnam	3.7	0.8%
17. Italy	2.5	0.6%
18. South Africa	2.2	0.5%
19. Netherlands	2.2	0 5%
20. New Zealand	2.1	0.5%
Other	25.9	5.9%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	FY 1991/92	FY 1992/93	FY 1993/94
Incoming	415.0	484.4	490.8
Outgoing	254.7	368.7	440.7
Surplus (Deficit)	160.3	115.7	50.1
Total Volume	669.7	853.1	931.5

Note: Fiscal year ends 31 March. Data based on billing point of traffic.

Thailand

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. United States	26.9	16.6%
2. Japan	24.6	15.2%
3. Singapore	16.5	10.2%
4. Hong Kong	12.8	7.9%
5. Taiwan	10.8	6.7%
6. United Kingdom	8.2	5.1%
7. Australia	6.3	3.9%
8. Germany	5.8	3.6%
9. China	5.4	3.3%
10. Korea, Rep. of	4.1	2.5%
11. France	4.1	2.5%
12. India	3.0	1.9%
13. Italy	2.8	1.7%
14. Canada	2.2	1.4%
15. Switzerland	2.0	1.2%
16. Netherlands	2.0	1.2%
17. Indonesia	1.9	1.2%
18. Myanmar	1.8	1.1%
19. Sweden	1.4	0.9%
20. Vietnam	1.4	0.9%
Other	17.8	11.0%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	175.2	212.7	218.7
Outgoing	115.3	132.4	161.8
Surplus (Deficit)	59.9	80.3	56.9
Total Volume	290.5	345.1	380.5

Note: Data based on billing point of traffic.

Turkey

Largest Telecommunications Routes, 1993

Destination	MiTT	Percentage of Outgoing Traffic
1. Germany	97.6	36.9%
2. United Kingdom	23.3	8.8%
3. United States	16.6	6.3%
4. France	16.3	6.2%
5. Netherlands	11.8	4.5%
6. Switzerland	9.2	3.5%
7. Italy	9.0	3.4%
8. Austria	7.4	2.8%
9. Russia	6.8	2.6%
10. Bulgaria	5.7	2.2%
11. Romania	5.5	2.1%
12. Belgium	5.3	2.0%
13. Saudi Arabia	4.1	1.5%
14. Israel	4.1	1.5%
15. Greece	4.0	1.5%
16. Iran	3.8	1 4%
17. Sweden	2.9	1.1%
18. Denmark	2.1	0.8%
19. Spain	2.0	0.8%
20. Canada	1.8	0.7%
Other	25.3	9.6%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	470.0	560.0	605.0
Outgoing	198.1	226.8	264.6
Surplus (Deficit)	271.9	333.2	340.4
Total Volume	668.1	786.8	869.6

United Arab Emirates

Largest Telecommunications Routes, 1993

	Destination	MiTT	Percentage of Outgoing Traffic
1.	India	61.4	18.0%
2.	Pakistan	32.5	9.5%
3.	Saudi Arabia	27.5	8.0%
4.	Egypt	26.1	7.7%
5.	United Kingdom	24.0	7.0%
6.	Oman	18.8	5.5%
7.	Iran	14.3	4.2%
8.	United States	12.9	3.8%
9.	Syria	11.7	3.4%
10.	Qatar	11.1	3.3%
11.	Jordan	10.4	3.0%
12.	Bahrain	10.3	3.0%
13.	Kuwait	10.0	2.9%
14.	Philippines	6.0	1.8%
15.	Lebanon	5.9	1.7%
16.	Bangladesh	5.4	1.6%
17.	Sudan	5.2	1.5%
18.	Yemen	4.6	1.3%
19.	Germany	4.5	1.3%
20.	France	4.4	1.3%
	Other	34.7	10.1%

MiTT is Minutes of Telecommunications Traffic. Data are in millions of minutes for public voice circuits.

National Traffic Balance

MiTT	**1991**	**1992**	**1993**
Incoming	N.A.	N.A.	N.A.
Outgoing	262.3	299.0	341.6
Surplus (Deficit)	N.A.	N.A.	N.A.
Total Volume	N.A.	N.A.	N.A.

Methodology and Sources

The traffic statistics in *TeleGeography 1994* were compiled primarily from an independent survey of telecommunications service providers. For some countries and carriers, traffic data have been estimated based upon annual reports, government publications and industry interviews. See the footnotes to each table for further information. The following publications were also consulted: *Direction of Traffic: International Telephone Traffic 1983-1992* (TeleGeography, Inc./ITU, Geneva, 1994), *Internationale Fernmeldestatistik* (Siemens, Munich, 1994); *The World's Telephones A Statistical Compilation as of January 1991-1992*, (AT&T, Indianapolis, IN, 1993).

A common accounting unit known as MiTT (Minutes of Telecommunications Traffic) is used throughout the report. MiTT generally refers to paid minutes of traffic on public switched voice circuits and thus includes voice as well as non-voice (facsimile, data) traffic. For the origins of MiTT and its various applications (economic forecasting, competition policy, geography), see G. Staple and M. Mullins "Telecom Traffic Statistics—MiTT Matter," *Telecommunications Policy*, Vol. 14, No. 2, June 1989, pp. 105-128. See also *Communications Outlook 1993* (OECD, Paris, 1993) for a comparison of MiTT with other telecommunication indicators.

Calling card traffic

Historically, most international calls were billed at the point of origination. The number of billed minutes thus coincided with the volume of outgoing traffic. Billed minutes also included collect or reverse charge calls because the calls were set up by an operator in the originating country. However, the recent use of credit and debit cards has shifted the billing point for many international calls. Calls from Country A to Country B (or Country C) may now be set up and billed in Country B.

Unless otherwise stated in the notes to a table, the outbound MiTT reported for countries in *TeleGeography 1994* refers to outbound traffic originated in the stated country even if it is billed in another country. That is, unless stated, traffic originated in a foreign country but billed to a calling card or credit card in the reporting country is not counted as outbound traffic. However, some countries (including the U.S.) report international traffic data based solely on the location where the traffic is billed; consequently, "outbound" traffic data for these countries include Home Country direct traffic originating in third countries. For these and other reasons, the national statistics in *TeleGeography* are not directly comparable, and incoming MiTT reported for one country may not match the outgoing MiTT on the same route by the correspondent country. Some double counting may also occur. For example, a Country Direct call from Malaysia to the U.S. which is billed to a U.S. calling card is reported here as outbound U.S. MiTT; the same call also is reported as outbound MiTT by Malaysia.

Third-country routing

The growing volume of traffic routed *via* a third country using Home Country Beyond and "call back" services is also making national traffic statistics harder to interpret. A Home Country Beyond call may originate in Country A, be billed to a calling card in Country B and terminate in Country C. Similarly, a call routed *via* a "call back" service may be placed by a subscriber in Country A, but originate in Country B and terminate in Country C. In both cases, the calls from Country A to Country C generally will not be counted in Country A's outbound MiTT but may be reflected by an increased volume of MiTT from Country B to Country C.

Thus, in countries where Home Country Beyond and call back services are widely used, a year-to-year comparison of national MiTT also requires examining the statistics of countries where the calls are being refiled or hubbed. For example, in

1993 Argentina's national carrier, Telintar, reported a growth in outbound MiTT of only 10%; traffic to the U.S. grew by 6.5% and traffic to Italy also rose by 6.5%, significantly below the historical (1988-1992) growth rate on this route of 15%. However, U.S. carriers reported that U.S. billed traffic on the U.S.-Argentina route in 1993 grew by 26.9% as compared to a 4.3% growth in Argentina-billed traffic on this route. U.S.-billed traffic to Italy in 1993 grew by 10.9%, whereas Italy-billed traffic to the U.S. declined by 16.2%. These figures suggest the magnitude of calls from Argentina (and other countries) which are now routed *via* the U.S. to Italy

To assist readers in making similar comparisons, the U.S. tables in *TeleGeography 1994* have been expanded to provide 1992 and 1993 route-by-route statistics for over sixty countries. For further discussion of the methodological issues raised by the growth of alternative call routing arrangements, see *Direction of Traffic op. cit.* Chapter 7.

Resellers

Traffic carried by resellers of international switched voice services generally is included in the MiTT for the facilities-based carrier whose facilities are resold. However, unless otherwise stated, MiTT data exclude traffic carried by resellers of international private line (IPLs) connected to the public switched network at one or both ends. Transit traffic is also excluded.

Other factors

There may also be other reasons (beyond those referred to above) which cause inbound traffic data on a given route to differ from the outbound traffic data for the originating country (e.g., calendar vs. fiscal year data). In any event, the route-by-route traffic data reported in *TeleGeography* for each country generally is based upon the survey data supplied to *TeleGeography* by the originating country, not the terminating country. Some differences exist between the historical statistics (1992 or earlier) reported in *TeleGeography 1994* and data stated in prior reports or *Direction of Traffic*. The variations reflect corrections and/or revised data subsequently provided to *TeleGeography*. In addition, rounding may cause the figures on total national traffic and surpluses and deficits to appear inconsistent with other national data by ±0.2.

Blue Pages

International Dialing Codes, by Number

1 Canada
United States
1-809 Anguilla, Antigua & Barbuda, Bahamas, Barbados, Bermuda, British Virgin Islands, Cayman Islands, Dominica, Dominican Republic, Grenada, Jamaica, Montserrat, Nevis Islands, Puerto Rico, St. Kitts, St. Lucia, St. Vincent & the Grenadines, Trinidad & Tobago, Turks & Caicos , U.S. Virgin Islands
20 Egypt
212 Morocco
213 Algeria
216 Tunisia
218 Libya
220 Gambia
221 Senegal
222 Mauritania
223 Mali
224 Guinea
225 Ivory Coast
226 Burkina Faso
227 Niger
228 Togo
229 Benin
230 Mauritius
231 Liberia
232 Sierra Leone
233 Ghana
234 Nigeria
235 Chad
236 Central African Republic
237 Cameroon
238 Cape Verde Islands
239 Sao Tome and Principe
240 Equatorial Guinea
241 Gabon
242 Congo
243 Zaire
244 Angola
245 Guinea-Bissau
246 Diego Garcia
247 Ascension Island
248 Seychelles
249 Sudan
250 Rwanda
251 Ethiopia
252 Somalia
253 Djibouti
254 Kenya
255 Tanzania
256 Uganda
257 Burundi
258 Mozambique
259 Zanzibar
260 Zambia
261 Madagascar
262 Reunion Island
263 Zimbabwe
264 Namibia
265 Malawi
266 Lesotho
267 Botswana
268 Swaziland
269 Comoros & Mayotte
27 South Africa
291 Eritrea
297 Aruba
298 Faroe Islands
299 Greenland
30 Greece
31 Netherlands
32 Belgium
33 France
33-628 Andorra
33-93 Monaco
34 Spain
350 Gibraltar
351 Portugal; Azores
352 Luxembourg
353 Ireland
354 Iceland
355 Albania
356 Malta
357 Cyprus
358 Finland
359 Bulgaria
36 Hungary
370 Lithuania
371 Latvia
372 Estonia
373 Moldova
378 San Marino
379 Vatican City
381 Yugoslavia
385 Croatia
386 Slovenia
387 Bosnia-Herzegovina
389 Macedonia (F.Y.R.)
39 Italy
40 Romania
41 Switzerland
41-75 Liechtenstein
42 Czech Republic
42 Slovak Republic
43 Austria
44 United Kingdom
45 Denmark
46 Sweden
47 Norway
48 Poland
49 Germany
500 Falkland Islands
501 Belize
502 Guatemala
503 El Salvador
504 Honduras
505 Nicaragua
506 Costa Rica
507 Panama
508 St. Pierre & Miquelon
509 Haiti
51 Peru
52 Mexico
53 Cuba
54 Argentina
55 Brazil
56 Chile
57 Colombia
58 Venezuela
590 Guadeloupe
591 Bolivia
592 Guyana
593 Ecuador
594 French Guiana
595 Paraguay
596 Martinique
597 Suriname
598 Uruguay
599 Netherlands Antilles
60 Malaysia
61 Australia
62 Indonesia
63 Philippines
64 New Zealand
65 Singapore
66 Thailand
670 Northern Marianas
671 Guam
672 Australian Territories
673 Brunei
674 Nauru
675 Papua New Guinea
676 Tonga Islands
677 Solomon Islands
678 Vanuatu
679 Fiji
680 Palau
681 Wallis & Fortuna
682 Cook Islands
683 Niue
684 American Samoa
685 Western Samoa
686 Kiribati
687 New Caledonia
688 Tuvalu
689 French Polynesia
690 Tokelau
691 Micronesia
692 Marshall Islands
7 Armenia
Belarus
Kazakhstan
Kyrgyzstan
Russia
Tajikistan
Turkmenistan
Ukraine
Uzbekistan
81 Japan
82 South Korea
84 Vietnam
850 North Korea
852 Hong Kong
853 Macao
855 Cambodia
856 Laos
86 China (PRC)
871/872/873/874 Inmarsat
880 Bangladesh
886 Taiwan
90 Turkey
91 India
92 Pakistan
93 Afghanistan
94 Sri Lanka
95 Myanmar (Burma)
960 Maldives
961 Lebanon
962 Jordan
963 Syria
964 Iraq
965 Kuwait
966 Saudi Arabia
967 Yemen
968 Oman
971 United Arab Emirates
972 Israel
973 Bahrain
974 Qatar
975 Bhutan
976 Mongolia
977 Nepal
98 Iran
994 Azerbaijan
995 Georgia

International Dialing Codes, by Country

Afghanistan	**93**
Albania	**355**
Tirana	42
Algeria	**213**
Algiers	2
American Samoa	**684**
Andorra	**33-628**
Angola	244
Luanda	2
Anguilla	**1-809**
Antigua & Barbuda	**1-809**
Argentina	**54**
Buenos Aires	1
Armenia	**7**
Yerevan	8852
Aruba	**297**
Ascension Island	**247**
Australia	**61**
Canberra	62
Melbourne	3
Sydney	2
Australian Territories	**672**
Austria	**43**
Vienna	1
Azerbaijan	**994**
Baku	8922
Bahamas	**1-809**
Bahrain	**973**
Bangladesh	**880**
Dhaka	2
Barbados	**1-809**
Belarus	**7**
Minsk	172
Belgium	**32**
Brussels	2
Belize	**501**
Belmopan	8
Benin	**229**
Bermuda	**1-809**
Bhutan	**975**
Bolivia	**591**
La Paz	2
Bosnia	**387**
Sarajevo	71
Botswana	**267**
Brazil	**55**
Brasilia	61
Rio de Janeiro	21
São Paulo	11
British Virgin Islands	**1-809**
Brunei	**673**
Bandar Seri Begawan	2
Bulgaria	**359**
Sofia	2
Burkina Faso	**226**
Burundi	**257**
Cambodia	**855**
Cameroon	**237**
Canada	**1**
Montreal	514
Ottawa	613
Toronto	416
Cape Verde	**238**
Cayman Islands	**1-809**
Central African Republic	**236**
Bangui	61
Chad	**235**
Chile	**56**
Santiago	2
China, People's Republic of	**86**
Beijing	1
Guangzhou	20
Shanghai	21
Colombia	**57**
Bogota	1
Cocos Islands; Norfolk & Christmas Islands	**672**
Comoros	**269**
Congo	**242**
Brazzaville	81/82/83
Costa Rica	**506**
Croatia	**385**
Zagreb	41
Cuba	**53**
Havana	7
Cyprus	**357**
Nicosia	2
Czech Republic	**42**
Prague	2
Denmark	**45**
Diego Garcia	**246**
Djibouti	**253**
Dominca	**1-809**
Dominican Republic	**1-809**
Ecuador	**593**
Quito	2
Egypt	**20**
Cairo	2
El Salvador	**503**
Equitorial Guinea	**240**
Eritrea	**291**
Estonia	**372**
Tallinn	2
Ethiopia	**251**
Addis Ababa	1
Falkland Islands	**500**
Faroe Islands	**298**
Fiji	**679**
Finland	**358**
Helsinki	0
France	**33**
Paris	1
French Antilles	**596**
French Guiana	**594**
French Polynesia	**689**
Gabon	**241**
Gambia	**220**
Georgia	**995**
Tbilisi	8832
Germany	**49**
Berlin	30
Bonn	228
Frankfurt	69
Munich	89
Ghana	**233**
Accra	21
Gibraltar	**350**
Greece	**30**
Athens	1
Greenland	**299**
Grenada	**1-809**
Guadeloupe	**590**
Guam	**671**
Guatemala	**502**
Guatemala City	2
Guinea	**224**
Guinea-Bissau	**245**
Guyana	**592**
Georgetown	2
Haiti	**509**
Honduras	**504**
Hong Kong	**852**
Hungary	**36**
Budapest	1
Iceland	**354**
Reykjavik	1
India	**91**
Bombay	22
Calcutta	33
New Delhi	11
Indonesia	**62**
Jakarta	21
Inmarsat	
East Atlantic	871
West Atlantic	874
Pacific	872
Indian	873
Iran	**98**
Tehran	21
Iraq	**964**
Baghdad	1
Ireland	**353**
Dublin	1
Israel	**972**
Jerusalem	2
Tel Aviv	3
Italy	**39**
Rome	6
Milan	2
Ivory Coast	**225**
Jamaica	**1-809**
Japan	**81**
Osaka	6
Tokyo	3
Jordan	**962**
Amman	6
Kazakhstan	**7**
Alma Ata	3272
Kenya	**254**
Nairobi	2
Kiribati	**686**
Kuwait	**965**
Kyrgyzstan	**7**
Bishkek	3312
Laos	**856**
Latvia	**371**
Riga	2
Lebanon	961
Beirut	1
Lesotho	**266**
Liberia	**231**
Libya	**218**
Tripoli	21
Liechtenstein	**41-75**
Lithuania	**370**
Vilinius	2
Luxembourg	**352**
Macao	**853**
Macedonia (F.Y.R.)	**389**
Skopje	91
Madagascar	**261**
Antananarivo	2
Malawi	**265**
Malaysia	60
Kuala Lumpur	3
Maldives	**960**
Mali	**223**
Malta	**356**
Marshall Islands	**692**
Martinique	**596**
Mauritania	**222**
Mauritius	**230**
Mayotte	**269**
Mexico	**52**
Guadalajara	36

Mexico City	5
Monterrey	83
Micronesia	**691**
Moldova	**373**
Chisinau	422
Monaco	**33-93**
Mongolia	**976**
Montserrat	**1-809**
Morocco	**212**
Casablanca	2
Rabat	7
Mozambique	**258**
Maputo	1
Myanmar (Burma)	**95**
Namibia	**264**
Windhoek	61
Nauru	**674**
Nepal	**977**
Kathmandu	1
Netherlands	**31**
Amsterdam	20
Netherlands Antilles	**599**
Nevis Islands	**1-809**
New Caledonia	**687**
New Zealand	**64**
Auckland	9
Wellington	4
Nicaragua	**505**
Managua	2
Niger	**227**
Nigeria	**234**
Lagos	1
Niue	**683**
North Korea	**850**
Pyongyang	2
Northern Marianas	**670**
Saipan	322
Norway	**47**
Oslo	2
Oman	**968**
Pakistan	**92**
Islamabad	51
Palau	**680**
Panama	**507**
Papua New Guinea	**675**
Paraguay	**595**
Asuncion	21
Peru	**51**
Lima	14
Philippines	**63**
Manila	2
Poland	**48**
Warsaw	22
Portugal	**351**
Lisbon	1
Puerto Rico	**1-809**
Qatar	**974**
Reunion Island	**262**
Romania	**40**
Bucharest	1
Russia	**7**
Moscow	095
St. Petersburg	812
Rwanda	**250**
St. Kitts	**1-809**
St. Lucia	**1-809**
St. Pierre & Miquelon	**508**
St. Vincent & the Grenadines	**1-809**
San Marino	**378**
São Tome and Principe	**239**
Saudi Arabia	**966**
Riyadh	1
Senegal	**221**
Seychelles	**248**
Sierra Leone	**232**
Freetown	22
Singapore	**65**
Slovakia	**42**
Bratislava	7
Slovenia	**386**
Ljubljana	61
Solomon Islands	**677**
Somalia	**252**
Mogadishu	1
South Africa	**27**
Johannesburg	11
Pretoria	12
South Korea	**82**
Seoul	2
Spain	**34**
Madrid	1
Barcelona	3
Sri Lanka	**94**
Colombo	1
Sudan	**249**
Khartoum	11
Suriname	**597**
Swaziland	**268**
Sweden	**46**
Stockholm	8
Switzerland	**41**
Berne	31
Zurich	1
Syria	**963**
Damascus	11
Tahiti	**689**
Taiwan	**886**
Taipei	2
Tajikistan	**7**
Dushanbe	3772
Tanzania	**255**
Dar Es Salaam	51
Thailand	**66**
Bangkok	2
Togo	**228**
Tokelau	**690**
Tonga	**676**
Trinidad & Tobago	**1-809**
Tunisia	**216**
Tunis	1
Turkey	**90**
Ankara	4
Istanbul	1
Turkmenistan	**7**
Ashkhabad	3632
Turks & Caicos	**1-809**
Tuvalu	**688**
Uganda	**256**
Kampala	41
Ukraine	**7**
Kiev	44
United Arab Emirates	**971**
Abu Dhabi	2
Dubai	4
United Kingdom	**44**
London	171/181
Manchester	61
United States	**1**
Chicago	312/630
Houston	713
Los Angeles	213
Miami	305
New York	212/718
Washington	202
Uruguay	**598**
Montevideo	2
Uzbekistan	**7**
Tashkent	3712
Vanuatu	**678**
Vatican City	**379**
Venezuela	**58**
Caracas	2
Vietnam	**84**
Wallis & Fortuna	**681**
Western Samoa	**685**
Yemen	**967**
Sanaa	51
Yugoslavia	**381**
Belgrade	11
Zaire	**243**
Kinshasa	12
Zambia	**260**
Lusaka	1
Zanzibar (Tanzania)	**259**
Zimbabwe	**263**
Harare	4

North American Area Codes, by State and Province

Alabama
- Birmingham .205
- Montgomery .334*

Alaska .907

Alberta .403

Arizona
- Phoenix .602
- Elsewhere .520**

Arkansas .501

British Columbia & NW Territories .604

California
- Anaheim .714
- Bakersfield .805
- Burbank .818
- Fresno .209
- Long Beach .310
- Los Angeles .213
- Oakland .510
- Riverside .909
- Sacramento .916
- San Diego .619
- San Francisco .415
- San Jose .408
- Santa Rosa .707

Colorado
- Colorado Springs .719
- Denver .303

Connecticut .203

Delaware .302

District of Columbia
- Washington .202

Florida
- Jacksonville .904
- Miami .305/954
- Orlando .407
- Tampa .813

Georgia
- Athens .706
- Atlanta .404
- Savannah .912

Hawaii .808

Idaho .208

Illinois
- Cairo .618
- Chicago .312/630
- Oak Brook .708
- Peoria .309
- Rockford .815
- Springfield .217

Indiana
- Evansville .812
- Gary .219
- Indianapolis .317

Iowa
- Coucil Bluffs .712
- Des Moines .515
- Dubuque .319

Kansas
- Topeka .913
- Wichita .316

Kentucky
- Dade Park .812
- Lexington .606
- Louisville .502

Louisiana
- New Orleans .504
- Shreveport .318

Maine .207

Manitoba .204

Maryland
- Baltimore .410
- Rockville .301

Massachusetts
- Boston .617
- Springfield .413
- Worcester .508

Michgan
- Detroit .313
- Flint .810
- Grand Rapids .616
- Lansing .517
- Sault Ste. Marie .906

Minnesota
- Duluth .218
- Minneapolis .612
- Rochester .507

Mississippi .601

Missouri
- Kansas City .816
- St. Louis .314
- Springfield .417

Montana .406

Nebraska
- North Platte .308
- Omaha .402

Nevada .702

New Brunswick .506

New Hampshire .603

New Jersey
- Elizabeth .908
- Newark .201
- Trenton .609

New Mexico .505

New York
- Albany .518
- Buffalo .716
- Hempstead .516
- Ithaca .607
- Syracuse .315
- White Plains .914

New York City
- Manhattan .212
- Bronx, Queens .718
- auxilliary code .917

Newfoundland .709

North Carolina
- Charlotte .704
- Greensboro .910
- Raleigh .919

North Dakota .701

Nova Scotia & Prince Edward Island .902

Ohio
- Cincinnati .513
- Cleveland .216
- Columbus .614
- Toledo .419

Oklahoma
- Oklahoma City .405
- Tulsa .918

Ontario
- Ft. William .807
- London .519
- North Bay .705
- Ottawa .613
- Toronto .416

Oregon .503

Pennsylvania
- Altoona .814
- Harrisburg .717
- Philadelphia .215
- Pittsburgh .412

Puerto Rico & Caribbean .809

Quebec
- Montreal .514
- Quebec .418
- Sherbrooke .819

Rhode Island .401

Saskatchewan .306

South Carolina .803

South Dakota .605

Tennessee
- Memphis .901
- Nashville .615

Texas
- Amarillo .806
- Austin .512
- Dallas .214
- El Paso .915
- Fort Worth .817
- Galveston .409
- Houston .713
- San Antonio .210
- Tyler .903

Utah .801

Vermont .802

Virginia
- Alexandria .703
- Richmond .804

Washington
- Seattle .206
- Spokane .509

West Virginia .304

Wisconisin
- Madison .608
- Milwaukee .414
- Eau Claire .715

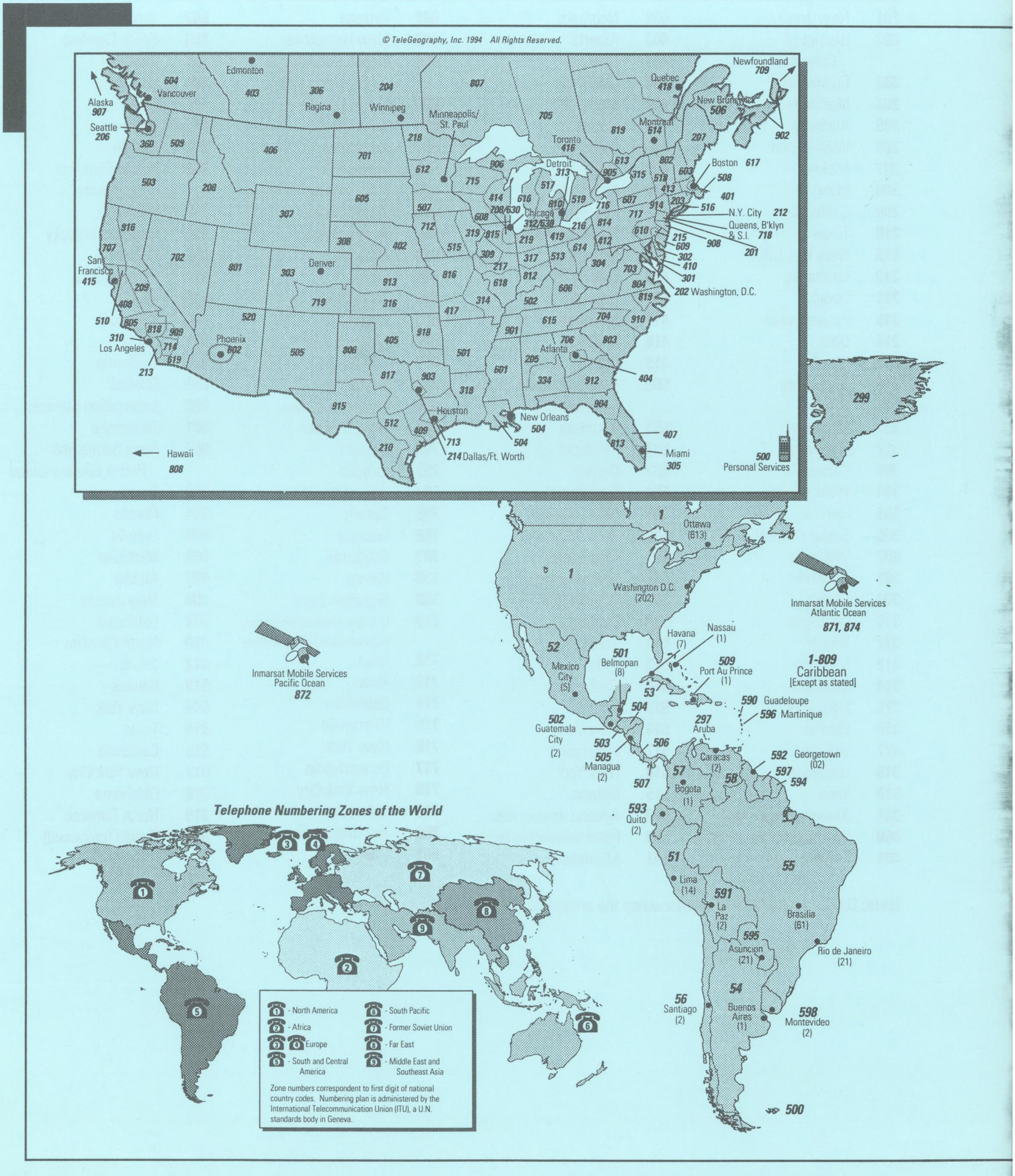
Wyoming .307

* Effective 15 January 1995
** Effective 19 March 1995

North American Area Codes, by Number

201	New Jersey
202	District of Columbia
203	Connecticut
204	Manitoba
205	Alabama
206	Washington
207	Maine
208	Idaho
209	California
210	Texas
212	New York City
213	California
214	Texas
215	Pennsylvania
216	Ohio
217	Illinois
218	Minnesota
219	Indiana
301	Maryland
302	Delaware
303	Colorado
304	West Virginia
305	Florida
306	Saskatchewan
307	Wyoming
308	Nebraska
309	Illinois
310	California
312	Illinois
313	Michgan
314	Missouri
315	New York
316	Kansas
317	Indiana
318	Louisiana
319	Iowa
334	Alabama (15 Jan. 1995)
360	Washington (15 Jan. 1995)
401	Rhode Island
402	Nebraska
403	Alberta
404	Georgia
405	Oklahoma
406	Montana
407	Florida
408	California
409	Texas
410	Maryland
412	Pennsylvania
413	Massachussetts
414	Wisconsin
415	California
416	Ontario
417	Missouri
418	Quebec
419	Ohio
500	Personal Communication Services (PCS)
501	Arkansas
502	Kentucky
503	Oregon
504	Louisiana
505	New Mexico
506	New Brunswick
507	Minnesota
508	Massachusetts
509	Washington
510	California
512	Texas
513	Ohio
514	Quebec
515	Iowa
516	New York
517	Michigan
518	New York
519	Ontario
520	Arizona (19 March 1995)
555	Public Information Services
601	Mississippi
602	Arizona
603	New Hampshire
604	British Columbia & NW Territories
605	South Dakota
606	Kentucky
607	New York
608	Wisconisin
609	New Jersey
610	Pennsylvania
612	Minnesota
613	Ontario
614	Ohio
615	Tennessee
616	Michigan
617	Massachusetts
618	Illinois
619	California
630	Illinois (1 July 1995)
701	North Dakota
702	Nevada
703	Virginia
704	North Carolina
705	Ontario
706	Georgia
707	California
708	Illinois
709	Newfoundland
710	U.S. Government Emergency Telecommunications Service
712	Iowa
713	Texas
714	California
715	Wisconsin
716	New York
717	Pennsylvania
718	New York City
719	Colorado
800	Toll-free services
801	Utah
802	Vermont
803	South Carolina
804	Virginia
805	California
806	Texas
807	Ontario
808	Hawaii
809	Puerto Rico and Caribbean
810	Michigan
812	Indiana/Kentucky
813	Florida
814	Pennsylvania
815	Illinois
816	Missouri
817	Texas
818	California
819	Quebec
900	Information Services
901	Tennessee
902	Nova Scotia and Prince Edward Island
903	Texas
904	Florida
905	Ontario
906	Michigan
907	Alaska
908	New Jersey
909	California
910	North Carolina
912	Georgia
913	Kansas
914	New York
915	Texas
916	California
917	New York City
918	Oklahoma
919	North Carolina
954	Florida (proposed)

Note: Dates in parentheses indicate when the area code will become active.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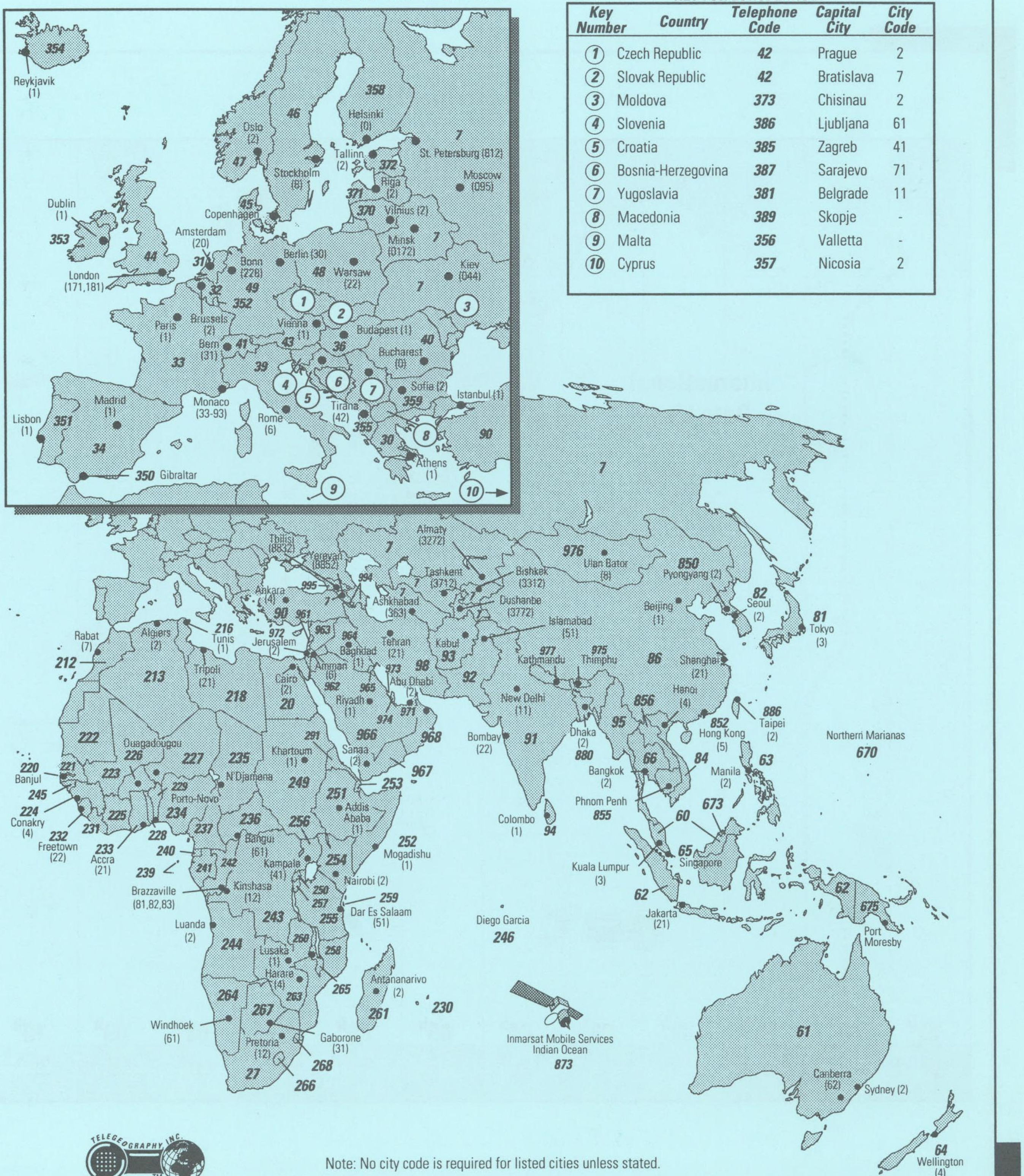
Alaska 907
Seattle 206
604 Vancouver
Edmonton
403
306 Regina
204 Winnipeg
807
Minneapolis/ St. Paul
218
612
705
Quebec 418
Montreal 514
819
Toronto 416
Newfoundland 709
New Brunswick 506
902
207
Boston 617
508
401
Detroit 313
906
715
414
616
517
810
519
905
613
315
518
802
603
413
203
516
N.Y. City 212
Queens, B'klyn & S.I. 718
914
607
716
717
610
215
609
908
201
302
410
301
202 Washington, D.C.
703
804
819
910
803
704
706
Atlanta
404
912
904
407
813
Miami 305
500 Personal Services
360
509
503
208
406
701
605
307
308
402
507
712
515
319
815
708/630 Chicago
312/630
608
309
217
618
314
219
317
812
419
513
614
412
304
606
502
615
901
916
707
San Francisco 415
702
801
303
Denver
719
913
316
816
417
405
918
501
601
205
334
510
408
209
805
818
909
310 Los Angeles
714
619
213
520
Phoenix 602
505
806
817
903
214 Dallas/Ft. Worth
318
915
512
409
713
Houston
210
504 New Orleans
504
Hawaii 808
299
1
Ottawa (613)
Washington D.C. (202)
Inmarsat Mobile Services Atlantic Ocean 871, 874
Inmarsat Mobile Services Pacific Ocean 872
52
Mexico City (5)
501 Belmopan (8)
Havana (7)
Nassau (1)
53
509 Port Au Prince (1)
1-809 Caribbean [Except as stated]
590 Guadeloupe
596 Martinique
297 Aruba
502 Guatemala City (2)
504
503
505 Managua (2)
506
507
Caracas (2)
57
Bogota (1)
58
592 Georgetown (02)
597
594
593 Quito (2)
51
Lima (14)
55
591
La Paz (2)
Brasilia (61)
595
Asuncion (21)
Rio de Janeiro (21)
54
56 Santiago (2)
Buenos Aires (1)
598 Montevideo (2)
500
Telephone Numbering Zones of the World
1 - North America
2 - Africa
3 4 Europe
5 - South and Central America
6 - South Pacific
7 - Former Soviet Union
8 - Far East
9 - Middle East and Southeast Asia
Zone numbers correspondent to first digit of national country codes. Numbering plan is administered by the International Telecommunication Union (ITU), a U.N. standards body in Geneva.

World Telephone Codes

KEY FOR EUROPE INSET

Key Number	Country	Telephone Code	Capital City	City Code
1	Czech Republic	42	Prague	2
2	Slovak Republic	42	Bratislava	7
3	Moldova	373	Chisinau	2
4	Slovenia	386	Ljubljana	61
5	Croatia	385	Zagreb	41
6	Bosnia-Herzegovina	387	Sarajevo	71
7	Yugoslavia	381	Belgrade	11
8	Macedonia	389	Skopje	-
9	Malta	356	Valletta	-
10	Cyprus	357	Nicosia	2



Note: No city code is required for listed cities unless stated.

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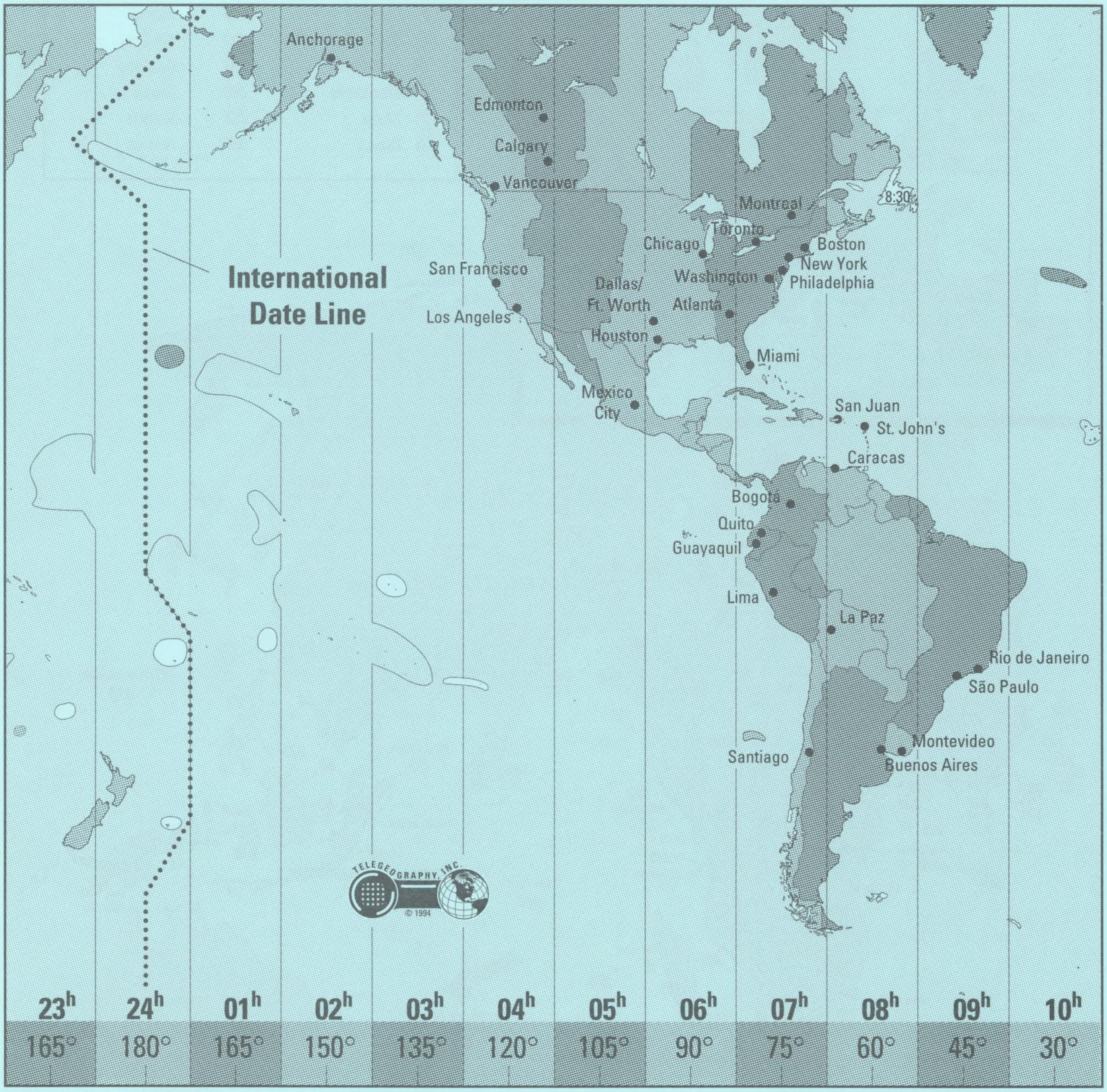
Tel. 202-467-0017; fax 202-467-5915



Anchorage
Edmonton
Calgary
Vancouver
Montreal
8:30
Toronto
Chicago
Boston
New York
Philadelphia
Washington
San Francisco
Dallas/
Ft. Worth
Atlanta
Los Angeles
Houston
Miami
International
Date Line
Mexico
City
San Juan
St. John's
Caracas
Bogota
Quito
Guayaquil
Lima
La Paz
Rio de Janeiro
São Paulo
Montevideo
Santiago
Buenos Aires
TELEGEOGRAPHY, INC.
© 1994
23h 24h 01h 02h 03h 04h 05h 06h 07h 08h 09h 10h
165° 180° 165° 150° 135° 120° 105° 90° 75° 60° 45° 30°

Time Zones


Oslo
Helsinki
Stockholm
Copenhagen
Moscow
Dublin
London
Berlin
Warsaw
Frankfurt
Prague
Kiev
Paris
Vienna
Rome
Istanbul
Madrid
Lisbon
Algiers
Tunis
Izmir
Ankara
Athens
Casablanca
Tangier
Tripoli
Tel Aviv
Tehran
Baghdad
16:30
17:45
Kuwait
15:30
Delhi
Kathmandu
Cairo
Riyadh
Karachi
Abu Dhabi
Jeddah
17:30
18:30
Sanaa
Bombay
Khartoum
Bangkok
Hong Kong
Manila
Beijing
Seoul
Tokyo
Osaka
Lagos
Addis Ababa
Ho Chi Minh City
Douala
Kuala Lumpur
Singapore
Nairobi
Victoria
Kinshasa
Dar es Salaam
Jakarta
Denpasar
Port Louis
Harare
Johannesburg
21:30
Sydney
Melbourne
Prime Meridian
Countries and areas which have adopted the Universal Time System (UTC).
Countries and areas with local deviations from the Universal Time System.
TELEGEOGRAPHY, INC.
© 1994
11h 12h 13h 14h 15h 16h 17h 18h 19h 20h 21h 22h
15° 0° 15° 30° 45° 60° 75° 90° 105° 120° 135° 150°


ARCTIC OCEAN
GREENLAND (DEN.)
ALASKA (U.S.)
CANADA
PACIFIC OCEAN
UNITED STATES
ATLANTIC OCEAN
Tropic of Cancer
BAHAMAS
MEXICO
DOMINICAN REP.
PUERTO RICO (U.S.)
CUBA
ANTIGUA AND BARBUDA
GUADELOUPE (FR.)
BELIZE
DOMINICA
MARTINIQUE (FR.)
HONDURAS
HAITI
JAMAICA
GUATEMALA
GRENADA
ST. LUCIA
BARBADOS
EL SALVADOR
NICARAGUA
TRINIDAD AND TOBAGO
COSTA RICA
VENEZUELA
GUYANA
FR. GUIANA
PANAMA
Equator
COLOMBIA
SURINAME
ECUADOR
KIRIBATI
160°
140°
120°
100°
TOKELAU
BRAZIL
COOK IS. (N.Z.)
W. SAMOA
AM. SAMOA
PERU
TONGA
FRENCH POLYNESIA
BOLIVIA
NIUE (N.Z.)
PARAGUAY
PITCAIRN (U.K.)
Tropic of Capricorn
CHILE
ARGENTINA
URUGUAY
PACIFIC OCEAN
FALKLAND IS. (U.K.)
Antarctic Circle
80°
60°
40°
20°
0°

Political Geography

EUROPE
1. NETHERLANDS
2. BELGIUM
3. LUXEMBOURG
4. CZECH REPUBLIC
5. SLOVAK REPUBLIC
6. SWITZERLAND
7. LIECHTENSTEIN
8. AUSTRIA
9. HUNGARY
10. SLOVENIA
11. CROATIA
12. BOSNIA
13. YUGOSLAVIA
14. ALBANIA
15. MACEDONIA (F.Y.R.)
16. MOLDOVA

ASIA
17. GEORGIA
18. ARMENIA
19. AZERBAIJAN
20. TURKMENISTAN
21. UZBEKISTAN
22. TAJIKISTAN
23. KYRGYZSTAN

AFRICA
24. BURKINA FASO
25. TOGO
26. EQUATORIAL GUINEA

National Telecommunications Indicators (A-J)

	Population 1993 (millions)	Area (Miles^2 thous.)	Main Lines 1993 (millions)	Main Lines 1990 (millions)	Lines/100 people 1993	Cellular phones 1993 (thous.)	Fax machines 1993 (thous.)	Internet Hosts August 1994
Algeria	27.4	920	1.1	0.8	3.9	4.8	8	n.a.
Argentina	33.4	1068	4.1	3.5	12.3	115.5	30	248
Australia	17.9	2968	8.5	8.1	47.8	760.0	600	1780
Austria	7.8	32	3.6	3.2	46.1	221.0	140	n.a.
Bahrain	0.6	<1	0.1	0.1	22.6	11.4	4	n.a.
Bangladesh	113.1	56	0.3	0.2	0.2	0.5	2	n.a.
Belgium	10.0	12	4.4	3.9	44.0	66.9	165	n.a.
Brazil	158.9	3286	11.7	9.4	7.4	180.2	200	5896
Bulgaria	8.7	43	2.3	2.1	26.3	1.0	10	n.a.
Canada	27.2	3852	16.3 d	15.3	59.7	1326.4	525	n.a.
Chile	13.7	292	1.5	0.8	11.1	85.2	15	3703
China	1183.6	3705	17.3	6.6	1.5	638.0	125	n.a.
Colombia	34.0	440	2.8 d	2.4	8.2	0.0	65	144
Croatia	4.8 d	22	1.0	n.a.	20.2	11.4	14	n.a.
Cuba	10.8	43	0.3 d	n.a.	3.2	0.2	1	n.a.
Cyprus	0.7	4	0.3	0.3	43.2	15.3	7	n.a.
Czech & Slovak Reps.	10.3	49	2.0 e	2.3	19.0	7.5	46	304 e
Denmark	5.2	17	3.1	2.9	58.9	359.3	185	n.a.
Dominican Republic	7.4	19	0.6	0.3	7.4	11.0	3	n.a.
Ecuador	11.0	109	0.6	0.5	5.4	0.0	30	256
Egypt	55.2	387	2.4	2.1	4.3	7.6	20	n.a.
Finland	5.0	131	2.8	2.7	54.9	466.1	115	421
France	57.2	213	30.8	27.7	53.9	579.0	1,000	1648
Germany	79.9	138	36.9	31.9	46.2	1770.0	1,296	1512
Greece	10.1	51	4.7	4.0	46.9	17.0	15	n.a.
Hong Kong	6.0	<1	3.0	2.5	50.2	285.6	234	62
Hungary	10.4	36	1.5	n.a.	14.4	45.7	30	n.a.
Iceland	0.3	40	0.1	0.1	54.7	17.4	4	n.a.
India	896.9	1269	8.0	5.0	0.9	0.0	45	n.a.
Indonesia	187.6	735	1.8	1.0	1.0	53.4	45	49
Iran	61.9	636	3.6	2.2	5.8	0.0	25	n.a.
Ireland	3.5	27	1.2	0.9	33.4	61.1	80	n.a.
Israel	5.4	10	2.0	1.6	36.5	50.0	80	n.a.
Italy	57.8	116	24.2	22.4	41.8	1207.0	250	435
Japan	124.8	146	57.7 d	55.3	46.2	2008.0	5,750	1564

Sources: World Bank, International Telecommunication Union, Internet Society, TeleGeography, Inc.

International Telephone Traffic

Outgoing mMiTT 1992	Outgoing mMiTT 1993	Outgoing mMiTT Change 92-93	Incoming mMiTT 1992	Incoming mMiTT 1993	Incoming mMiTT Change 92-93	Surplus/(Deficit) 1992	Surplus/(Deficit) 1993
118.0	121.0	2.5%	n.a.	n.a.	n.a.	n.a.	n.a.
124.3	137.1	10.3%	159.7	192.3	20.4%	35.4	55.2
670.0	745.0	11.2%	n.a.	n.a.	n.a.	n.a.	n.a.
713.4	767.4	7.6% a	692.3	751.0	8.5%	(21.1)	(16.4)
74.1	77.0	3.9%	n.a.	n.a.	n.a.	n.a.	n.a.
14.3	17.2	20.2%	66.8	83.9	25.6%	52.5	66.7
911.1	979.4	7.5% a	952.7	1025.3	4.6%	41.6	45.9
169.9	182.4	7.4% a	330.6	373.8	13.1%	160.7	191.4
81.0	91.0	12.3%	n.a.	n.a.	n.a.	n.a.	n.a.
2262.0	2477.0	9.5% a	2667.0	3066.0	15.0%	405.0	589.0
55.0	61.0	10.9%	85.6	n.a.	n.a.	30.6	n.a.
635.1	895.0	40.9%	n.a.	n.a.	n.a.	n.a.	n.a.
94.5	102.4	8.4% a	238.0	278.7	17.1%	143.5	176.3
104.7	117.2	12.0%	189.1	170.3	-9.9%	84.4	53.0
12.4	n.a.	n.a.	18.6	n.a.	n.a.	6.2	n.a.
85.3	93.8	9.9%	73.7	72.2	-2.0%	11.6	(21.6)
178.0	181.4	1.9%	236.0	253.2	7.3%	58.0	71.8
424.5	452.3	6.6%	425.2	460.0	8.2%	0.7	7.6
53.5	58.3	9.0%	n.a.	318.4	n.a.	n.a.	260.0
28.6	33.1	16.1%	82.4	101.4	23.1%	58.8	68.3
73.2	80.0	9.3%	n.a.	n.a.	n.a.	n.a.	n.a.
235.0	252.9	7.6%	n.a.	n.a.	n.a.	n.a.	n.a.
2449.0	2576.0	5.2% a	2540.0	2710.0	6.7%	91.0	134.0
4087.0	4679.6	14.5% a	3100.0	3707.8	19.6%	(987.0)	(971.8)
298.9	336.2	12.5% a	359.7	406.1	12.9%	60.8	70.0
1136.6	1376.9	21.1% c	1009.4	1260.3	24.9%	(127.2)	(116.5)
183.8	213.2	16.0%	150.5	192.8	28.1%	(33.3)	(20.4)
22.1	24.1	9.0% a	21.7	23.4	7.9%	(0.4)	(0.7)
259.6	283.9	9.4% c	354.6	441.0	24.4%	95.0	157.1
118.1	143.8	21.8% a	165.5	201.8	21.9%	47.4	58.0
131.3	156.5	19.2%	n.a.	n.a.	n.a.	n.a.	n.a.
296.6	383.9	29.4% c	383.0	423.0	10.4%	86.4	39.0
153.1	175.5	14.6%	266.0	n.a.	n.a.	112.9	n.a.
1473.4	1609.7	9.3%	1541.0	1672.7	8.6%	67.6	63.0
1283.5	1411.2	11.0% c	891.5	981.2	11.0%	(392.0)	(429.8)

a. MiTT based on billing point of traffic.
b. Year ending 30 September.
c. Year ending 31 March
d. 1992
e. Czech Republic only

Source: TeleGeography, Inc.

National Telecommunications Indicators (K-Z)

	Population 1993 (millions)	Area (Miles^2 thous.)	Main Lines 1993 (millions)	Main Lines 1990 (millions)	Lines/100 people 1993	Cellular phones 1993 (thous.)	Fax machines 1993 (thous.)	Internet Hosts August 1994
Korea, Republic of	44.0	38	16.7	13.5	38.0	384.7	350	348
Kuwait	2.4	7	0.4	0.3	15.2	60.1	25	n.a.
Luxembourg	0.4	1	0.2	0.2	56.7	5.1	6	n.a.
Macau	0.5	<1	0.1	0.1	27.7	18.1	7	n.a.
Malaysia	19.2	127	2.4	1.6	12.6	309.0	53	n.a.
Mexico	91.3	756	7.6	5.2	8.4	385.3	180	5164
Morocco	27.1	172	0.8	0.4	3.0	6.7	8	n.a.
Netherlands	15.2	16	7.6	6.9	50.3	216.0	400	291
New Zealand	3.5	104	1.6	1.6	45.8	143.8	45	334
Norway	4.3	125	2.3	2.1	52.9	375.0	130	n.a.
Pakistan	122.3	307	1.6	0.9	1.3	16.0	7	n.a.
Peru	23.1	496	0.7	0.6	3.0	36.9	5	42
Philippines	65.2	116	0.9	0.7	1.3	76.9	30	n.a.
Poland	38.7	121	4.4	3.3	11.4	10.7	30	n.a.
Portugal	10.5	36	3.3	2.4	31.1	101.2	30	n.a.
Qatar	0.5	4	0.1	0.1	23.2	4.3	5	n.a.
Russia	148.7	6592	23.4	n.a.	15.7	10.0	125	259
Saudi Arabia	16.6	830	1.6	1.4	9.5	19.0	75	n.a.
Singapore	3.1	<1	1.3	1.0	39.8	179.0	60	67
Slovenia	2.0	8	0.5	n.a.	26.0	6.5	11	n.a.
South Africa	38.5	471	3.7	3.3	9.5	40.0	60	n.a.
Spain	39.2	195	14.3	12.6	36.3	257.3	215	246
Sri Lanka	17.6	25	0.2	0.1	0.9	13.0	10	n.a.
Sweden	8.6	174	5.9	5.9	68.3	774.5	325	260
Switzerland	6.8	16	4.3	3.9	62.8	249.2	169	n.a.
Taiwan	20.9	14	8.0	6.8	38.1	538.5	275	376
Thailand	58.5	198	2.2	1.3	3.7	436.0	60	73
Tunisia	8.6	63	0.4	0.3	4.9	2.3	12	n.a.
Turkey	59.6	301	11.0	6.9	18.5	84.2	70	n.a.
United Arab Emirates	1.7	32	0.6	0.4	32.4	70.5	25	n.a.
United Kingdom	57.8	94	26.6	4.0	46.1	2215.0	1,200	1449
United States	256.2	3619	148.1	136.3	57.8	16009.5	10,000	n.a.
Uruguay	3.1	68	0.5	0.4	16.9	5.0	8	101
Venezuela	21.1	352	2.1	1.5	9.9	177.0	16	399
Yugoslavia	10.5	40	1.9	3.8	18.3	0.0	13	n.a.

Sources: World Bank, International Telecommunication Union, Internet Society, TeleGeography, Inc.

International Telephone Traffic

Outgoing mMiTT				Incoming mMiTT			Surplus/(Deficit)	
1992	1993	Change 92-93		1992	1993	Change 92-93	1992	1993
305.9	355.4	16.2%		453.9	510.5	12.5	148.0	155.1
112.7	116.8	3.7%		n.a.	n.a.	n.a.	n.a.	n.a.
181.0	199.3	10.1%		107.5	131.7	22.5%	(73.5)	(67.6)
76.9	89.9	16.9%		68.6	71.3	3.9%	(8.3)	(18.6)
216.5	258.1	19.2%		249.0	304.2	22.2%	32.5	46.1
683.5	625.4	-8.5%	a	1115.0	1370.6	22.9%	431.5	745.2
102.6	125.0	21.8%		n.a.	n.a.	n.a.	n.a.	n.a.
1133.9	1238.2	9.2%	a	1039.0	1163.0	11.9%	(94.9)	(59.2)
189.0	219.0	15.9%	a	n.a.	n.a.	n.a.	n.a.	n.a.
349.0	376.2	7.8%		314.0	322.5	2.7%	(35.0)	(53.7)
44.2	56.5	27.9%		n.a.	305.7	n.a.	n.a.	249.2
32.1	39.0	21.5%		128.1	152.4	19.0%	96.0	113.4
135.8	164.0	20.8%		462.1	n.a.	n.a.	326.3	n.a.
212.7	272.7	28.2%		366.6	431.5	17.7%	153.9	158.8
212.0	232.6	9.7%	a	n.a.	438.2	n.a.	n.a.	205.6
50.7	58.3	15.0%		n.a.	n.a.	n.a.	n.a.	n.a.
175.6	201.0	14.4%		230.7	268	16.2%	55.1	67.0
464.6	447.5	-3.7%		292.1	n.a.	n.a.	(172.5)	n.a.
412.0	480.0	16.5%	c	n.a.	n.a.	n.a.	n.a.	n.a.
46.2	62.8	36.0%		n.a.	n.a.	n.a.	n.a.	n.a.
221.7	255.0	15.0%		250.7	n.a.	n.a.	29.0	n.a.
804.5	846.9	5.3%		847.2	908.4	7.2%	42.7	61.5
17.8	19.5	9.6%		n.a.	65	n.a.	n.a.	45.5
691.0	740.0	7.1%		595.0	630	5.9%	(96.0)	(110.0)
1551.0	1572.0	1.4%		1191.5	1258.7	5.6%	(359.5)	(313.3)
368.7	440.7	19.5%	a,c	484.4	490.8	1.3%	115.7	50.1
132.4	161.8	22.2%	a	212.7	218.7	2.8%	80.3	56.9
68.0	67.0	-1.5%	b	n.a.	n.a.	n.a.	n.a.	n.a.
226.8	264.6	16.7%		560.0	605	8.0%	333.2	340.4
299.0	341.6	14.2%		n.a.	n.a.	n.a.	n.a.	n.a.
2849.0	3130.0	9.9%	c	2789.0	3086	10.7%	(60.0)	(44.0)
10173.6	11461.2	12.7 %	a	5153.9	5392.8	4.6%	(5,019.7)	(6,068.4)
30.2	37.4	23.8%	a	53.0	58	9.4%	22.8	20.6
115.5	133.3	15.4%	a	128.6	148.3	15.3%	13.1	15.0
142.8	181.5	27.1%		n.a.	223.5	n.a.	n.a.	42.0

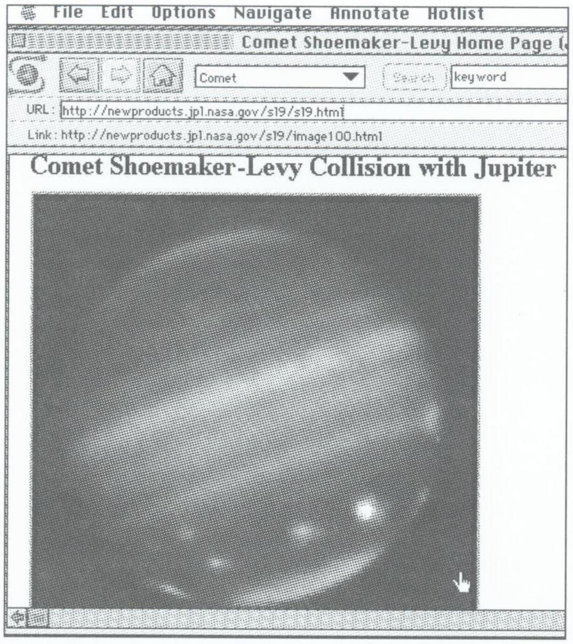
a. MiTT based on billing point of traffic.
b. Year ending 30 September.
c. Year ending 31 March
d. 1992

Source: TeleGeography, Inc.

Notes

Notes

The E-Mail Comet



http://newproducts.jpl.nasa.gov/s19/s19.html

While comet Shoemaker-Levy mounted its fireworks display at Jupiter, another kind of tour de force was underway on a computer in the astronomy department at the University of Maryland. An Internet "exploder"—a system capable of multiplying any incoming electronic mail message hundreds of times and automatically sending the copies to a predetermined mailing list—had linked hundreds of observers in an unprecedented on-line community. "The exploder was one of the greatest things that ever happened to observational astronomy," says planetary scientist Paul Weissman of the Jet Propulsion Laboratory (JPL).

Full participation in the Voyager flybys of the 1980s and in earlier spacecraft encounters, after all, was generally limited to a coterie of scientists. Teams operating each Voyager instrument met daily at JPL in Pasadena, California, to review the latest data and decide what would be released that day to the rest of the planetary science community and the public. For Shoemaker-Levy, that kind of centralization was out of the question. There was no mission control, no project scientist—just hundreds (if not thousands) of astronomers aiming different instruments at Jupiter from around the world.

The flow of information was sure to be freer than during earlier events in planetary science, but it also threatened to be slower—because of the lack of coordination. So last January, astronomers planning to observe the impacts set up the exploder, which ultimately linked about 250 observing groups and theorists. One result was that during impact week, theorists could start puzzling over startling observations almost immediately. For example, when David Rabinowitz and Harold Butner of the Carnegie Institution of Washington, observing from Chile, saw Jupiter's satellite Io redden for 7 minutes during the impact of fragment B, they sent a message to the exploder. In minutes to hours, depending on network traffic, the exploder had dispatched the puzzling news from Chile to everyone else on the mailing list.

Similarly, astronomers preparing to make observations could modify their plans depending on what others had seen. Astronomers waiting for sunset in Arizona, for example, were privy to what their colleagues had just seen from a tiny island in the Indian Ocean, including information on when the impacts were occurring and which filters and exposure worked best.

[A] few theorists trying to make sense of the stream of messages sounded a little wistful for times when the pace was more deliberate. "Its like trying to drink from a fire hose," says Donald Yeomans of JPL. "There's too much to digest before the next message comes in." But Yeomans, who like all scientists prefers a data glut to a shortage, adds: "It's fun."

Excerpted with permission from Richard A. Kerr, "The Comet Explodes by E-Mail," *Science,* vol. 265, 29 July 1994, p. 602. ©AAAS 1994.

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