# TeleGeography 2001

# TeleGeography® 2001

Global Telecommunications Traffic Statistics and Commentary



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# Preface

Global communications—to paraphrase a familiar axiom—is a journey, not a destination. There is no finish line in our industry. Technology continues to evolve rapidly and relentlessly, the players are in a constant state of transformation, and even the rules of competitive engagement are in flux. All of this makes for an extremely exciting trip. But trying to keep abreast of this change and understand where we're headed is a tremendous challenge.

Fortunately, TeleGeography's annual report helps us make some sense out of the industry swirl surrounding us. For 11 years now, this report has been one of the most reliable and comprehensive overviews of the global communications industry—an essential "roadmap" for understanding the journey we're on. It provides accurate profiles of the industry's major carriers and their market shares; Internet backbone maps and rankings; international traffic statistics and analyses; and detailed pricing information. It also helps to clarify and define important industry trends such as deregulation and privatization. In this edition, for the first time, you will find a summary of the minutes-of-use for Voice over IP (VoIP) traffic, a useful addition given the recent growth of this sector and the attention it's getting from end-users, ISPs, data vendors, and existing telecom operators.

As we all know, next generation services like VoIP are a small part of a much larger phenomenon—the explosive growth of the Internet worldwide. Here in the United States, this phenomenon has already firmly taken hold. The U.S. alone accounts for more than 40 percent of current global Internet usage, and our e-commerce spending is expected to reach over $35 billion this year. According to a number of recent reports, however, the biggest growth in Internet usage and spending during the next several years is likely to take place in Europe and Asia-Pacific. For example, Europe is expected to add more new Internet users than any other world region, and Asia-Pacific will experience the most rapid annual growth rate. With those kinds of expectations, it's extremely important to have a solid understanding of the global marketplace, the key players who shape it, and the relationships and alliances that unfold and shift almost daily. Clearly, a report like TeleGeography's will continue to be invaluable.

On behalf of the entire WorldCom family, I am pleased to commend this *TeleGeography 2001* report to your attention. We're proud to sponsor this report and to continue our long-standing support of the annual TeleGeography series—one of the few tools available today that actually makes the often unpredictable global telecommunications journey just a little easier to navigate.

Robert K. Lacy

Vice President
WorldCom International Expansion Support

# Acknowledgements

We wish to thank the numerous carriers, government departments, regulators, and international organizations from around the world who responded to our requests for information. This report would not exist without the help of the dedicated people at these organizations who took the time to ensure that the data reported here are as current and accurate as possible.

We would also like to thank the people who helped review early and final drafts of this book, including: Heidi Harris Bersin, Teddy Chu, Richard Elliott, Kevin Heneghan, Cathy Hsu, Cynthia Hswe, Doug Johnson, Tim Kelly, Robert Luczak, Craig McTaggart, Michael Minges, Nigel Panter, Chris Reid, Don Weightman, Brian Walsh, and Brent Wilkins.

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The Editors

# Executive Summary

The web of supply and demand in the international telecom industry becomes more intricately woven each year. The purpose of the *TeleGeography* annual report is to help readers understand how that web is evolving through careful observation and rigorous reporting. The highlights of this year's edition follow.

**Competition**

As of July 2000, more than 2,800 companies worldwide were authorized to build international telephone networks. Three years before, there were less than 600. Although most of these companies are too small to be noticed, their gross impact on global traffic flows is hard to miss. In total, the facilities-based carriers which started business since 1989 now carry almost a quarter of the world's international call minutes. In places like Hong Kong and Germany, for example—where the incumbents had only lost their monopolies in 1998—new entrants gained more than a third of the international minutes market in just one year.

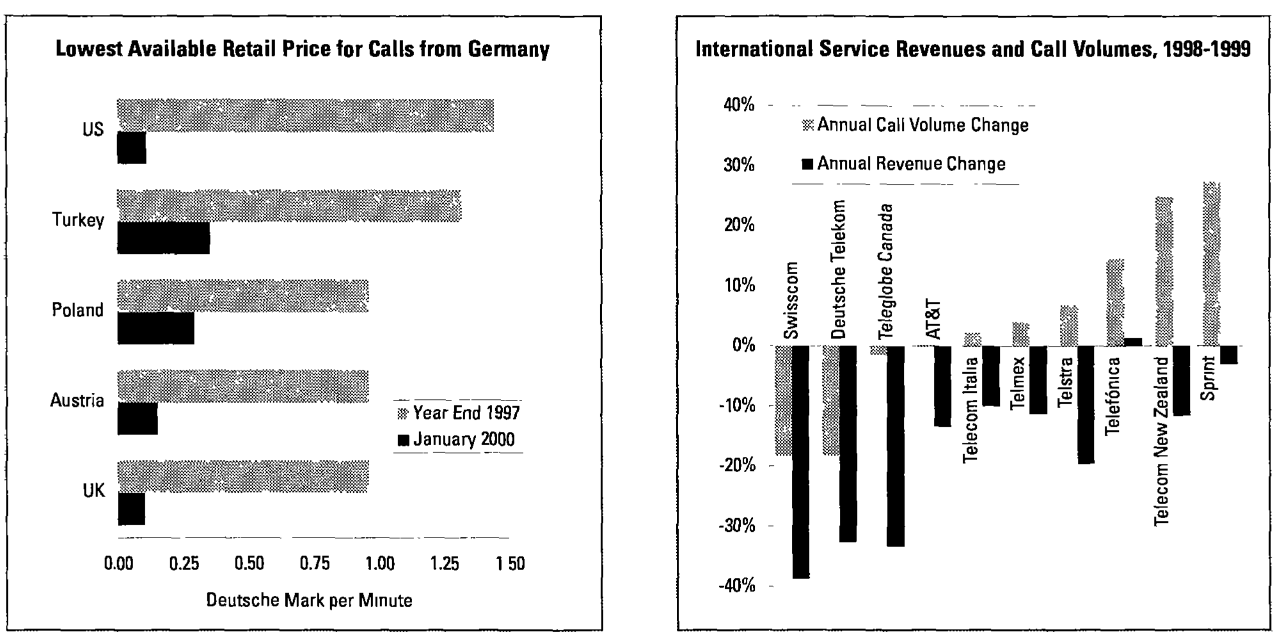
**Pricing**

Prices for international calls are falling fast. Cutthroat competition in the international services industry is providing the incentive—and falling settlement and bandwidth costs the means—for carriers to slash prices. Call prices from parts of recently liberalized Western Europe (e.g., Germany) to many international destinations have fallen 90 percent in just two years. Ironically, the only thing holding up international call prices on many competitive routes is the cost of local interconnection at either end of the call. In the long run, as the settlements regime disintegrates in favor of an interconnection model, we can expect local, domestic long distance, and international consumer prices to converge. Just as we were going to press, the German regulator helped prove the point by permitting Deutsche Telekom to charge just 9 pfennigs (4¢) per minute for calls to the United States—only one pfennig more than a call to the apartment next door.

**Facilities**

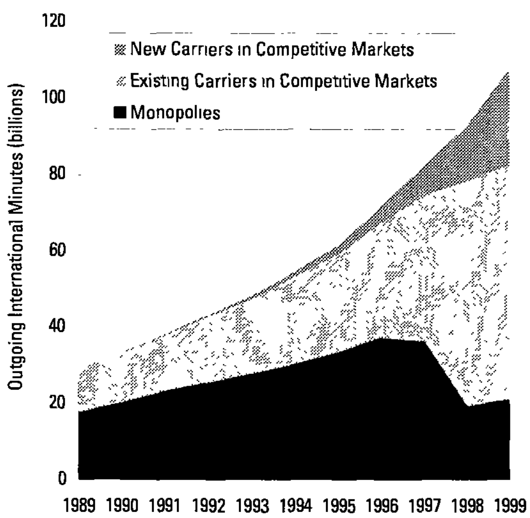
The undersea bandwidth boom reached an unprecedented single-year growth rate in 2000. Submarine cables installed in 2000 increased aggregated trans-Atlantic bandwidth by a factor of 12 in just one year, to over two terabits per second. And while huge growth rates in long-haul capacity have been standard fare for the latter half of this decade, bandwidth at the edges—in the metropolitan area network (MAN)—has been in short supply until recently. This short-

**Figure 1. Falling Prices, Falling Revenue**




Source: Regierungsbehörde für Telekommunikation und Post (RegTP), company reports, TeleGeography research © TeleGeography, Inc. 2000

**Figure 2. Top Carriers and Competition**




**The Top 10 International Carriers**

| Rank | Company (Country) | Outgoing Traffic (millions of minutes) 1998 | 1999 |
|---|---|---|---|
| 1. | AT&T (U.S.) | 10,798.5 | 10,816.5 |
| 2. | WorldCom (U.S.) | 7,195.0 | 8,294.9 |
| 3. | France Télécom (France) | 3,911.0 | 4,390.0 |
| 4. | BT (U.K.) | 4,249.3 | 4,029.1 |
| 5. | Deutsche Telekom (Germany) | 4,711.0 | 3,860.0 |
| 6. | Sprint (U.S.) | 2,916.0 | 3,714.4 |
| 7. | C&W Com. (U.K.) | 2,646.2 | 3,177.0 |
| 8. | Telecom Italia (Italy) | 2,339.4 | 2,390.6 |
| 9. | Swisscom (Switzerland) | 2,258.0 | 2,259.0 |
| 10. | China Telecom (China) | 1,711.5 | 1,950.0 |
| | Top 10 Total | 42,735.9 | 44,881.5 |
| | **Global Total** | **93,350.0** | **107,800.0** |

Source: TeleGeography research



age sparked a MAN building boom—first in the U.S. and then in Europe. In most international business cities, at least three (and often more) networks are being constructed, creating a unprecedented capacity infrastructure filled with many hundreds of fiber pairs.

### Internet Backbones

So what is filling up all this new capacity? Although people do make more phone calls each year, much new bandwidth is being devoured by hungry Internet service providers (ISPs). In 2000, ISPs began to take advantage of the fiber explosion, and some upgraded their international backbone connections from 155 Mbps to 2.5 Gbps (or 2,500 Mbps). This led to a tripling or quadrupling of bandwidth on many routes, especially those connecting North America to Europe (13 to 56 Gbps) and to Asia (6 to 20 Gbps).

### Traffic Flows

International telephone traffic grew by over 15 percent in 1999, to 107.8 billion minutes, fueled by falling prices and the mobile phone boom in Europe and Asia. Call volume grew especially rapidly in Western Europe, where new carriers piled into recently liberalized markets, and where mobile operators added 75 million customers. International traffic from countries such as the Netherlands and Germany, which had been growing at five percent or less in 1996 and 1997, increased by 14 to 18 percent in 1999. Nevertheless, demand did not grow fast enough to compensate for the steep drop in prices, as many carriers, including Telstra, Sprint, and Telmex, reported increased call volumes, but lower revenues from international calls.

Mobile phones played an increasingly important role in international telephone traffic in 1999—approximately 11.5 percent of international calls were placed from mobile phones. Almost two-thirds of this traffic was generated in Europe, where cross-border roaming contributed substantially to international call volumes. Swisscom, for example, reported that mobiles originated one-third of outbound international calls in 1999.

Voice over Internet Protocol (VoIP) traffic began to have an appreciable impact on international call volumes in 1999. Total international VoIP traffic grew more than tenfold, to approximately 1.7 billion minutes. Although VoIP accounted for only approximately 1.6 percent of total international traffic in 1999, it had a disproportionate impact on some routes, particularly from the U.S. to developing countries. The largest route for international VoIP, by far, is from the U.S. to Mexico. In 1999, calls between these two countries accounted for nearly 30 percent of all international VoIP minutes.

### Conclusion

This year's edition of *TeleGeography*—the most comprehensive yet—expands on the points above with a collection of 15 topical essays and over 250 statistical tables and charts. Like the markets we cover, however, the form and function of TeleGeography are evolving. We welcome your questions, comments, and criticisms to help improve future editions. Please send your correspondence to the coordinates listed on the title page of this book.

# Carriers

# The Growth of International Services Competition

### Sixty Percent Growth in Competition

As of July 2000, more than 2,800 companies worldwide were authorized to build facilities to offer international telephone service. Three years before, there were less than 600 (see Figure 1. The International Carrier Boom). In the fastest growing markets (the U.S. and Western Europe), the pace is not likely to slow down, even in the face of the recent stock market slide. One might assume that closing the door to international capital would impede new entrants. But many new carriers do not own extensive submarine cable capacity and switching assets, so their start-up costs can be minimal. In the U.S. especially, the hundreds of small companies that are authorized to own networks may never build them.

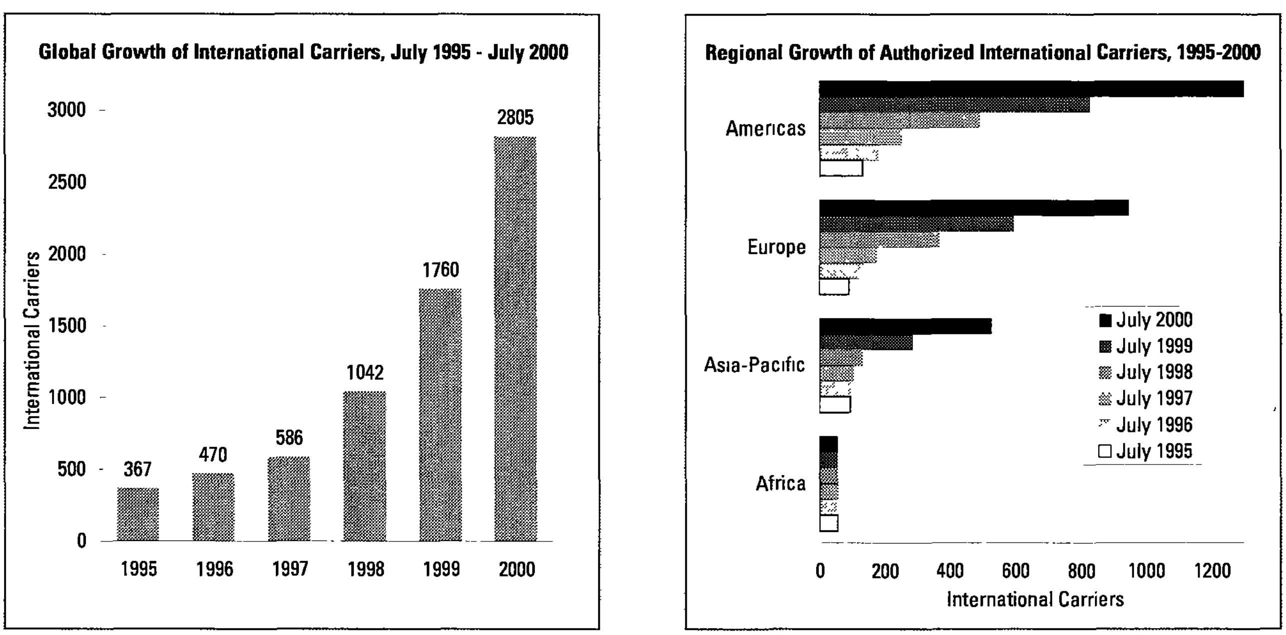
Nonetheless, a handful of carriers have built new networks, and they have collectively chipped away at incumbent market shares. In total, the facilities-based carriers which started business since 1989 now carry almost a quarter of the world's international telephone traffic (see the "Overview of International Traffic Trends" in the Traffic Analysis section below).

The relationship between the network builders and the swarm of "virtual" carriers—which repackage the facilities and services of network builders—is one of symbiosis. New market entrants, while they represent a competitive threat, can also be the incumbent's best customers. And, in some cases, new specialist wholesale carriers are serving up their facilities in the other direction—to established carriers that are encumbered by marketing expenses and bureaucratic processes.

### The New Breed of Virtual Carrier

Both facilities-based and virtual carriers alike are always on the hunt for new ways to cut prices without shrinking profit margins. The latest development in alternative traffic routing is creating a new kind of packet-switched symbiosis. Once the network builders determine how to send commercial grade traffic on IP networks reliably and to devise a way to settle accounts properly, the ranks of international carriers will swell even more rapidly. Indeed, IP connectivity may lead to unregulated international carriers on virtually every street corner, in every corner of the world.

**Figure 1. The International Carrier Boom**




Note: Figures include all carriers authorized to provide international facilities-based service or international simple resale (ISR).

Source: TeleGeography research

## Figure 2. Countries with International Telephone Service Competition

| | | Number of Authorized International Carriers | | | | | |
|---|---|---|---|---|---|---|---|
| Rank | Country | July 2000 | July 1999 | July 1998 | July 1997 | July 1996 | July 1995 |
| 1 | United States | 1,100 | 679 | 393 | 175 | 115 | 65 |
| 2 | United Kingdom | 306 | 215 | 144 | 100 | 65 | 35 |
| 3 | Hong Kong | 150 | 80 | 4 | 1 | 1 | 1 |
| 4 | Japan | 115 | 50 | 13 | 3 | 3 | 3 |
| 5 | Germany | 90 | 40 | 32 | 1 | 1 | 1 |
| 6 | France | 89 | 50 | 29 | 1 | 1 | 1 |
| 7 | Canada | 75 | 49 | 21 | 21 | 19 | 18 |
| 8 | Netherlands | 60 | 30 | 23 | 3 | 1 | 1 |
| 9 | Italy | 52 | 15 | 9 | 1 | 1 | 1 |
| 10 | Switzerland | 50 | 40 | 21 | 1 | 1 | 1 |
| 11 | Denmark | 45 | 18 | 11 | 9 | 7 | 1 |
| 12 | Australia | 40 | 28 | 14 | 10 | 8 | 8 |
| 13 | Austria | 40 | 17 | 13 | 1 | 1 | 1 |
| 14 | Ireland | 40 | 25 | 5 | 3 | 3 | 1 |
| 15 | Korea, Rep. | 40 | 24 | 3 | 2 | 2 | 2 |
| 16 | Singapore | 40 | 1 | 1 | 1 | 1 | 1 |
| 17 | Norway | 35 | 14 | 7 | 1 | 1 | 1 |
| 18 | Russia* | 30 | 30 | 1 | 1 | 1 | 1 |
| 19 | Spain | 30 | 16 | 9 | 1 | 1 | 1 |
| 20 | Sweden | 26 | 16 | 13 | 11 | 9 | 7 |
| 21 | Belgium | 21 | 18 | 11 | 1 | 1 | 1 |
| 22 | New Zealand | 21 | 19 | 11 | 9 | 9 | 2 |
| 23 | Finland | 20 | 8 | 8 | 8 | 8 | 5 |
| 24 | Peru | 19 | 18 | 1 | 1 | 1 | 1 |
| 25 | Mexico | 16 | 16 | 15 | 9 | 1 | 1 |
| 26 | Portugal | 15 | 1 | 1 | 1 | 1 | 1 |
| 27 | Philippines | 12 | 12 | 12 | 9 | 9 | 9 |
| 28 | Chile | 10 | 10 | 9 | 9 | 9 | 9 |
| 29 | El Salvador | 10 | 10 | 10 | 1 | 1 | 1 |
| 30 | Luxembourg | 10 | 4 | 1 | 1 | 1 | 1 |
| 31 | Taiwan | 10 | 1 | 1 | 1 | 1 | 1 |
| 32 | Iceland | 8 | 3 | 1 | 1 | 1 | 1 |
| 33 | Malaysia | 5 | 5 | 5 | 5 | 5 | 4 |
| 34 | Argentina | 4 | 2 | 1 | 1 | 1 | 1 |
| 35 | Colombia | 3 | 3 | 3 | 1 | 1 | 1 |
| 36 | Dominican Rep. | 3 | 3 | 3 | 3 | 3 | 3 |
| 37 | Israel | 3 | 3 | 3 | 3 | 1 | 1 |
| 38 | Kazakhstan | 3 | 3 | 3 | 1 | 1 | 1 |
| 39 | Ecuador | 3 | 3 | 3 | 3 | 1 | 1 |
| 40 | Bermuda | 2 | 2 | 2 | 2 | 2 | 1 |
| 41 | Brazil | 2 | 2 | 1 | 1 | 1 | 1 |
| 42 | Brunei | 2 | 2 | 2 | 2 | 2 | 2 |
| 43 | China | 2 | 2 | 2 | 2 | 2 | 2 |
| 44 | Dominica | 2 | 2 | 1 | 1 | 1 | 1 |
| 45 | Georgia | 2 | 2 | 1 | 1 | 1 | 1 |
| 46 | Guatemala | 2 | 2 | 1 | 1 | 1 | 1 |
| 47 | Indonesia | 2 | 2 | 2 | 2 | 2 | 2 |
| 48 | Nepal | 2 | 1 | 1 | 1 | 1 | 1 |
| 49 | Ukraine | 2 | 2 | 2 | 2 | 2 | 2 |

Note: Figures include all carriers authorized to provide facilities-based international service or international simple resale as of July 1 for each year.

* Estimates include Russian carriers authorized to provide service only in certain municipalities.

Source: TeleGeography research

# Market Shares of International Carriers

| | Percentage of Outgoing Minutes | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Country/Carrier** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
| **Australia** | | | | | | | | | | | |
| Telstra | | | 100.0 | 98.0 | 87.0 | 76.3 | 73.4 | 62.0 | 55.0 | 49.0 | 49.5 |
| C&W Optus | | | | 2.0 | 13.0 | 21.9 | 23.4 | 27.0 | 26.0 | 22.0 | 21.9 |
| AAPT | | | | | | | | | 11.0 | 13.4 | 13.6 |
| Primus | | | | | | | | | 3.0 | 4.0 | 5.0 |
| Teleglobe | | | | | | | | | | 4.4 | 4.4 |
| Others | | | | | | 1.8 | 3.2 | 11.0 | 5.0 | 7.2 | 5.6 |
| **Austria** | | | | | | | | | | | |
| Telekom Austria | | | | | | | | | 100.0 | 95.0 | 80.0 |
| UTA Telekom | | | | | | | | | | 1.5 | 6.0 |
| Tele2 | | | | | | | | | | | 5.0 |
| tele.ring | | | | | | | | | | | 3.0 |
| Others | | | | | | | | | | 3.5 | 6.0 |
| **Belgium** | | | | | | | | | | | |
| Belgacom | | | | | | | | | 100.0 | 87.0 | 81.0 |
| Others | | | | | | | | | | 13.0 | 19.0 |
| **Canada *** | | | | | | | | | | | |
| Stentor | 71.0 | 70.0 | 70.0 | 69.0 | 66.0 | 54.0 | 44.0 | 44.0 | 41.0 | 40.0 | n.a. |
| Bell Canada | | | | | | | | | | | 23.0 |
| Teleglobe | 29.0 | 30.0 | 30.0 | 31.0 | 29.0 | 33.0 | 30.0 | 23.0 | 26.0 | 24.0 | 20.0 |
| Sprint Canada | | | | | | | 15.0 | 21.0 | 17.0 | 18.0 | 20.0 |
| AT&T Canada | | | | | 1.0 | 5.0 | 8.0 | 9.0 | 10.0 | 14.0 | 9.0 |
| Primus | | | | | | | | | | | 9.0 |
| Telus | | | | | | | | | | | 6.0 |
| Others | | | | | 4.0 | 8.0 | 3.0 | 3.0 | 5.0 | 4.0 | 13.0 |
| **Chile *** | | | | | | | | | | | |
| CTC Mundo/Globus | | | | <1.0 | 17.5 | 31.2 | 31.0 | 31.5 | 33.0 | 35.0 | 33.0 |
| ENTEL Chile | | | 100.0 | 80.0 | 57.5 | 40.0 | 40.6 | 37.3 | 33.0 | 31.0 | 31.0 |
| Chile Sat | | | | 20.0 | 25.0 | 19.7 | 19.4 | 15.2 | 17.0 | 13.0 | 15.0 |
| BellSouth Chile | | | | | | 6.6 | 6.8 | 10.0 | 10.0 | 10.0 | 10.0 |
| AT&T (FirstCom) | | | | | | 1.2 | <1.0 | 2.8 | 3.0 | 5.0 | 3.0 |
| TransAm | | | | | | <1.0 | <1.0 | 2.8 | 3.0 | 3.0 | 3.0 |
| Others | | | | | | <1.0 | <1.0 | <1.0 | <1.0 | 3.0 | 5.0 |
| **Denmark** | | | | | | | | | | | |
| Tele Danmark | | | | | | | 100.0 | 92.5 | 84.4 | 67.5 | 55.3 |
| Tele2 | | | | | | | | 4.0 | 6.6 | 12.4 | 13.2 |
| Telia Danmark | | | | | | | | 3.5 | 6.3 | 9.9 | 10.7 |
| Global One | | | | | | | | | | | 6.6 |
| RSL Com | | | | | | | | | | | 3.7 |
| Interoute | | | | | | | | | | | 3.7 |
| Teleglobe | | | | | | | | | | | 3.1 |
| Others | | | | | | | | | 2.7 | 10.3 | 3.7 |
| **Dominican Republic** | | | | | | | | | | | |
| Codetel | | | | 100.0 | >90.0 | 85.8 | 83.0 | 77.0 | 73.8 | 72.2 | 78.1 |
| Tricom | | | | | n.a. | 6.7 | 7.5 | 12.8 | 12.9 | 15.5 | 14.2 |
| AACR | | | | | n.a. | 7.5 | 9.5 | 10.2 | 13.3 | 12.3 | 7.7 |

Notes:

Data based on outgoing international traffic for the public switched network and International Simple Resale (ISR) covering the full calendar or fiscal year. Some data aggregated in "Others" rows include market shares for carriers shown individually in later years. Market shares may not total to 100 percent due to rounding.

* Canada: The Stentor alliance, which was dissolved in 1999, included Bell Canada, Telus, MTS, SaskTel, and Aliant. BCE, the parent company of Bell Canada, announced the purchase of Teleglobe in February 2000. Until October 1998, Teleglobe held a monopoly on all non-U.S. routes. Sprint Canada market shares include traffic carried by Fonorola, which merged with Sprint Canada in 1998. AT&T Canada market shares include ACC traffic prior to 1999 merger. Primus acquired the consumer division of AT&T Canada in May 1999.

* Chile: CTC Mundo/Globus market shares prior to 1998 merger aggregate CTC Mundo and Globus (formerly VTR) traffic.

Source: TeleGeography research

| | | | | | Percentage of Outgoing Minutes | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Country/Carrier** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
| **El Salvador** | | | | | | | | | | | |
| CTE Antel Telecom | | | | | | | | | 100.0 | 91.5 | 85.0 |
| Telefónica de El Salvador | | | | | | | | | | | 7.0 |
| Teleglobe | | | | | | | | | | | 6.0 |
| Others | | | | | | | | | | 8.5 | 2.0 |
| **Finland** | | | | | | | | | | | |
| Sonera | | | | | 100.0 | 90.0 | 72.8 | 66.0 | 58.9 | 54.7 | 53.0 |
| Finnet International | | | | | | 5.0 | 19.1 | 24.2 | 28.2 | 28.0 | 25.7 |
| Telia Finland | | | | | | 3.0 | 7.7 | 8.8 | 9.3 | 12.0 | 8.6 |
| RSL Com | | | | | | | | | | | 5.6 |
| Others | | | | | | 2.0 | 0.4 | 0.9 | 3.5 | 5.2 | 7.1 |
| **France** | | | | | | | | | | | |
| France Télécom | | | | | | | | | 100.0 | 93.0 | 88.7 |
| Teleglobe | | | | | | | | | | 3.6 | 4.6 |
| Cegetel | | | | | | | | | | 1.9 | 4.0 |
| Others | | | | | | | | | | <1.0 | 2.7 |
| **Germany *** | | | | | | | | | | | |
| Deutsche Telekom | | | | | | | | | 100.0 | 80.3 | 55.4 |
| Mannesmann | | | | | | | | | | 7.2 | 13.1 |
| WorldCom | | | | | | | | | | 1.8 | 4.9 |
| Viag Interkom | | | | | | | | | | 1.4 | 3.9 |
| Teleglobe | | | | | | | | | | 1.8 | 2.4 |
| RSL Com | | | | | | | | | | | 2.3 |
| Others | | | | | | | | | | 7.5 | 18.0 |
| **Hong Kong *** | | | | | | | | | | | |
| C&W Hong Kong Telecom | | | | | | | | | 100.0 | 90.0 | 61.3 |
| New World Telephone | | | | | | | | | | 2.0 | 14.3 |
| New T&T Hong Kong | | | | | | | | | | 2.0 | 12.0 |
| Teleglobe | | | | | | | | | | | 5.1 |
| Others | | | | | | | | | | 6.0 | 7.3 |
| **Indonesia** | | | | | | | | | | | |
| PT Indosat | | | | | 100.0 | 99.5 | 95.4 | 88.5 | 84.8 | 88.3 | 86.5 |
| PT Satelindo | | | | | | 0.5 | 4.6 | 11.5 | 15.2 | 11.7 | 13.5 |
| **Ireland** | | | | | | | | | | | |
| Eircom | | | | | | | | 100.0 | 91.0 | 78.0 | 74.0 |
| Esat Telecommunications | | | | | | | | | 5.0 | 8.0 | 11.0 |
| WorldCom | | | | | | | | | 3.0 | 3.0 | 3.0 |
| Others | | | | | | | | | 1.0 | 11.0 | 12.0 |
| **Israel** | | | | | | | | | | | |
| Bezeq | | | | | | | | 100.0 | 72.5 | 51.4 | 45.9 |
| Barak ITC | | | | | | | | | 15.0 | 24.8 | 30.0 |
| Golden Lines | | | | | | | | | 12.5 | 23.7 | 24.1 |
| **Italy** | | | | | | | | | | | |
| Telecom Italia | | | | | | | | | 100.0 | 88.6 | 77.1 |
| Infostrada | | | | | | | | | | 4.5 | 8.4 |
| Teleglobe | | | | | | | | | | 3.8 | 4.2 |
| Albacom | | | | | | | | | | 1.0 | 1.6 |
| Wind Telecomunicazioni | | | | | | | | | | | 1.6 |
| Others | | | | | | | | | | 2.0 | 7.1 |

Notes:

* Germany: Mannesmann market shares include international traffic carried by mobile operator Mannesmann Mobilfunk and the long distance carriers Mannesmann ARCOR and o.tel o

* Hong Kong: C&W Hong Kong Telecom was acquired by Pacific Century CyberWorks in August 2000.

Source: TeleGeography research

# Market Shares of International Carriers (continued)

| Country/Carrier | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Percentage of Outgoing Minutes | | | | | | | | | | |
| **Japan *** | | | | | | | | | | | |
| KDD | 93.3 | 88.0 | 73.3 | 69.7 | 66.9 | 66.3 | 66.2 | 63.9 | 62.7 | 58.0 | 51.1 |
| C&W IDC | 3.7 | 6.5 | 13.3 | 15.3 | 16.9 | 17.3 | 17.3 | 18.7 | 18.4 | 18.2 | 17.5 |
| Japan Telecom | 3.0 | 5.5 | 13.4 | 15.0 | 16.2 | 16.4 | 16.5 | 17.5 | 19.0 | 18.3 | 17.4 |
| Teleglobe | | | | | | | | | | | 3.2 |
| NTT | | | | | | | | | | | 1.2 |
| Others | | | | | | | | | | 5.5 | 9.6 |
| **Korea, Rep.** | | | | | | | | | | | |
| Korea Telecom | | | 100.0 | 79.9 | 74.5 | 68.7 | 72.6 | 73.5 | 69.0 | 66.6 | 59.5 |
| DACOM | | | | 20.1 | 25.5 | 31.3 | 27.4 | 26.5 | 27.0 | 21.9 | 24.7 |
| Onse | | | | | | | | | 4.0 | 11.5 | 15.8 |
| **Malaysia *** | | | | | | | | | | | |
| Telekom Malaysia | | | | | | | 100.0 | 90.0 | 80.0 | 77.0 | 58.5 |
| Celcom | | | | | | | | 8.0 | 11.0 | 10.0 | 14.5 |
| Maxis | | | | | | | | | | 7.6 | 11.2 |
| TIME Telekom | | | | | | | | | | 5.0 | 8.7 |
| Digi | | | | | | | | | | | 7.2 |
| Others | | | | | | | | 2.0 | 9.0 | <1.0 | n.a. |
| **Mexico** | | | | | | | | | | | |
| Telmex | | | | | | | | 100.0 | 83.0 | 78.0 | 68.0 |
| Alestra | | | | | | | | | 8.5 | 10.5 | 16.0 |
| Avantel | | | | | | | | | 7.5 | 8.5 | 10.0 |
| Teleglobe | | | | | | | | | | | 2.0 |
| Protel | | | | | | | | | | 1.0 | 1.0 |
| Iusacell | | | | | | | | | | | 1.0 |
| Others | | | | | | | | | 1.0 | 2.0 | 2.0 |
| **Netherlands** | | | | | | | | | | | |
| PTT Telecom (KPN) | | | | | | | | 100.0 | 95.0 | 84.9 | 75.6 |
| RSL Com | | | | | | | | | | | 3.0 |
| EnerTel | | | | | | | | | 2.0 | 2.0 | 2.5 |
| Teleglobe | | | | | | | | | | | 1.6 |
| Others | | | | | | | | | 3.0 | 13.3 | 17.3 |
| **New Zealand** | | | | | | | | | | | |
| Telecom N. Zealand | 100.0 | 92.0 | 82.0 | 80.0 | 78.4 | 74.8 | 78.0 | 78.2 | 74.6 | 77.5 | 72.5 |
| CLEAR | | 8.0 | 18.0 | 20.0 | 21.6 | 25.2 | 22.0 | 19.8 | 20.2 | 12.3 | 17.9 |
| Teleglobe | | | | | | | | | | 6.9 | 6.2 |
| Others | | | | | | | | 2.0 | 5.2 | 3.3 | 3.4 |
| **Norway** | | | | | | | | | | | |
| Telenor | | | | | | | | | 100.0 | 93.5 | 73.0 |
| Tele2 Norge | | | | | | | | | | | 7.0 |
| World Access | | | | | | | | | | | 6.0 |
| Telia | | | | | | | | | | 5.0 | 5.0 |
| Others | | | | | | | | | | 1.5 | 9.0 |

Notes:

* Japan: Japan Telecom market shares include ITJ prior to 1997 merger.

* Malaysia: Binariang changed its name to Maxis Communications in 1999.

Source: TeleGeography research

| | Percentage of Outgoing Minutes | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Country/Carrier** | **1989** | **1990** | **1991** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** |
| **Philippines *** | | | | | | | | | | | |
| PLDT | | | 100.0 | 91.6 | 84.2 | 69.0 | 68.0 | 79.0 | 73.0 | 69.0 | 59.2 |
| Globe Telecom | | | | | | | | 2.0 | 7.0 | 8.6 | 17.6 |
| Digitel | | | | | | | | 2.0 | 3.0 | 4.3 | 5.8 |
| Bayan Tel | | | | | | | <1.0 | 4.0 | 5.0 | 5.7 | 5.5 |
| Capitol Wireless | | | | | | <1.0 | <1.0 | 1.0 | 1.0 | 3.5 | 4.6 |
| Eastern | | | | | | 7.0 | 6.0 | 5.0 | 7.0 | 6.4 | 4.0 |
| Philippine Global Com. | | | | 8.4 | 15.8 | 23.0 | 23.0 | 6.0 | 3.0 | 1.1 | 1.8 |
| Islacom | | | | | | | | <1.0 | <1.0 | <1.0 | 1.4 |
| Others | | | | | | | | | | <1.0 | <1.0 |
| **Spain** | | | | | | | | | | | |
| Telefónica | | | | | | | | | 100.0 | 90.5 | 86.0 |
| Retevisión | | | | | | | | | | 4.5 | 7.0 |
| Teleglobe | | | | | | | | | | | 2.5 |
| Lince | | | | | | | | | | | 2.5 |
| Others | | | | | | | | | | 5.0 | 2.0 |
| **Sweden** | | | | | | | | | | | |
| Telia | | | | 100.0 | 92.0 | 87.0 | 76.0 | 69.0 | 66.0 | 62.0 | 53.0 |
| Tele2 | | | | | 8.0 | 13.0 | 21.0 | 22.0 | 22.0 | 24.0 | 18.0 |
| RSL Com | | | | | | | | | | | 8.0 |
| Telenordia | | | | | | | | | | | 7.0 |
| World Access | | | | | | | | | | | 4.0 |
| WorldCom | | | | | | | | | | | 4.0 |
| Teleglobe | | | | | | | | | | | 2.0 |
| Others | | | | | | | 3.0 | 9.0 | 12.0 | 14.0 | 4.0 |
| **Switzerland** | | | | | | | | | | | |
| Swisscom | | | | | | | | | 100.0 | 93.5 | 82.7 |
| diAx | | | | | | | | | | 0.7 | 6.7 |
| Sunrise | | | | | | | | | | 3.0 | 5.1 |
| Others | | | | | | | | | | 2.8 | 5.5 |
| **United Kingdom *** | | | | | | | | | | | |
| BT | 91.0 | 86.0 | 81.0 | 76.8 | 74.2 | 68.6 | 67.7 | 60.0 | 54.9 | 51.6 | 39.7 |
| C&W Com. | 9.0 | 14.0 | 19.0 | 23.2 | 24.0 | 28.1 | 25.8 | 26.8 | 30.3 | 32.2 | 31.3 |
| WorldCom | | | | | | | | 6.6 | 5.1 | 5.1 | 10.0 |
| Teleglobe | | | | | | | | | | 4.2 | 4.8 |
| RSL Com | | | | | | | | | | | 3.0 |
| WorldxChange | | | | | | | | 3.0 | 3.6 | 3.0 | 2.0 |
| Global One | | | | | | | | 3.1 | 1.5 | 1.5 | 2.0 |
| Others | | | | | 1.8 | 3.3 | 6.5 | <1.0 | 4.6 | 2.2 | 7.2 |
| **United States *** | | | | | | | | | | | |
| AT&T | 83.3 | 78.4 | 74.8 | 70.3 | 62.2 | 60.1 | 54.3 | 50.2 | 44.7 | 39.6 | 36.5 |
| WorldCom | 10.2 | 14.6 | 17.8 | 21.2 | 25.4 | 28.6 | 32.0 | 32.9 | 31.2 | 28.8 | 28.0 |
| Sprint | 5.8 | 6.4 | 6.3 | 7.3 | 10.3 | 11.1 | 11.3 | 13.2 | 12.0 | 11.7 | 12.5 |
| Teleglobe USA | | | | | | | | | 1.3 | 3.3 | 5.7 |
| World Access | | | | | | | | | 1.0 | 2.7 | 3.8 |
| Viatel | | | | | | | | | 0.3 | 0.8 | 3.0 |
| Primus | | | | | | | | | 0.3 | 0.5 | 2.9 |
| STAR Telecom. | | | | | | | | | 0.5 | 1.8 | 2.7 |
| Others | 0.7 | 0.7 | 1.1 | 1.2 | 2.1 | 0.2 | 2.4 | 3.7 | 8.7 | 10.8 | 4.9 |

Notes:

* Philippines: PLDT market shares include Smart Communications traffic prior to 1999 acquisition.

* United Kingdom: The figures for Cable & Wireless Communications reflect data for Mercury prior to its April 1997 merger with Bell Cablemedia, Videotron, and NYNEX CableComms. WorldxChange market shares include ACC Long Distance U.K. traffic prior to 1999 acquisition.

* United States: Market shares for U.S. carriers prior to 1993 exclude traffic to Canada and Mexico. WorldCom market shares prior to 1998 merger aggregate MCI and WorldCom traffic. World Access market shares include FaciliCom traffic prior to 1999 merger. In February 2000, World Access announced agreements to acquire STAR and WorldxChange. Viatel traffic includes Destia, which was acquired by Viatel in November 1999.

Source: TeleGeography research

# The Top 40 International Carriers

| Rank | Company | Origin Country | Outgoing Traffic (millions of minutes) 1999 | 1998 | Change 98-99 | 1999 Revenue (US$ billions) Total | Int'l Service |
|---|---|---|---|---|---|---|---|
| 1. | AT&T (a) | U.S. | 10,816.5 | 10,798.5 | 0.2% | $62.6 | $4.9 |
| 2. | WorldCom (a) | U.S. | 8,294.9 | 7,195.0 | 15.3% | $37.1 | $3.5 |
| 3. | France Télécom | France | 4,390.0 | 3,911.0 | 12.2% | $29.0 | $1.3 |
| 4. | BT (b) | U.K. | 4,029.1 | 4,249.3 | -5.2% | $35.3 | $2.0 (est.) |
| 5. | Deutsche Telekom (a) | Germany | 3,860.0 | 4,711.0 | -18.1% | $37.8 | $1.5 |
| 6. | Sprint (a) | U.S. | 3,714.4 | 2,916.0 | 27.4% | $19.9 | $0.8 |
| 7. | C&W Com. (a, b) | U.K. | 3,177.0 | 2,646.2 | 20.1% | $3.0 | $1.1 (est.) |
| 8. | Telecom Italia (a) | Italy | 2,390.6 | 2,339.4 | 2.2% | $33.9 | $1.4 |
| 9. | Swisscom | Switzerland | 2,259.0 | 2,258.0 | 0.0% | $7.4 | $0.5 |
| 10. | China Telecom | China | 1,950.0 | 1,711.5 | 13.9% | $33.7 | $2.0 (est.) |
| 11. | Teleglobe USA (a) | U.S. | 1,679.7 | 830.3 | 102.3% | $2.9 | $0.1 |
| 12. | C&W Hong Kong (a, b) | Hong Kong | 1,668.3 | 1,681.6 | -0.8% | $3.6 | $1.4 |
| 13. | Telefónica (a) | Spain | 1,665.0 | 1,518.0 | 9.7% | $24.5 | $0.8 |
| 14. | PTT Telecom (KPN) (a) | Netherlands | 1,625.0 | 1,600.0 | 1.6% | $8.6 | $1.7 |
| 15. | Singapore Telecom (a, b) | Singapore | 1,350.0 | 1,235.0 | 9.3% | $2.9 | $1.0 |
| 16. | Bell Canada | Canada | 1,305.0 | 1,350.0 | -3.3% | $12.6 | $0.3 (est.) |
| 17. | Belgacom (a) | Belgium | 1,288.0 | 1,271.0 | 1.3% | $4.9 | $0.6 |
| 18. | Teleglobe (a) | Canada | 1,130.0 | 1,145.0 | -1.3% | $2.9 | $0.4 |
| 19. | Sprint Canada | Canada | 1,130.0 | 865.0 | 30.6% | $19.9 | $0.4 (est.) |
| 20. | World Access (a) | U.S. | 1,129.5 | 678.8 | 66.4% | $0.5 | $0.1 |
| 21. | Telekom Austria (a) | Austria | 1,080.0 | 1,100.0 | -1.8% | $4.0 | $0.2 (est.) |
| 22. | Telmex (a) | Mexico | 1,063.1 | 1,022.8 | 3.9% | $10.1 | $1.2 |
| 23. | Saudi Telecom | Saudi Arabia | 1,060.0 | 932.6 | 13.7% | $4.0 (est.) | $0.2 (est.) |
| 24. | Telstra (b) | Australia | 1,046.0 | 836.0 | 25.1% | $12.5 | $0.6 |
| 25. | WorldCom U.K. (a, b) | U.K. | 1,015.0 | 425.0 | 138.8% | $37.1 | $0.4 (est.) |
| 26. | KDD (a) | Japan | 1,000.0 | 1,100.0 | -9.1% | $5.4 | $1.5 |
| 27. | Etisalat | U.A.E. | 963.0 | 874.8 | 10.1% | $1.7 | $0.2 (est.) |
| 28. | Chunghwa Telecom | Taiwan | 949.3 | 862.0 | 10.1% | $6.4 | $0.6 (est.) |
| 29. | Rostelecom (a) | Russia | 928.2 | 1,038.3 | -10.6% | $0.9 | $0.6 |
| 30. | Mannesmann | Germany | 915.0 | 425.0 | 115.3% | $9.7 | $0.3 (est.) |
| 31. | Viatel (a) | U.S. | 901.6 | 202.3 | 345.6% | $0.2 | < $0.1 |
| 32. | Primus (a) | U.S. | 868.5 | 124.9 | 595.4% | $0.8 | $0.1 |
| 33. | STAR Telecom. (a) | U.S. | 785.8 | 457.4 | 71.8% | $1.1 | < $0.1 |
| 34. | Eircom (a, b) | Ireland | 749.1 | 613.0 | 22.2% | $2.0 | $0.1 |
| 35. | OTE | Greece | 725.7 | 681.3 | 6.5% | $2.0 | $0.6 |
| 36. | Telia | Sweden | 725.0 | 750.0 | -3.3% | $6.3 | $0.3 |
| 37. | Turk Telekomunikasyon | Turkey | 698.4 | 644.1 | 8.4% | $3.7 | $0.2 (est.) |
| 38. | Telekomunikacja Polska | Poland | 624.0 | 602.4 | 3.6% | $3.3 | $0.2 (est.) |
| 39. | Telecom New Zealand (b) | New Zealand | 590.6 | 473.3 | 24.8% | $2.2 | $0.2 |
| 40. | Embratel (a) | Brazil | 574.8 | 545.8 | 5.3% | $3.1 | $1.0 |

Note: Traffic figures are for public switched telephone network (PSTN) circuits only (service resale is excluded). Data for U.S. and U.K carriers include International Simple Resale (ISR). Carrier rankings based on originating country minutes only; when based on the aggregated traffic of all subsidiaries, the top multinational carriers include: AT&T/BT (Concert), WorldCom, and Teleglobe. International service revenues generally reflect net of PSTN service revenues after adding or subtracting for settlement payments, but may also include some private line revenue All revenue figures converted from original currency at conversion rate current to year end reported Some revenues figures have been estimated (est.).

a Data based on billing point of call, not originating point.

b Data are for the fiscal year ending 31 March. Telstra and Telecom New Zealand FY ends 30 June.

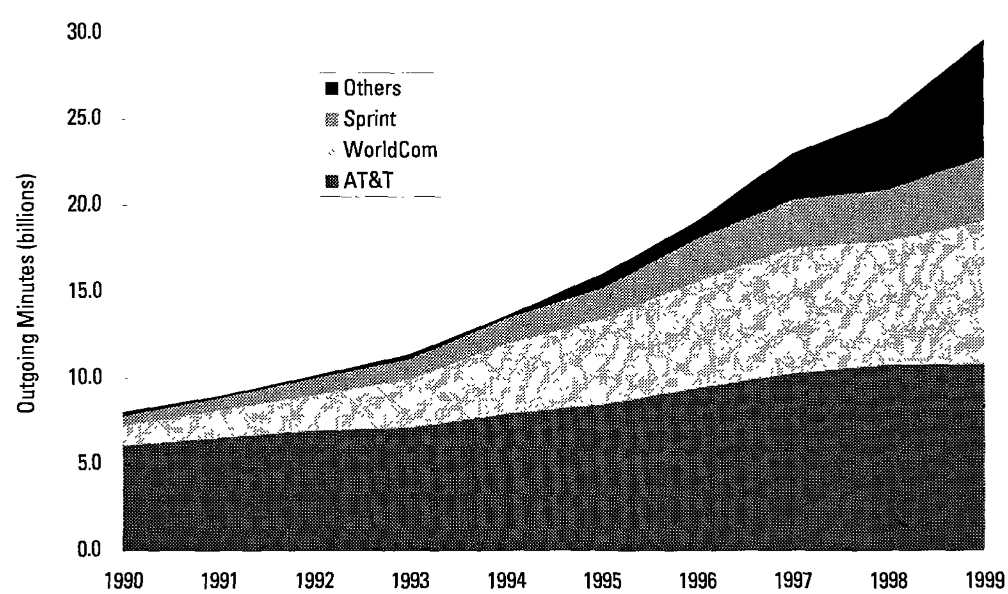
Source TeleGeography research, FCC, and company reports

# The Top U.S. International Carriers

**Outgoing Facilities-Based Traffic (millions of minutes)**

| Rank | Company | 1999 | 1998 | Growth |
|---|---|---|---|---|
| 1 | AT&T | 10,816.5 | 10,798.5 | 0% |
| 2 | WorldCom | 8,294.9 | 7,195.0 | 15% |
| 3 | Sprint | 3,714.4 | 2,916.0 | 27% |
| 4 | Teleglobe USA | 1,679.7 | 830.3 | 102% |
| 5 | World Access | 1,129.5 | 678.8 | 66% |
| 6 | Viatel | 901.6 | 202.3 | 346% |
| 7 | Primus Telecommunications | 868.5 | 124.9 | 595% |
| 8 | STAR Telecommunications | 785.8 | 457.4 | 72% |
| 9 | RSL Communications | 389.5 | 214.3 | 82% |
| 10 | Pacific Gateway Exchange | 284.1 | 641.4 | -56% |
| 11 | Startec Global Communications | 207.2 | 20.0 | 936% |
| 12 | IDT Corporation | 151.3 | 9.4 | 1510% |
| 13 | GTE Corporation | 60.9 | 52.7 | 16% |
| 14 | Telefónica Larga Distancia (Puerto Rico) | 42.5 | 45.5 | -7% |
| 15 | Tricom USA | 41.6 | 66.1 | -37% |

**Carrier Share of Outgoing Traffic, 1990-1999**




Note: Traffic figures are for public switched network circuits based on billing point of call, not originating point. International Simple Resale (ISR) is included in facilities-based totals.

Source: TeleGeography research and FCC carrier filings

# A Primer on Bandwidth Exchanges

The term "bandwidth exchange" has been pulled and stretched to cover the canvas of diverse business models and operational approaches. But what exactly is a bandwidth exchange? Part of the definitional problem originates from the complexity inherent in the telecom industry's web of supply and demand—whether it be for cross-border telephone calls, intracity fiber optic connections, or access to the Internet's cloud. A second, more obvious, obstacle to a clear definition is the newness of the bandwidth exchange business—many companies have redirected and redefined their strategic focus (and marketing programs) more than once in just a few short years of existence.

Nonetheless, these bandwidth bazaars all share a common purpose: to facilitate transactions between buyers and sellers. Their challenge—and the source of their diversity—is to develop the best methodology for facilitating each type of transaction. This primer differentiates the services exchanged, as well as the role played by the matchmaker in each deal. We will begin with a brief description of the companies involved—including Band-X, now TeleGeography's corporate parent.

**Background**

The traditional process of buying and selling communications bandwidth—for carriers, ISPs, and multinational corporations alike—can be time-consuming and labor-intensive. The process typically requires direct negotiation over price, quality, and delivery. An exchange, however, can extend, complement, or replace all or part of a buyer's or seller's sales force at various stages of the process. Furthermore, bandwidth buyers can use exchanges to find quickly the best price/quality ratio on offer, and bandwidth sellers with excess capacity can earn incremental revenues with minimal effort.

A bandwidth exchange may consist of a bullpen of brokers, perhaps part of a larger team of traders, who spend their days scanning price listings and phoning potentially interested parties. We classify these brokerages, along with bulletin-board operators, as "virtual matchmakers." Alternatively, an exchange may be based upon a switch connected to a computerized system where anonymous buyers and sellers swap traffic. Such exchanges, which have facilities where members interconnect their networks for physical delivery, fall under the category of "physical matchmakers." Both operational models, virtual and physical, assist buyers and sellers of bandwidth in finding counterparties and completing transactions. Of the more than 35 companies with actual or stated plans to trade bandwidth, at least twelve have facilities which route capacity between buyers and sellers. The remaining two-thirds of existing exchanges, accordingly, are virtual matchmakers.

Bandwidth exchanges also differ by their own degree of involvement in the bandwidth transaction. Some exchanges are neutral, favoring neither buyer nor seller; others are created by a party to the trades. The latter category includes "market maker" exchanges—exchanges whose founders are in the carrier or capacity building business. The oft-cited market maker example is Enron, the energy company which is investing heavily in both a nationwide network build-out and the development of a bandwidth trading exchange (see Figure 1. Selected Bandwidth Exchanges).

But why would an energy company enter the world of telecommunications bandwidth? The power industry's experience with energy trading may prove applicable to the emerging bandwidth marketplace. Enron's vision of the communications market relies on the commoditization of bandwidth, where a liquid market allows the trading of forward contracts and financial derivatives by bandwidth users, as well as speculators and arbitrageurs. This vision may bear fruit. Our discussion here, however, focuses on the current state of the bandwidth exchange industry and emphasizes the delivery market for bandwidth—the buying and selling of bandwidth for actual use—rather than the still mostly theoretical trading world of bandwidth financial instruments.

**Services**

To date, most bandwidth trading has focused on international telephone calls, or "minutes," and raw network connectivity, or "bandwidth circuits." More recently, bandwidth exchange Band-X has also begun trading Internet transit, or "routed IP" services. Some exchanges may also broker related services to their customers, such as colocation space in carrier hotels, or empty ducts between points in a city.

**Minutes.** Telephone carriers typically meter service to their customers in minutes or a portion thereof. Thus, because carriers around the world have agreed on standard definitions of a "conversation minute," they are able to route minutes easily from one network to another through their switches.

## Figure 1. Selected Bandwidth Exchanges

| Exchange | Type of Matchmaker | Products Currently Traded | Switch, Router, or Hub Locations | Notes |
|---|---|---|---|---|
| Asia Capacity Exchange (ACE)<br>www.ace-asia.com | Hybrid | Minutes<br>Bandwidth circuits | Hong Kong<br>Los Angeles | • Formed e-bandwidthtraders.org (eBTO) with TheGTX and RateXchange to promote interests of online exchanges<br>• Plans to broker options on bandwidth within next six months |
| AIG Telecom<br>www.aigtelecom.com | Physical | Minutes | Jersey City, NJ | • AIG is the buyer to every seller, and seller to every buyer |
| Arbinet-thexchange<br>www.thexchange.com | Physical | Minutes | New York<br>London | • Handles billing and settlement, takes on counterparty risk<br>• Automated integration of web site, switch, and OSS<br>• Plans to expand into new cities and products (e.g., bandwidth circuits) |
| Band-X<br>www.band-x.com | Hybrid | Minutes<br>Bandwidth circuits<br>Internet access<br>Colocation | London<br>Hong Kong<br>New York<br>Paris<br>Amsterdam<br>Dublin | • Minutes and Internet access services are routed through Band-X facilities<br>• Acts as virtual matchmaker for bandwidth circuit transactions and co-location<br>• Is deploying facilities in ten countries this year, including India, Brazil, and S. Africa, where offices are already open |
| Bandwidth.com<br>www.bandwidth.com | Virtual | Bandwidth circuits | n.a. | • Partnered with Chapel Hill Broadband, which brokers wholesale capacity leads |
| Chapel Hill Broadband<br>www.chbroadband.com | Virtual | Bandwidth circuits<br>Colocation | n.a. | • Provides carrier-neutral brokering of wholesale capacity, including dark fiber and wavelengths<br>• May also represent buyer or seller in negotiating specific contracts |
| Enron Broadband Services<br>www.enron.net | Physical | Bandwidth circuits | New York<br>Los Angeles | • Intending to create a commodities market for bandwidth circuits<br>• Developing nationwide network of *pooling points* |
| Global TeleXchange (TheGTX)<br>www.thegtx.com | Hybrid | Minutes<br>Bandwidth circuits | New York<br>London<br>Miami<br>Los Angeles<br>Frankfurt<br>Amsterdam | • Brokers bandwidth circuits as virtual matchmaker<br>• Building "mesh network" of interconnected hubs to trade minutes<br>• Also intends to trade application services |
| RateXchange<br>www.ratexchange.com | Hybrid | Bandwidth circuits | 8 delivery hubs in North America<br>London<br>Frankfurt | • Operates an electronic trading system for commoditized bandwidth trading<br>• Formed alliance with brokerage Amerex Bandwidth |

Note: The list of bandwidth exchanges presented here is not exhaustive. City locations are listed in approximate order of deployment and magnitude as of Oct. 2000.

Source: TeleGeography research and company reports

**Figure 2. Common Bandwidth Trading Parameters**

| Minutes | Bandwidth Circuits |
|---|---|
| • Origination location (switch/city) | • Origination location (city) |
| • Termination location (city or country) | • Termination location (city or country) |
| • Quality metric (Answer Seizure Ratio, Post Dial Delay, or Call Quality Index) | • Rate (price) |
| • Rate (price) | • Speed (e.g., T3/45 Mbps) |
| • Timing/Availability (start and end date of service) | • Transport (e.g., fiber-optic cable) |
| | • Commitment (in months) |
| | • Availability (start date) |

Note: Adapted from the Asia Capacity Exchange (ACE) website, www.ace-asia.com



Many exchanges, including Band-X, Arbinet, and TheGTX, currently trade minutes. The total volume of minutes traded through exchanges is difficult to ascertain. But our research indicates that international traffic flows through exchanges could reach 300 to 500 million minutes in 2000—about 0.5 percent of the world's traffic.

The minutes bought and sold through an exchange may include either traditional, circuit-switched minutes, or Voice-over-IP (VoIP) minutes. Some exchanges specialize in IP minutes (e.g., Pulver.com's Min-X); others allow members to specify if VoIP minutes are desired (e.g., Arbinet). Those exchanges with their own switching facilities may trade circuit-switched and IP minutes without differentiation if their switches route both SS7 (circuit-switched) signaling and IP protocols. Although hard numbers are difficult to come by, it is generally agreed that VoIP minutes make up a small, though growing, share of the total minutes traded. Arbinet, for example, reports that nearly ten percent of its traded traffic is Voice-over-IP.

Minutes offers are typically listed on exchanges on a country-to-country or city-to-city basis: for example, "U.S. to India at $0.13 per minute." And although each minute is, by definition, the same 60 seconds of connect time, a minute's quality is not standard and can vary considerably. For this reason, minutes offers frequently contain a quality metric as well (see Figure 2. Common Bandwidth Trading Parameters).

**Bandwidth Circuits.** International carriers of voice and fax services may purchase wholesale minutes, as discussed above, to route calls to their desired destinations. Alternatively, buyers may lease or purchase bandwidth circuits between points and provision switches at the ends. Thus, minutes and bandwidth circuits can be, in some instances, substitutes for each other. But there the comparison ends. Minutes are a service which ride on a physical circuit; bandwidth circuits are the capacity which may be provisioned to carry any application. A buyer purchases minutes by quantity, and bandwidth circuits by capacity, for a given time period.

Bandwidth circuits are typically listed in city pairs and by potential carrying capacity: for example, New York to London at 2 Mbps. In addition to the geographic and capacity parameters, bandwidth circuit exchangers must specify their commitment period. Commitments can range from one year leases to Indefeasible Rights of Use (IRUs) for the lifetime of the facility.

Bandwidth circuits take various forms. The circuit may be a satellite link, a segment of a terrestrial network, or an undersea submarine cable connection between world regions. As the medium used to carry the traffic differs, so too does the circuit's level of provisioning. A company may purchase dark fiber, which is optical fiber not connected to transmission equipment. Alternatively, a company may prefer a circuit which is already "lit" to handle its application of choice. A new class of bandwidth products—wavelengths—has recently emerged for buyers and sellers of optical fiber. A wavelength, or a single channel on an optical fiber system, is typically sold at 2.5 Gbps or 10 Gbps increments (see TeleGeography's *International Bandwidth 2000* report for a detailed explanation of the various options available).

Given the wide range of bandwidth circuit increments and technologies, determining universal standards and contracts is far from a simple task. Band-X has developed a standardized Service Level Agreement (SLA), which includes both provisioning time and SLA post-provisioning, for bandwidth circuit trades on its exchange. A few organizations,

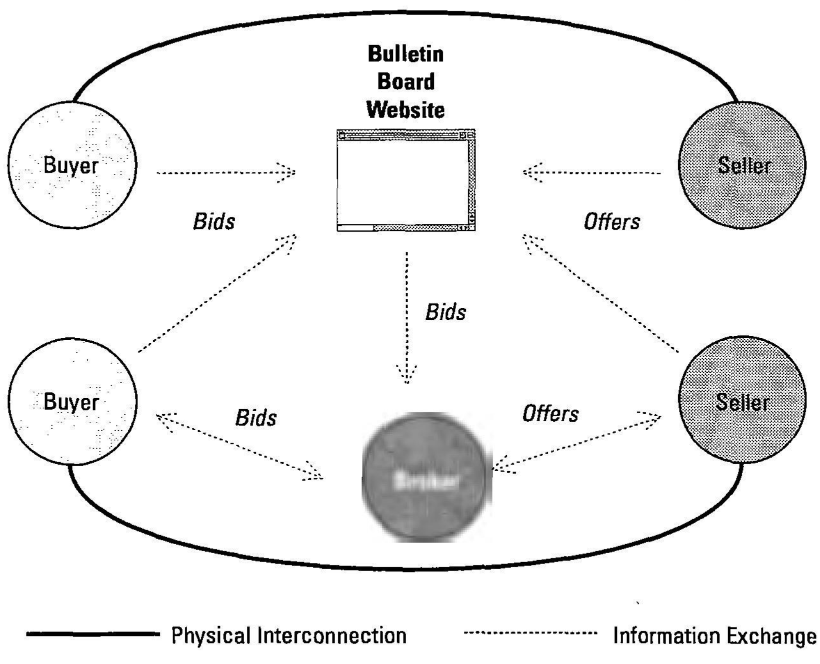
## Figure 3. Case Study: Bandwidth.com

Blessed with a highly prized domain name, Bandwidth.com began operations as a bulletin-board virtual matchmaker for bandwidth circuit sales. The company generates enterprise, or retail, customer sales leads through its website and passes them along to carriers. Bandwidth.com's partnership with brokerage Chapel Hill Broadband allows it to provide wholesale bandwidth matchmaking services as well.

A typical user of the Bandwidth.com website may be, for example, a corporate network manager searching for a dedicated circuit between two of its locations. The potential bandwidth buyer fills out a form on Bandwidth.com's home page where he indicates his bandwidth needs, contact information, and any additional details of interest to sellers. Bandwidth.com users may request information on point-to-point bandwidth circuits of speeds ranging from fractional T-1s to OC-48s. When the potential buyer submits his request, Bandwidth.com forwards it to the sales representatives of more than 50 carriers. At this point, the web site's participation in the bandwidth deal ends. Carriers directly contact the potential buyers with their pricing quotes, and the two parties negotiate the terms of the contract on their own. Provisioning of the bandwidth circuit and financial settlement of the transaction also occur "off-line." For its role as a matchmaker, Bandwidth.com receives a referral fee from the selling carrier of either ten percent of the sale up-front, or two to five percent of the sale's monthly revenue.

Bandwidth.com also serves carriers and ISPs looking to buy wholesale bandwidth through a partnership with brokerage firm Chapel Hill Broadband. Bandwidth.com sends along these wholesale leads from its website to Chapel Hill, which then contacts the potential sellers it has on hand. When a probable match is found, Chapel Hill may continue to work with the counterparties to formulate the bandwidth contract. Whereas Bandwidth.com exemplifies the passive, lead-generating bulletin-board model, Chapel Hill actively matches buyers and sellers through the efforts of its brokers. Together, the two companies illustrate the wide range of available virtual matchmaker services.

**Virtual Matchmaker Models: Bulletin Boards and Brokers**




In one virtual matchmaker model, buyers and sellers post bids and offers on an electronic bulletin board. When the counterparties come to terms, they interconnect with each other, outside of the exchange. Brokers, also virtual matchmakers, may reference an electronic bulletin board in helping to put buyers and sellers together.

Source: TeleGeography research and company reports

including one organized by carrier association CompTel, have convened to resolve the issue; not surprisingly, one of the thorniest issues has been the liquidation of damages if one party does not abide by the terms of a bandwidth deal. As with creating quality of service measurements for bandwidth circuits, standardizing bandwidth contracts across multiple exchanges and carriers will take time.

How active is bandwidth circuit trading? As the pooling points necessary for facilities-based bandwidth circuit trading are still in their early stages of development, the number of deals facilitated by virtual matchmakers far outnumber those by physical matchmakers. From July to September 2000, brokerage Chapel Hill Broadband reported two to three hundred requests for wholesale capacity through the Bandwidth.com lead-generating website. Physical matchmaker Enron, in contrast, says it will facilitate about 100 bandwidth deals this year.

**Internet transit (IP routed).** Exchanges may also help match buyers and sellers of upstream Internet access, or transit. To date, Band-X remains the only bandwidth exchange to provide physical matchmaker services for Internet transit. Like bandwidth circuit buyers, Internet transit buyers purchase dedicated capacity for a specific time period. However, unlike bandwidth circuits, Internet transit capacity is not restricted to a point-to-point route. Instead, a buyer of Internet transit receives a guaranteed connection to an Internet backbone, which will carry the buyer's traffic over various, unspecified paths to reach its intended recipient. Recipient locations are IP addresses, not physical places.

The exchange itself does not provide the IP transit; rather, the exchange helps the buyer to find and connect to an "upstream" ISP. For example, a large company may require high-speed Internet access for the next few months. Instead of negotiating with a number of ISPs, determining the best price and quality match, and signing a contract with the chosen provider for a fixed length of time, the company may enlist the services of a bandwidth exchange. Buyers can choose from various, anonymous ISPs based on price and performance, and, in some cases, can switch providers as often as once a month (for a detailed description of Band-X's routed IP service, see Figure 4. Case Study: Band-X).

### Operational models

The business practices of bandwidth exchanges are in constant flux, and many include elements of multiple business models. Keeping this in mind, we consider two operational categories: virtual and physical matchmakers. The examples highlighted in the accompanying figures illustrate the individual approaches of certain exchanges.

**Virtual matchmaker.** Virtual matchmakers help to put bandwidth buyers and sellers together without physically interconnecting the counterparties. There are two non-exclusive categories of virtual matchmakers: electronic bulletin-board operators and over-the-counter (OTC) brokers.

Electronic bulletin-board operators post sellers' offers and buyers' bids on a website, speeding the information-gathering process for the parties involved. The posting process may be automated, with website members directly listing their prices; or, employees of the bulletin-board operator may enter the information into the site after communicating with the buyers and sellers. Generally, a bulletin-board offers a passive means of generating leads, as it is left to the interested parties to act on the bids and offers posted (see Figure 3. Case study: Bandwidth.com). Band-X, a virtual matchmaker for bandwidth circuits, has developed a more interactive approach by holding reverse auctions on its website, where sellers place competitive offers on specified routes in real time.

Frequently referred to as "dating services," OTC brokers search for bandwidth or minutes terms which match buyers' or sellers' requirements; the broker often works out the details of the deal over the phone. An OTC broker may rely on electronic bulletin-board services to find prices, and then call clients to alert them to attractive deals. Or a broker may have his own "inventory" of available bandwidth that he has collected, as an independent operator, from contacting sellers of capacity. In contrast to bulletin-board operators, OTC brokers provide active matching services to buyers and sellers, often adding value to their clients through their personal connections and effort.

OTC brokers are generally carrier-neutral—their concern is to complete bandwidth deals, not to favor one buyer or seller over another. At times, however, a broker may represent one party from the bid or offer stage through to contract negotiation. For example, Chapel Hill Broadband, which most often acts as a neutral broker, may also be hired to negotiate a specific transaction on behalf of the buyer or seller.

Virtual matchmakers, in addition, may facilitate the delivery of the minutes or bandwidth trade. For example, although by definition a virtual matchmaker owns no interconnect facilities, it may hold information on where its clients are colocated, and suggest locations for interconnection. As with other deals made through virtual matchmakers, these transactions are not anonymous, as both parties must work together to provision their networks for delivery.

**Physical matchmaker.** Physical matchmakers do more than match buyers to sellers; they actively facilitate the delivery of the bandwidth deal through their own facilities. Such

## Figure 4. Case Study: Band-X

Band-X Ltd. operates trading floors for four products: switched minutes, routed IP transit, telehouse colocation, and network bandwidth (including clear channel circuits, dark fiber, ducts, and wavelengths). The first two trading floors—switched minutes and routed IP—are facilities-based, meaning that buyers and sellers plug in to Band-X's switching or routing equipment in London to complete the trade. Bandwidth and colocation services are agency-based; for these services, Band-X helps the buyer and seller find each other and assists with the delivery of the transaction. For bandwidth and colocation, therefore, Band-X acts as a virtual matchmaker.

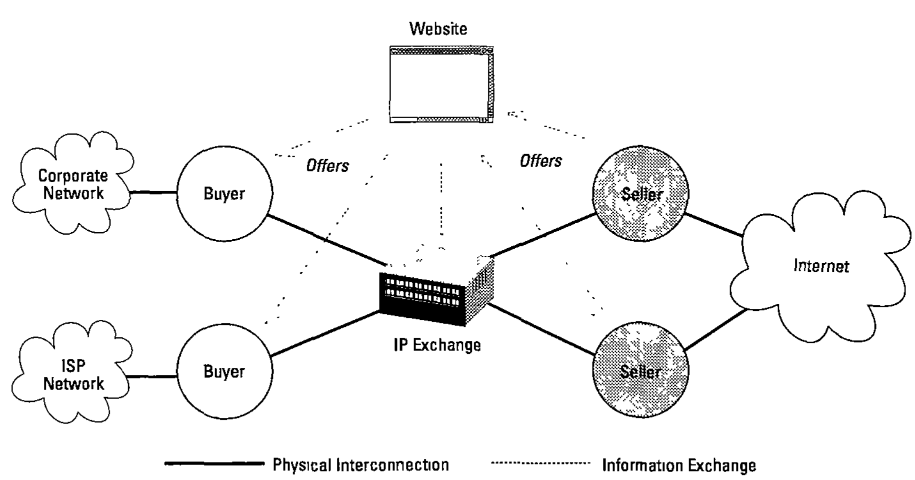
To understand how Band-X's physical matchmaking works, we examine the routed IP service in more detail. "Routed IP" refers to public Internet access at specific levels of capacity. For example, a buyer of routed IP may be a smaller Internet Service Provider (ISP) who chooses to connect to Band-X in lieu of directly connecting to a larger ISP. Band-X, in turn, has interconnected with participating sellers of IP capacity—including Cable & Wireless, Level 3, and Telia—and negotiated transit and peering arrangements with them. Connecting to Band-X allows the buyer to comparison shop between multiple providers by price and quality metrics, and to change providers on request as new offer information, updated daily, becomes available. Buyers gain flexibility in their choice of ISP in addition to a steady stream of quality monitoring information. Also, the buyer benefits from price declines as the market moves: if a seller reduces its price on Band-X, the buyer's price is automatically adjusted downward to the new level. Price increases, however, only take effect after a 14-day notice, so that buyers have the opportunity to switch to a new provider, if desired.

The routed IP buyer finds his supplier of choice through Band-X's web site, where he can examine anonymous sellers' transit prices and associated quality indexes. Band-X derives its quality index from measurements made at over 200 representative web sites across several regions. The quality metrics include traceroutes (the number of hops needed for a packet to reach its destination and back), latency (packet round-trip time), pings (packet loss due to network congestion or other problems), and throughput (the rate at which traffic transits the network). Band-X updates its quality index metrics approximately every half hour and allows routed IP buyers to view a provider's quality measure for different geographical zones and over various periods of time. Thus, IP buyers may use region-specific quality measurements to choose targeted areas of coverage.

Once an IP buyer has selected a provider based on his preference for price and quality, he inputs his required port type and connection speed—from one to 155 Mbps—into Band-X's web site. The website returns a price quote, which the buyer may accept or decline. Acceptance of the quote notifies Band-X, which confirms the transaction by phone or email.

The routed IP buyer, once he has accepted the quote, works with Band-X to interconnect with Band-X's IP exchange. Other services, including Domain Name Service (DNS) and mail back-up, may also be provided by the exchange. Band-X configures its routers for the buyer, allocating any needed IP addresses, and notifies the buyer when his connection is in operation. Once turned up, the buyer may view his traffic through the connection by logging in to Band-X's web site. Band-X bills the buyer and settles all accounts.

**Band-X Model: Internet Access**




*In the model illustrated, buyers and sellers of Internet access connect to a physical matchmaker's routers. Buyers choose anonymous sellers based on offers posted on the exchange's website.*

*Source: TeleGeography research and company reports* © TeleGeography, Inc. 2000

## Figure 5. Pooling Points and Physical Matchmakers

Trading bandwidth on a physical level, whether it be wavelengths or STM1s, presents some unique technological difficulties. In order to switch circuits between anonymous counterparties in real time, not only must carriers resolve standardization and contractual issues—they must have the infrastructure in place that will allow the physical exchange and subsequent monitoring of traded capacity. Traditional colocation or telehouse facilities may provide physical locations of interconnection, but most are not equipped to permit trading circuits of varying increments, nor to measure the delivered quality of service. In addition, masking the identity of the bandwidth traders at traditional interconnect facilities is generally impossible.

The creation of "pooling points" aims to resolve these interconnection and monitoring issues. Although pooling points may be virtual, which involves utilizing intermediary carriers for interconnection, our discussion focuses on the physical locations where carriers plug in to each other for the purposes of exchanging bandwidth circuits (see "MANs: The Golden Mile" in the Facilities section of this report). Central to the pooling point is a "bandwidth manager," a piece of equipment that allows capacity to be switched remotely and automatically between buyers and sellers—while measuring the quality of the delivered bandwidth and ensuring anonymity of the counterparties.

Energy company Enron, a pioneer in developing bandwidth trading facilities, has built pooling points in New York and Los Angeles, and plans to have more than ten others in the United States alone this year. The company also intends to deploy pooling points overseas, including Tokyo, Amsterdam, Frankfurt, and Paris. Enron claims that its investments in pooling point infrastructure, as well as its role in convening bandwidth contract standardization meetings, are intended to speed the development of a commoditized bandwidth circuit trading market.

Recent market entrant LighTrade Inc. focuses exclusively on deploying pooling points throughout the United States and other countries. The company started in 2000 with plans to install equipment in Atlanta, Chicago, Denver, Dallas, Miami, San Francisco, San Jose, Seattle, and Washington, D.C. The heart of LighTrade's pooling points consists of a Lucent WaveStar Bandwidth Manager, which allows the switching of capacity at specified increments, as well as remote quality-of-service monitoring.

While most observers agree that pooling points are a prerequisite for a commoditized bandwidth circuit trading market, the immediacy of their implementation is less certain. Developing the infrastructure to support an array of circuit technologies remains a significant challenge, as does convincing carriers of the benefits of interconnection.



exchanges deploy switches or hubs where their members may interconnect. The decision of which switch or hub equipment to use depends upon the kind of services the exchange provides; facilities that carry minutes differ from facilities that allow bandwidth circuit trades. For minutes, switches of various shapes and sizes route calls from seller to buyer and monitor their flow. Bandwidth circuits, in contrast, are not so easily switched between carriers. A number of companies are currently developing an infrastructure for trading bandwidth circuits which provides the necessary measurement and routing capabilities. At this writing, however, physical trading of bandwidth circuits remains in its infancy (see Figure 5. Pooling Points and Physical Matchmakers).

A physical matchmaker may deploy one or many switches or hubs and may or may not interconnect them. Clearly, more hubs extend an exchange's geographic reach, allowing more buyers and sellers to interconnect at a lesser cost. Some exchanges have multiple, separate facilities (e.g., Band-X); others are building a network of hubs that are linked together (e.g., TheGTX). Again, an exchange's network architecture reflects the orientation of the service provided by the exchange, as well as the exchange's preferred technological blueprint. Even if an exchange owns its own hubs, it may broker deals that are "off-hub," if it is more cost-efficient for the parties to interconnect through their own facilities.

Owning facilities may allow a physical matchmaker to offer anonymous trading services to its interconnected members and to measure actively the traded minutes or circuits. Monitoring of service quality, in such instances, becomes critical for buyer confidence. Physical matchmakers may post quality metrics on their website or even guarantee quality levels to buyers. Band-X has pioneered its own algorithm for determining the quality of IP network access that is available through its facilities (again, see Figure 4).

A few physical matchmakers have developed facilities that allow transactions to happen in "real time"—instantly, without human intervention. Once connected to the exchange's hub, a member of such an automated exchange can find a counterparty and provision the service delivery entirely through a Web-based interface (see Figure 6. Case Study: Arbinet).

### Payment and Risk

As exchanges differ by service and operational model, so too do they vary by fee structure. Buyers and sellers compensate bandwidth exchanges through commissions on

## Figure 6. Case Study: Arbinet-thexchange

Arbinet-thexchange Inc. has linked its website to its New York switching facilities and operating support system (OSS), allowing traders to buy and sell minutes automatically.

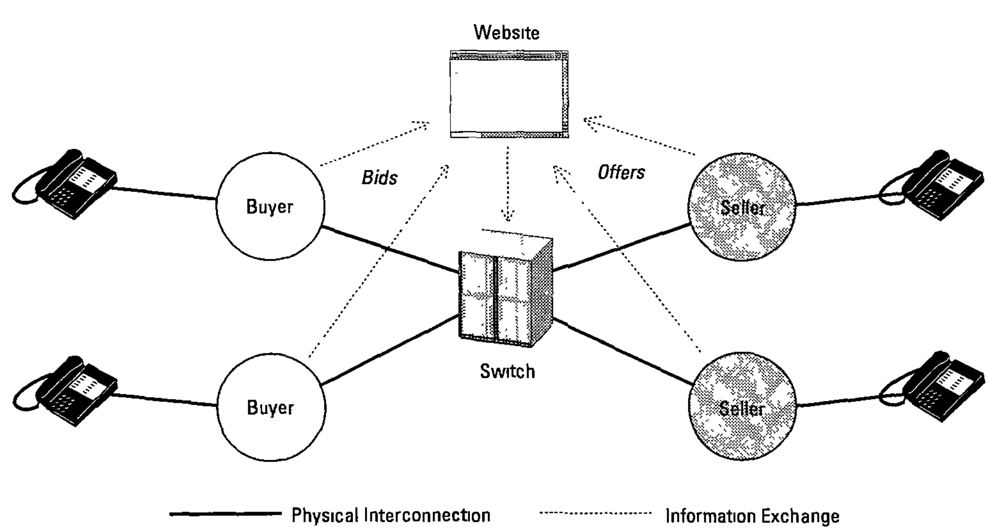
Call originators and terminators who wish to use Arbinet's automated trading floor first pay $5,000 in application fees to undergo a background and credit check. Then they connect to Arbinet either directly or through an agreement with local network operator FiberNet, which offers access to Arbinet's New York switch from major area telehouses. Each month thereafter the customer pays a flat-rate connection fee ranging from about $750 to $1,100, depending on the size of their connection into the exchange's switch. Arbinet's fee structure also varies by the type of service level desired by the customer. But unlike many other brokers or exchanges, Arbinet's fees now include no usage component; the company does not take a commission on any of the trades going through its switch.

A buyer or seller wishing to place a bid or an offer enters Arbinet's trading floor by logging in to Arbinet's website. The buyer/seller then chooses from over 20 different variables to list the bid/offer. These variables specify the desired route, quality, and price. Geographically, Arbinet's customers may identify country or city endpoints for the calls (e.g., New York to Brazil). Quality metrics include ASR (answer seizure ratio), PDD (post dial delay), and VQoS (a qualitative ranking). Pricing is listed at a cents per minute rate. The buyer/seller then prioritizes the variables by importance, allowing the software to search for the best match based on the customer's specifications and rankings. Arbinet's system searches for the customer's "price or better" at "quality or better." In other words, if a buyer lists 4¢ per minute from New York to Brazil in his bid, and a 3¢ per minute offer is available, Arbinet will match and charge the buyer at the 3¢ per minute rate.

Once a match is found, Arbinet's operating system notifies its switch, and minutes are routed automatically from one customer to another. This process is anonymous; the buyer and seller do not know the identity of the counterparty. As the minutes flow through its switch, Arbinet monitors the quality of the calls and the constantly changing prices listed on the floor. The company uses this monitoring to offer dynamic routing, where Arbinet's server reroutes a buyer's calls as new options become available. A buyer's minutes, for example, may start out being routed to carriers X, Y, and Z. If carrier X drops its price considerably and its quality remains the same, the remaining buyer's minutes would all then be automatically routed to carrier X's network. The buyer would be aware of the decrease in price but would have no knowledge of the underlying call routing changes. Similarly, if the quality on a route changes, Arbinet's switch re-routes the calls accordingly.

With the delivery underway, the web site and switch automatically interface with the billing systems to settle accounts. Arbinet invoices the buyer and pays the seller, generally before receiving payment from the buyer. In this way, the exchange is taking on full "counterparty risk." The seller is guaranteed its payment, even if Arbinet never collects from the buyer.

**Physical Matchmaker Model: Minutes**




A physical matchmaker specializing in minutes connects buyers and sellers to its switch. Price matching may be done through the exchange's website.

Source: TeleGeography research and company reports © TeleGeography, Inc. 2000 deals they facilitate, fees for membership in the exchange, or revenue from advertising or other ancillary services.

Consistent with practices in the energy industry, brokerage houses and lead generators may generate commissions only from bandwidth sellers, not buyers. But not always. Chapel Hill Broadband, for instance, has a variable fee structure that depends on the type and volume of the transaction it enables. Chapel Hill's commission can range to as high as seven percent, if assessed on both buyer (three percent) and seller (four percent).

On its switched minutes trading floor, Band-X takes a five percent total commission—two percent from buyers and three percent from sellers. For "networks," or bandwidth circuit deals, Band-X charges the successful bid/offer poster, whether buyer or seller, a two and a half percent commission on the first $200,000 and one percent thereafter.

Some exchanges have moved away from charging commissions altogether. Arbinet, for example, has chosen to replace commissions on minutes trades with flat-rate capacity-based fees. Similarly, RateXchange has forsaken commissions on bandwidth circuit deals in favor of increasing its market presence.

Bandwidth exchanges can also take on counterparty risk in the financial transaction. In such cases, the exchange pays the seller directly, regardless of whether it is able to collect payment from the buyer. The seller, therefore, is relieved of any worries of bad debt or risk management. Exchanges which offer these clearing services "take title" to the minutes or bandwidth sold, becoming the buyer to every seller, and the seller to every buyer. For example, AIG Telecom buys blocks of minutes from the selling carrier, pays the seller, sells the minutes to the purchaser, and later invoices and collects from the buyer. To protect themselves, bandwidth exchanges often require participating members to undergo extensive background credit checks.

**Summary**

Bandwidth exchanges have a common goal: to facilitate the buying and selling of communications capacity. Most notably, exchanges help companies deal in minutes, bandwidth circuits, and Internet access.

Exchanges provide virtual or physical matchmaking services—or a combination of the two. Virtual matchmakers facilitate bandwidth trades without physically linking buyers and sellers. Of the virtual matchmakers, bulletin-board operators serve as passive lead generators, while OTC brokers play an active role in bringing counterparties together. Physical matchmakers, which have facilities where their members interconnect, may offer anonymous trading and monitoring capabilities at varying degrees of automation.

Payment structures of exchanges include differing commission schedules and membership fees. Bandwidth exchanges may assume counterparty risk by guaranteeing payment to sellers.

Difficult as it may be to categorize bandwidth exchanges, the industry's ongoing evolution is sure to bring greater standardization as well as significant change.

*TeleGeography, Inc. is a wholly-owned subsidiary of the bandwidth exchange Band-X Ltd. The editors of* TeleGeography 2001 *are solely responsible for the accuracy and completeness of this article.*

# Pricing

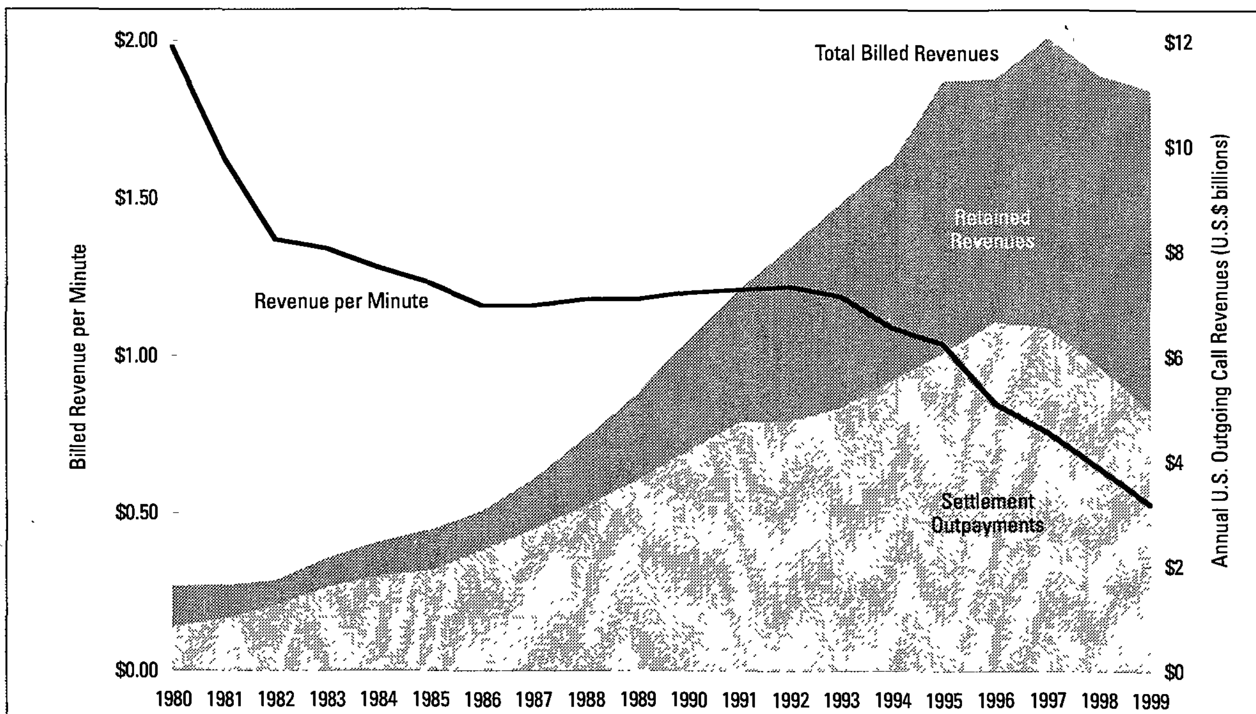
# Overview of International Pricing Trends

There are not many industries in which revenues fall despite double digit volume growth. Unfortunately, developments in 1999 suggest you can count the international telecom service market among them. In the U.S., plunging prices overcame a 17 percent increase in outgoing call minutes to force down gross international service revenues for the second year in a row (see Figure 1. U.S. Carrier Revenues and Settlement Outpayments, 1980-1999). Still, the news was not all bad. Although billed revenues for outgoing international calls fell by an average of $0.06 per minute, *retained revenues actually increased* (see Figure 2. U.S. Carrier Revenues for International Voice Service, 1998-1999). U.S. carriers can thank rapidly falling settlement rates—the fees they must pay to foreign telcos to terminate international calls—for the dramatic cost savings. U.S. operators were not the only ones to benefit. Carriers in other markets also experienced substantial decreases in settlement costs (see Figure 4. Settlement Payments per Minute for Outgoing Calls 1998-1999).

### A Welcome Demise?

Three significant factors accounted for the erosion of settlement rates. First, unilateral regulatory action by the U.S. Federal Communications Commission (FCC) may be taking effect. In 1997, the FCC adopted an order requiring U.S. carriers to negotiate settlement rates at or below prescribed "benchmark" rates. These rate levels, and their required implementation dates, varied according to the per capita income of correspondent countries. Benchmarks ranged from $0.15 per minute by January 1999 for the wealthiest countries to $0.23 per minute by 2003 for some developing countries. Although settlement rates between the U.S. and numerous countries remain high, a number of routes have seen dramatic decreases. For example, the settlement rate for traffic between the U.S. and Kuwait has fallen from $0.78 to $0.15 per minute in just the last year (see the section on "International Settlements Rates" below). Even though benchmarks directly affect only U.S. carriers and their foreign correspondents, the FCC's efforts may well be

**Figure 1. U.S. Carrier Revenues and Settlement Outpayments, 1980-1999**




Note: Excludes calls to Canada and Mexico.
Source: FCC

## Figure 2. U.S. Carrier Revenues for International Voice Service, 1998-1999

| | Total Receipts (US$ millions) | | | | | Average Revenue per Minute (US$/minute) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Billed Revenue | Settlement Outpayment | Retained Revenue | Settlement Inpayment | Net Revenue | Billed Revenue | Settlement Outpayment | Retained Revenue | Settlement Inpayment |
| AT&T (1998) | 7,700.3 | 3,373.6 | 4,326.6 | 1,072.6 | 5,399.3 | 0.71 | 0.31 | 0.40 | 0.23 |
| AT&T (1999) | 6,677.0 | 2,544.4 | 4,132.6 | 730.5 | 4,863.1 | 0.62 | 0.24 | 0.38 | 0.15 |
| WorldCom (1998) | 4,298.1 | 2,308.9 | 1,989.2 | 755.5 | 2,744.7 | 0.60 | 0.32 | 0.28 | 0.25 |
| WorldCom (1999) | 5,051.1 | 2,116.9 | 2,934.2 | 548.7 | 3,482.9 | 0.61 | 0.26 | 0.35 | 0.18 |
| Sprint (1998) | 1,421.4 | 796.8 | 624.6 | 297.9 | 922.5 | 0.49 | 0.27 | 0.21 | 0.16 |
| Sprint (1999) | 1,379.0 | 776.0 | 603.0 | 221.7 | 824.8 | 0.37 | 0.21 | 0.16 | 0.12 |
| **Top 3 Total (1998)** | **13,419.8** | **6,479.4** | **6,940.5** | **2,126.0** | **9,066.4** | **0.64** | **0.31** | **0.33** | **0.22** |
| **Top 3 Total (1999)** | **13,107.1** | **5,437.3** | **7,669.8** | **1,500.9** | **9,170.7** | **0.57** | **0.24** | **0.34** | **0.15** |

Note: This table breaks down international voice service revenue for the three largest U.S. international carriers. In 1999, for example, AT&T collected $6.7 billion from customers for U.S. international outgoing calls, and paid foreign carriers $2.5 billion to terminate those calls. Thus, the company gained $4.1 billion by carrying U.S. outgoing calls. Because FCC regulations generally entitled each U.S. carrier to terminate incoming calls based on the percentage of U.S. outgoing traffic it originates, AT&T also collected a significant sum ($731 million) on foreign settlement inpayments, netting $4.9 billion on international voice service.

Source: FCC carrier filings

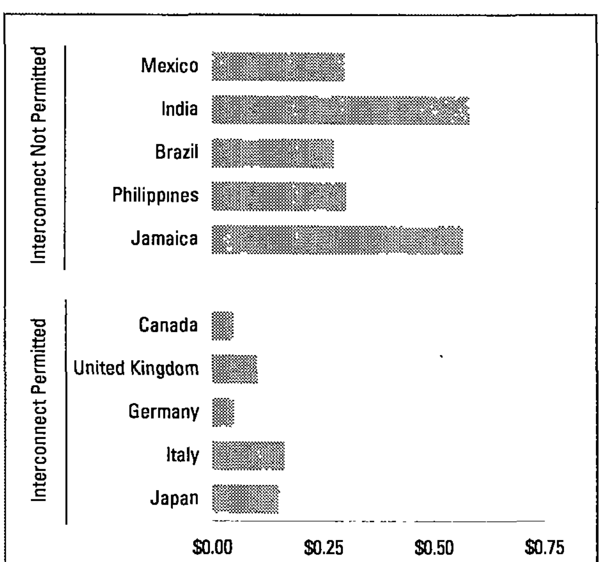


having a wider impact. Carriers in other countries can leverage these publicly-available rates—together with the threat of refile through the U.S.—to negotiate their own, lower rates.

Second, the threat of illegal bypass may be pushing down rates. A number of countries have implemented an uneven schedule for market liberalization, permitting competition for Value Added Network (VAN) and Internet services while keeping traditional Public Switched Telecommunications Network (PSTN) services in the domain of the national monopoly. In these markets, some foreign operators have sneaked incoming international traffic into the local PSTN via these VANs and the Internet, avoiding settlement payments altogether. With international call volumes from Voice-over-IP (VoIP) alone accounting for 1.7 billion minutes in 1999 and nearly four billion minutes in 2000, the mere threat of bypass may be forcing some countries to realize that high settlement rates are increasingly difficult to sustain (see the "VoIP Routes and Traffic" article in this report for more information on VoIP traffic flows).

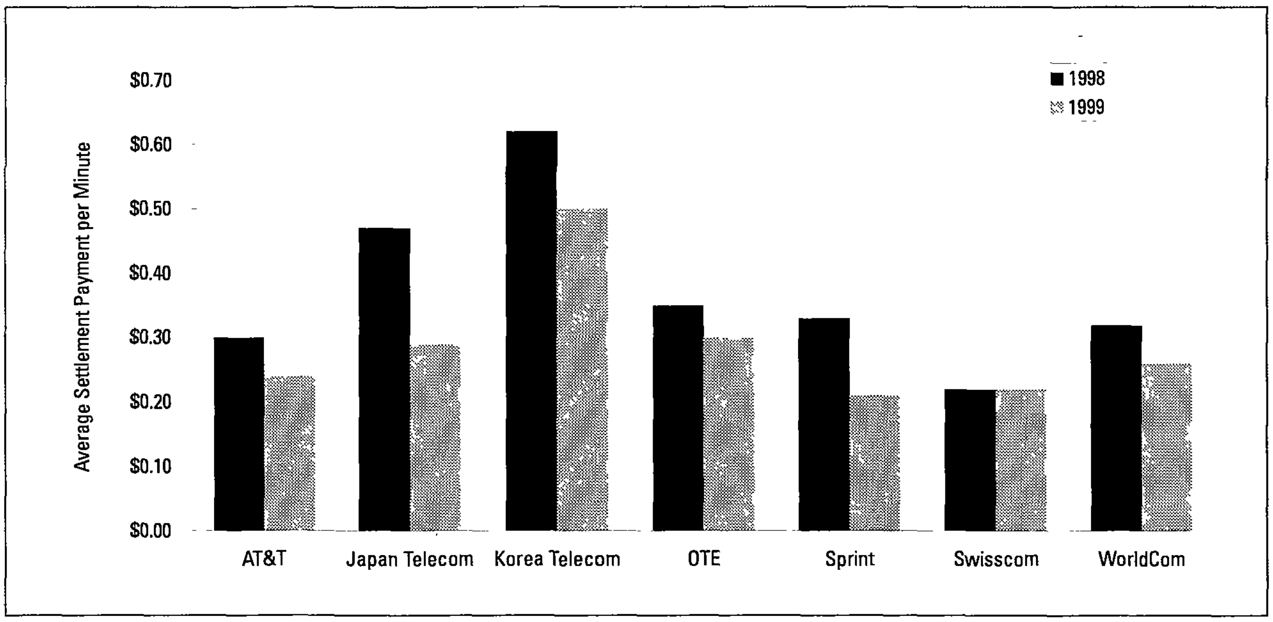
Finally, the spread of competition for public switched services has helped push down settlement rates. In many competitive markets, foreign carriers seeking to land their traffic now have the option of eschewing traditional settlement rates in favor of direct interconnect fees. These charges—usually the same fees that domestic long distance operators pay to send traffic onto local networks—often are far lower than traditional settlement rates. The difference between settlement rates in competitive and non-competitive markets is dramatic (see Figure 3. AT&T Settlement Payments per Minute to Select Destinations, 1999). With two-thirds of the world's international telephone traffic flows among countries with direct interconnect options in place, it should come as little surprise that carrier termination costs are falling.

## Figure 3. AT&T Settlement Payments per Minute to Select Destinations, 1999




Source: FCC carrier filings

**Figure 4. Settlement Payments per Minute for Outgoing Calls, 1998-1999**




Source: FCC carrier filings, company reports, and TeleGeography research



### The Other Side of the Coin

Combined, these developments mean that many carriers have been able to pass on some savings to consumers through lower international call prices, while protecting their own bottom line. Of course, not all companies have benefited from the changing economics of international call service provision. Some carriers in developing countries, where net traffic inflows are common, have depended on foreign settlement inpayments for a substantial portion of their total revenue. For these carriers, falling settlement rates are bad news indeed. PLDT, the dominant carrier in the Philippines, receives four times as many calls as it sends. Settlement payments from just one foreign carrier (AT&T) accounted for nearly one-fifth of all PLDT international service revenues in 1999. In January 2000, PLDT lowered its settlement rate with U.S. carriers from 33¢ per minute to the FCC benchmark rate of 19¢. With the tightening of settlement cash inflow and price pressure at home, international service revenue represents an ever shrinking portion of PLDT's total revenue: 56 percent in 1997, 36 percent in 1998, and just 32 percent in 1999. Falling international settlement rates are forcing PLDT, like so many other carriers in developing markets, to seek revenue from other sources (e.g., residential line charges, local calling, domestic interconnect fees, and wireless services) to shore up its bottom line.

### What Lies Ahead

The following pages trace the lines of this complex story in greater detail, providing sample cost data at each stage of an international call (bandwidth, settlement/interconnection, wholesale rates, and retail tariffs). The analysis includes:

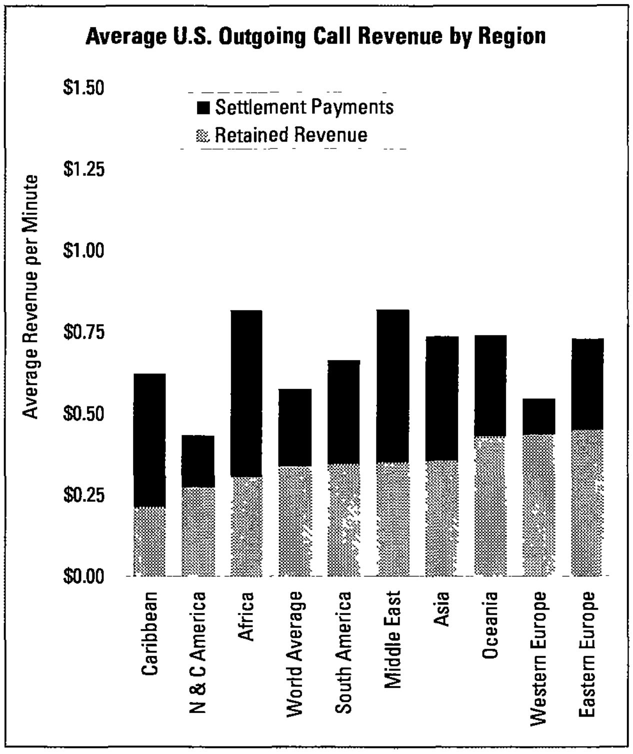
- International Call Costs to and from the U.S. These tables summarize the various cost elements required to complete an international call. They illustrate how interconnection fees, compared to capacity prices, account for a relatively large and growing portion of carriage costs, and how carriers often can save money by circumventing the traditional settlement rate mechanism where possible.

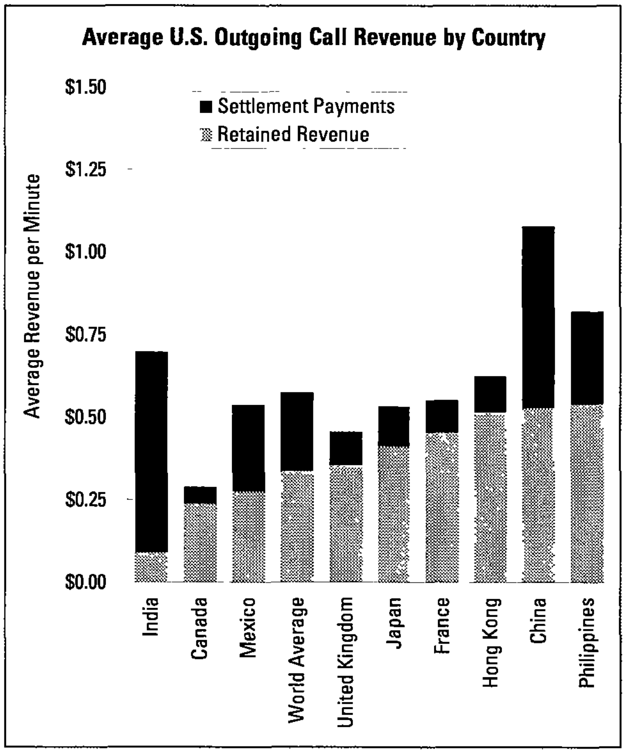
- IPL Lease Rates. These charts illustrate why bandwidth costs are a shrinking portion of call costs by tracking how fast—and on what routes—lease rates for International Private Line (IPL) circuits have fallen.

- Settlement Rates. These charts compare U.S. and U.K. settlement rates over time and by destination. The FCC and ITU benchmark settlement rates are also provided, showing which countries have met the U.S. criteria and which have not.

- "The New Calculus: A Primer on Interconnection Accounting." Even on competitive routes where regulations permit bypass of the traditional settlement rate regime, local access fees account for a large percentage of international carriage costs. This section summarizes the regulatory methodologies used to establish interconnect fees, and provides termination rates to 30 destinations in 1998, 1999, and 2000.

**Figure 5. U.S. Carrier International Call Revenue by Destination, 1999**




Note: Charts show average revenue on U.S. international outgoing calls for the three largest U.S. international carriers. Total column height shows the average price for calls on a given route. Retained revenue equals average price minus settlement payment, and includes such components as access fees for origination, network costs, and profit.

Source: FCC carrier filings



• Wholesale Rates and Retail Tariffs. So how do shifts in call component costs affect prices for the end-user? This section includes sample wholesale rates using circuit switched and Voice-over-IP (VoIP) transmission and a matrix of international rates from 24 countries.

• "Follow the Money: Network-to-Network Payments for Internet Telephony and Other IP Traffic Streams." Settlement rate controversies are not limited to the realm of circuit switched traffic. Inter-network payments are an increasingly urgent topic in the Internet world as well. The Pricing chapter concludes with this essay, which explores options for IP network settlements.

# Elements of an International Call

An international service provider has a number of options to send its customers' calls abroad. This section compares the cost elements of those options. Referring to the table on pages 36 to 37, let's use a call from Washington, DC to Berlin as an example. Not including call-back, refile, and other forms of non-traditional traffic switching, a U.S. carrier has five basic methods of transporting a customer's call to its destination in Germany:

*1. Ownership/Settlement.* To switch the call from the customer's telephone to its own long distance network, the international carrier pays the local exchange carrier (LEC) in Washington an origination fee, and then uses its own capacity to bring the call to New York, where the international cable to Germany begins. Costs for the domestic portion of the call equal approximately 1¢ per minute. The carrier shifts the call onto the international "half circuit" it owns, then pays the German carrier a settlement fee to transfer the call onto its matching half circuit and to the final destination. The U.S. carrier's marginal cost of using its own backhaul and international circuit is insignificant: 0.1¢ per minute. The settlement rate, at 10.0¢ per minute, is far more expensive. Total cost: 11.1¢ per minute.

*2. Lease/Settlement.* A carrier is not required to own the circuits that it uses. Instead, it can lease both the domestic capacity between cities, and the half circuit to Germany. Total cost, including origination, backhaul, private line lease, and settlement payment: 11.8¢ per minute.

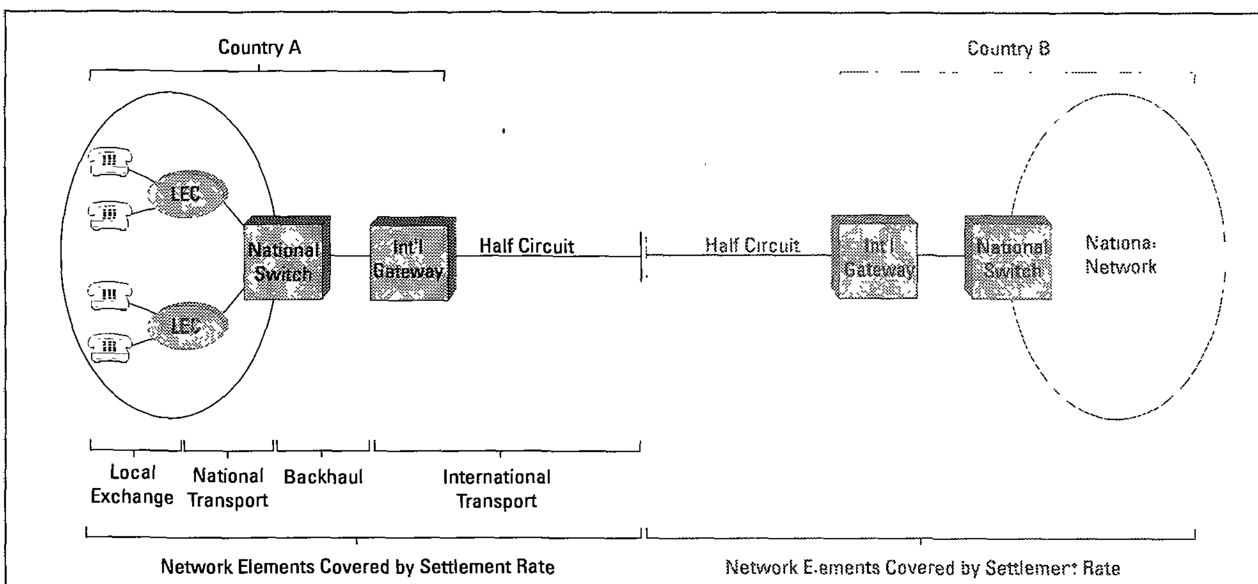
*3. Ownership/Interconnect.* Competition rules in Germany permit foreign carriers to interconnect directly with the domestic telephone network. Rather than financing a half circuit and paying a settlement fee, a U.S. carrier can purchase a whole circuit all the way to an international gateway in Germany, then pay the German carrier a 2.2¢ per minute fee to switch the call to Berlin. Total cost, including origination and backhaul: 3.3¢ per minute.

*4. Lease/Interconnect.* Also known as International Simple Resale (ISR), a carrier can lease capacity to carry the call over a whole circuit from Washington to Berlin. Total cost, including origination, backhaul, private line lease, and interconnection in Germany: 4¢ per minute.

*5. Service Resale.* A telephone service provider may wish to avoid carrying its own traffic to Germany altogether by purchasing the minutes transported over another carrier's network in bulk and marketing those minutes as its own. The charge required for end-to-end service resale is a "wholesale rate" covering origination, U.S. domestic long distance, and the underlying carrier's international transport and termination charges. Total cost: 8.2¢ per minute.

The following pages examine the component costs of transmitting an international call on selected routes, both to and from the United States. The calculations exclude Selling, General, & Administrative (SG&A) costs, which can form a significant portion of actual carrier expenses.

**Figure 1. International Call Components**




Source: TeleGeography research © TeleGeography, Inc. 2000

# International Carrier Call Costs from the U.S.

| | Per Minute Cost (U.S. cents) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Origination Cost | Int'l Circuit Ownership | Int'l Circuit Lease | Settlement Rate | Interconnect Rate | Wholesale Rate | **Total Cost** | **Retail Price/** Profit (Loss) |
| **Americas** | | | | | | | | |
| U.S.-Canada (Toronto) | | | | | | | | **7.0** |
| Own - Settlement | 1.0 | 0.04 | — | 10.0 | — | — | **11.1** | (4.1) |
| Own - Interconnect | 1.0 | 0.04 | — | — | 0.5 | — | **1.6** | 5.4 |
| Lease - Settlement | 1.1 | — | 0.1 | 10.0 | — | — | **11.2** | (4.2) |
| Lease - Interconnect | 1.1 | — | 0.1 | — | 0.5 | — | **1.7** | 5.3 |
| Wholesale for resellers | — | — | — | — | — | 3.0 | **3.0** | 4.0 |
| U.S.-Mexico | | | | | | | | **39.0** |
| Own - Settlement | 1.0 | 0.8 | — | 19.0 | — | — | **20.8** | 18.2 |
| Own - Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Lease - Settlement | 1.1 | — | 3.7 | 19.0 | — | — | **23.8** | 15.2 |
| Lease - Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Wholesale for resellers | — | — | — | — | — | 19.4 | **19.4** | 19.6 |
| U.S.-Chile | | | | | | | | **45.0** |
| Own - Settlement | 1.0 | 0.3 | — | 35.0 | — | — | **36.4** | 8.6 |
| Own - Interconnect | 1.0 | 0.3 | — | — | 1.8 | — | **3.2** | 41.8 |
| Lease - Settlement | 1.1 | — | 1.4 | 35.0 | — | — | **37.4** | 7.6 |
| Lease - Interconnect | 1.1 | — | 1.4 | — | 1.8 | — | **4.2** | 40.8 |
| Wholesale for resellers | — | — | — | — | — | 13.2 | **13.2** | 31.8 |
| **Europe** | | | | | | | | |
| U.S.-Germany | | | | | | | | **17.0** |
| Own - Settlement | 1.0 | 0.1 | — | 10.0 | — | — | **11.1** | 5.9 |
| Own - Interconnect | 1.0 | 0.1 | — | — | 2.2 | — | **3.3** | 13.7 |
| Lease - Settlement | 1.1 | — | 0.7 | 10.0 | — | — | **11.8** | 5.2 |
| Lease - Interconnect | 1.1 | — | 0.7 | — | 2.2 | — | **4.0** | 13.0 |
| Wholesale for resellers | — | — | — | — | — | 8.2 | **8.2** | 8.8 |
| U.S.-U.K. | | | | | | | | **10.0** |
| Own - Settlement | 1.0 | 0.1 | — | 10.0 | — | — | **11.1** | (1.1) |
| Own - Interconnect | 1.0 | 0.1 | — | — | 1.7 | — | **2.8** | 7.2 |
| Lease - Settlement | 1.1 | — | 0.3 | 10.0 | — | — | **11.4** | (1.4) |
| Lease - Interconnect | 1.1 | — | 0.3 | — | 1.7 | — | **3.1** | 6.9 |
| Wholesale for resellers | — | — | — | — | — | 6.8 | **6.8** | 3.2 |

Notes See following page

Source: TeleGeography research

| | Origination Cost | Int'l Circuit Ownership | Int'l Circuit Lease | Settlement Rate | Interconnect Rate | Wholesale Rate | **Total Cost** | **Retail Price/** Profit (Loss) |
|---|---|---|---|---|---|---|---|---|
| | | | | **Per Minute Cost (U.S. cents)** | | | | |
| **Asia** | | | | | | | | |
| U.S.-Australia | | | | | | | | **17.0** |
| Own - Settlement | 1.0 | 0.6 | — | 14.5 | — | — | **16.1** | 0.9 |
| Own - Interconnect | 1.0 | 0.6 | — | — | 1.7 | — | **3.3** | 13.7 |
| Lease - Settlement | 1.1 | — | 2.1 | 14.5 | — | — | **17.7** | (0.7) |
| Lease - Interconnect | 1.1 | — | 2.1 | — | 1.7 | — | **4.9** | 12.1 |
| Wholesale for resellers | — | — | — | — | — | 8.9 | **8.9** | 8.1 |
| U.S.-Hong Kong | | | | | | | | **34.0** |
| Own - Settlement | 1.0 | 0.2 | — | 6.5 | — | — | **7.7** | 26.3 |
| Own - Interconnect | 1.0 | 0.2 | — | — | 1.7 | — | **2.9** | 31.1 |
| Lease - Settlement | 1.1 | — | 2.7 | 6.5 | — | — | **10.2** | 23.8 |
| Lease - Interconnect | 1.1 | — | 2.7 | — | 1.7 | — | **5.4** | 28.6 |
| Wholesale for resellers | — | — | — | — | — | 7.8 | **7.8** | 26.2 |
| U.S.-India | | | | | | | | **66.0** |
| Own - Settlement | 1.0 | 1.9 | — | 54.0 | — | — | **56.9** | 9.1 |
| Own - Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Lease - Settlement | 1.1 | — | 12.7 | 54.0 | — | — | **67.8** | (1.8) |
| Lease - Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Wholesale for resellers | — | — | — | — | — | 53.3 | **53.3** | 12.7 |
| U.S.-Japan | | | | | | | | **26.0** |
| Own - Settlement | 1.0 | 0.2 | — | 14.0 | — | — | **15.3** | 10.7 |
| Own - Interconnect | 1.0 | 0.2 | — | — | 2.4 | — | **3.6** | 22.4 |
| Lease - Settlement | 1.1 | — | 3.2 | 14.0 | — | — | **18.2** | 7.8 |
| Lease - Interconnect | 1.1 | — | 3.2 | — | 2.4 | — | **6.6** | 19.4 |
| Wholesale for resellers | — | — | — | — | — | 9.5 | **9.5** | 16.6 |

Notes:

Prices are indicative of carriers' cost per call, but may not reflect actual costs. Selling, General, & Administrative (SG&A) costs are excluded.

All costs expressed in U.S. cents and are exclusive of taxes. Component costs may not appear to sum to total cost due to rounding.

Rates are based on international calls originating from Washington, D C at peak hours. All rates are current as of August 2000.

Origination cost includes access charges paid to Local Exchange Carrier (Verizon) and U.S. domestic network costs for transmitting calls to international gateway.

Circuit ownership costs reflect half circuit ownership for India. All other circuit ownership costs are for whole circuits.

Circuit ownership costs include price of backhaul

Calculations converting circuit ownership prices to per minute costs assume that each 64 Kbps circuit is used for ten years and that each voice path is used four hours (240 minutes) per day.

Interconnection rates show price for national termination, except for Canada and Japan, where the regional rate is used.

Direct interconnection by foreign carriers to the domestic public switched telephone network is not permitted in India or Mexico

Settlement rates are for peak rate traffic terminated by the largest foreign carrier

U.S.-Mexico settlement rates vary according to originating and terminating locations in both countries. The simple average for all U.S.-Mexico rates is presented here.

Retail rates are based on the WorldCom One calling plan.

Source: TeleGeography research

# International Carrier Call Costs to the U.S.

| | Per Minute Cost (U.S. cents) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Origination Cost | Int'l Circuit Ownership | Int'l Circuit Lease | Settlement Rate | Interconnect Rate | Wholesale Rate | **Total** | **Retail/** Profit (Loss) |
| **Americas** | | | | | | | | |
| Canada-U.S. | | | | | | | | **13.0** |
| Own Settlement | 0.5 | 0.04 | — | 10.0 | — | — | **10.6** | 2.4 |
| Own Interconnect | 0.5 | 0.04 | — | — | 1.0 | — | **1.5** | 11.5 |
| Lease Settlement | 0.5 | — | 0.1 | 10.0 | — | — | **10.7** | 2.3 |
| Lease Interconnect | 0.5 | — | 0.1 | — | 1.0 | — | **1.6** | 11.4 |
| Mexico-U.S. | | | | | | | | **47.9** |
| Own Settlement | 2.6 | 0.8 | — | 19.0 | — | — | **22.4** | 25.5 |
| Own Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Lease Settlement | 2.6 | — | 3.7 | 19.0 | — | — | **25.3** | 22.6 |
| Lease Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Chile-U.S. | | | | | | | | **38.0** |
| Own Settlement | 1.8 | 0.3 | — | 35.0 | — | — | **37.1** | 0.9 |
| Own Interconnect | 1.8 | 0.3 | — | — | 1.0 | — | **3.1** | 34.9 |
| Lease Settlement | 1.8 | — | 1.4 | 35.0 | — | — | **38.2** | (0.2) |
| Lease Interconnect | 1.8 | — | 1.4 | — | 1.0 | — | **4.2** | 33.8 |
| **Europe** | | | | | | | | |
| Germany-U.S. | | | | | | | | **9.2** |
| Own Settlement | 2.2 | 0.1 | — | 10.0 | — | — | **12.3** | (3.1) |
| Own Interconnect | 2.2 | 0.1 | — | — | 1.0 | — | **3.3** | 5.9 |
| Lease Settlement | 2.2 | — | 0.7 | 10.0 | — | — | **12.9** | (3.7) |
| Lease Interconnect | 2.2 | — | 0.7 | — | 1.0 | — | **3.9** | 5.3 |
| U.K.-U.S. | | | | | | | | **32.0** |
| Own Settlement | 1.7 | 0.1 | — | 10.0 | — | — | **11.8** | 20.2 |
| Own Interconnect | 1.7 | 0.1 | — | — | 1.0 | — | **2.8** | 29.2 |
| Lease Settlement | 1.7 | — | 0.3 | 10.0 | — | — | **12.0** | 20.0 |
| Lease Interconnect | 1.7 | — | 0.3 | — | 1.0 | — | **3.0** | 29.0 |

Notes: See following page.
Source. TeleGeography research

| | Per Minute Cost (U.S. cents) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Origination Cost | Int'l Circuit Ownership | Int'l Circuit Lease | Settlement Rate | Interconnect Rate | Wholesale Rate | **Total** | **Retail/** Profit (Loss) |
| **Asia** | | | | | | | | |
| Australia-U.S. | | | | | | | | **22.0** |
| Own Settlement | 1.7 | 0.6 | — | 14.5 | — | — | **16.8** | 5.2 |
| Own Interconnect | 1.7 | 0.6 | — | — | 1.0 | — | **3.3** | 18.7 |
| Lease Settlement | 1.7 | — | 2.1 | 14.5 | — | — | **18.3** | 3.7 |
| Lease Interconnect | 1.7 | — | 2.1 | — | 1.0 | — | **4.8** | 17.2 |
| Hong Kong-U.S. | | | | | | | | **38.0** |
| Own Settlement | 1.7 | 0.2 | — | 6.5 | — | — | **8.4** | 29.6 |
| Own Interconnect | 1.7 | 0.2 | — | — | 1.0 | — | **2.9** | 35.1 |
| Lease Settlement | 1.7 | — | 2.7 | 6.5 | — | — | **10.9** | 27.1 |
| Lease Interconnect | 1.7 | — | 2.7 | — | 1.0 | — | **5.4** | 32.6 |
| India-U.S. | | | | | | | | **132.0** |
| Own Settlement | 2.1 | 1.9 | — | 54.0 | — | — | **58.0** | 74.0 |
| Own Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Lease Settlement | 2.1 | — | 12.7 | 54.0 | — | — | **68.8** | 63.2 |
| Lease Interconnect | — | — | — | — | — | — | **n.a.** | n.a. |
| Japan-U.S. | | | | | | | | **37.0** |
| Own Settlement | 2.4 | 0.2 | — | 14.0 | — | — | **16.6** | 20.4 |
| Own Interconnect | 2.4 | 0.2 | — | — | 1.0 | — | **3.6** | 33.4 |
| Lease Settlement | 2.4 | — | 3.2 | 14.0 | — | — | **19.6** | 17.5 |
| Lease Interconnect | 2.4 | — | 3.2 | — | 1.0 | — | **6.5** | 30.5 |

Notes:

Prices are indicative of carriers' cost per call, but may not reflect actual costs Selling, General, & Administrative (SG&A) costs are excluded.

All costs expressed in U.S cents and are exclusive of taxes. Component costs may not appear to sum to total cost due to rounding.

Retail rates are based on residential discount call plans of the largest foreign carrier. All rates reflect international calls terminating in Washington, DC at peak hours and are current to August 2000.

Non-U.S. carriers may own significant portions of home country local networks, in which case origination costs are counted as intra-corporate transfers.

Circuit ownership costs reflect half circuit ownership for India. All other circuit ownership costs are for whole circuits.

Circuit ownership costs include price of backhaul.

Origination charges for India are estimated.

Calculations converting circuit ownership prices to per minute costs assume that each 64 Kbps circuit is used for ten years and that each voice path is used four hours (240 minutes) per day.

Direct interconnection to the U.S domestic public switched telephone network is not permitted for carriers from India or Mexico.

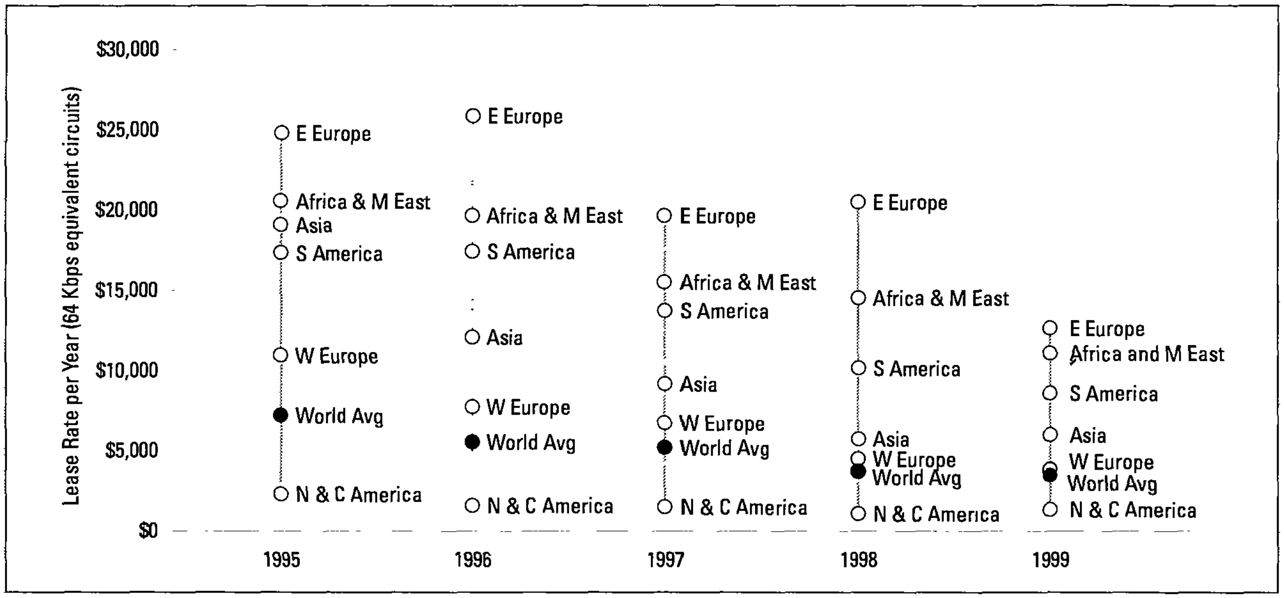
Settlement rates are for peak rate traffic terminated by the largest foreign carrier.

U S.-Mexico settlement rates vary according to originating and terminating locations in both countries. The simple average for all U.S.-Mexico rates is presented here.

Source: TeleGeography research

# International Private Line Prices

## Figure 1. International Private Line Lease Prices from U.S., 1995-1999

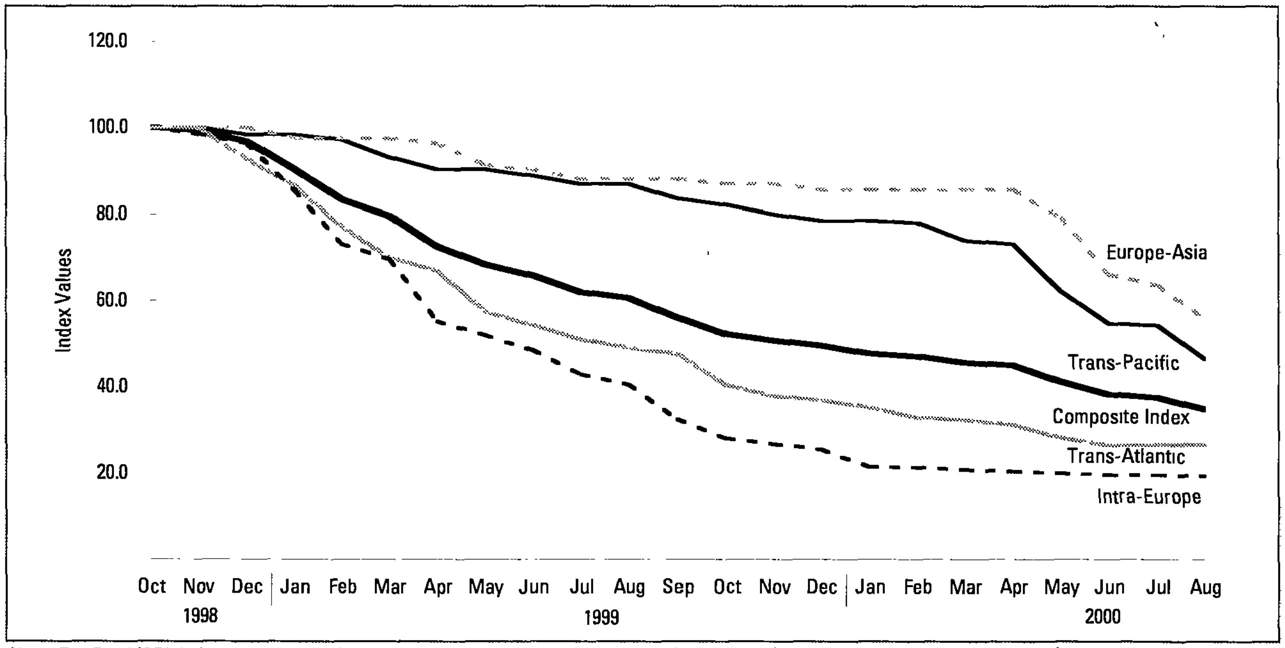



Note: Data reflect averages of annual revenue collected by U.S. international carriers for 64 Kbps circuit leases to countries within each region.

Source: FCC carrier filings and TeleGeography research



## Figure 2. Band-X Bit Index, 1998-2000




Note: The Band-X Bit Index measures relative price movement for one-year E-1 or T-1 circuit leases (depending upon the geographic area) on major routes. This chart summarizes index values into regional indices, based on simple averages for the following groupings: Europe-Asia (London to Sydney, Hong Kong); Trans-Pacific (Los Angeles to Beijing, Hong Kong, Tokyo); Trans-Atlantic (New York to Frankfurt, London, Moscow); Intra-Europe (London to Amsterdam, Brussels, Frankfurt, Madrid, Milan, Paris); Composite (all tracked routes).

Source: Band-X Ltd. (www.band-x.com)

# International Settlement Rates

| Destination | United States 1998 | United States 1999 | United States 2000 | United Kingdom 1998 | United Kingdom 1999 |
|---|---|---|---|---|---|
| Andorra | 0.29 | 0.29 | 0.28 | 0.22 | 0.13 |
| Argentina | 0.35 | 0.33 | 0.19 | 0.86 | 0.56 |
| Australia (Telstra) | 0.15 | 0.15 | 0.15 | 0.28/0.17 | 0.24/0.08 |
| Austria | 0.13 | 0.14 | 0.14 | 0.20 | 0.19 |
| Bahamas | 0.30/0.15 | 0.30/0.15 | 0.15 | 0.38 | 0.36 |
| Bahrain | 0.65 | 0.55 | 0.55 | 0.82 | 0.64 |
| Bangladesh | 0.80 | 0.80 | 0.67 | 0.99 | 0.97 |
| Belarus | 0.43 | 0.43 | 0.35 | 0.35 | 0.34 |
| Belgium | 0.14 | 0.14 | 0.14 | 0.10 | 0.10 |
| Bolivia | 0.46 | 0.43 | 0.29 | 0.90 | 0.89 |
| Brazil | 0.33 | 0.30 | 0.19 | 0.49 | 0.36 |
| Canada | 0.10/0.06 | 0.10/0.06 | 0.10/0.06 | 0.10/0.08 | 0.10/0.04 |
| Chile | 0.35 | 0.35 | 0.35 | 0.90 | 0.89 |
| China | 0.70 | 0.58 | 0.50 | 1.08 | 0.89 |
| Colombia | 0.40 | 0.38 | 0.33 | 0.90 | 0.56 |
| Costa Rica | 0.35 | 0.29 | 0.28 | 0.69 | 0.47 |
| Croatia | 0.28 | 0.25 | 0.22 | 0.33 | 0.33 |
| Cyprus | 0.38 | 0.37 | 0.37 | 0.25 | 0.20 |
| Czech Republic | 0.28 | 0.18 | 0.18 | 0.21 | 0.20 |
| Denmark | 0.11 | 0.11 | 0.12 | 0.10 | 0.07 |
| Dominican Republic | 0.30 | 0.26 | 0.19 | 0.67 | 0.56 |
| El Salvador | 0.39 | 0.31 | 0.27 | 1.54 | 1.18 |
| Finland | 0.16 | 0.14 | 0.14 | 0.15 | 0.13 |
| France | 0.11 | 0.10 | 0.10 | 0.11 | 0.10 |
| French Polynesia | 0.70 | 0.70 | 0.70 | 1.64 | 1.27 |
| Germany | 0.11 | 0.10 | 0.10 | 0.10/0.08 | 0.10/0.04 |
| Ghana | 0.50 | 0.50 | 0.38 | 0.66 | 0.52 |
| Greece | 0.28 | 0.17 | 0.13 | 0.29 | 0.24 |
| Guyana | 0.85 | 0.85 | 0.85 | 0.90 | 0.89 |
| Hong Kong | 0.36 | 0.07 | 0.07 | 0.45 | 0.42 |
| Hungary | 0.28 | 0.19 | 0.16 | 0.18 | 0.18 |
| Iceland | 0.24 | 0.14 | 0.14 | 0.23 | 0.23 |
| India | 0.64 | 0.64 | 0.54 | 0.95 | 0.87 |
| Indonesia | 0.53 | 0.48 | 0.25 | 1.21 | 0.64 |
| Iran | 1.05 | 0.90 | 0.78 | 1.21 | 1.18 |
| Ireland | 0.11 | 0.10 | 0.10 | 0.16 | 0.16 |
| Israel | 0.30 | 0.15 | 0.15 | 0.25 | 0.24 |
| Italy | 0.11 | 0.11 | 0.11 | 0.16 | 0.13 |
| Japan | 0.15 | 0.14 | 0.14 | 0.59 | 0.48 |
| Jordan | 0.68 | 0.50 | 0.50 | 1.21 | 0.97 |

Notes:

1. All rates expressed in US$. Equivalent dollar values are presented for accounting rates that are established in Special Drawing Rights (SDRs), gold francs, or pounds sterling
2. The average U.S. settlement rates for 1998 are weighted by the total minutes between the U.S. and each location in that year. Rates in subsequent years are for August 1999 and July 2000.
3. Where two rates are shown, there are peak/off-peak rates or growth-based rates (traffic above a benchmark level is eligible for a lower rate).
4. Rates are for the largest carrier serving the route. Different settlement rates may apply to competing carriers

| Destination | United States 1998 | United States 1999 | United States 2000 | United Kingdom 1998 | United Kingdom 1999 |
|---|---|---|---|---|---|
| Kazakhstan | 0.69 | 0.51 | 0.34 | 0.82 | 0.64 |
| Korea, Rep. | 0.43 | 0.36 | 0.26 | 0.64 | 0.50 |
| Kuwait | 0.80 | 0.78 | 0.15 | 0.82 | 0.80 |
| Luxembourg | 0.14 | 0.14 | 0.14 | 0.23 | 0.24 |
| Macau | 0.50 | 0.50 | 0.15 | 0.53 | 0.51 |
| Malaysia | 0.40 | 0.40 | 0.19 | 0.51 | 0.50 |
| Mexico | 0.37 | 0.19 | 0.19 | 0.45 | 0.44 |
| Moldova | 1.04 | 1.04 | 1.04 | 0.30 | 0.24 |
| Netherlands | 0.10 | 0.07 | 0.07 | 0.07 | 0.06 |
| New Zealand | 0.13 | 0.14 | 0.14 | 0.20 | 0.19 |
| Norway | 0.09 | 0.08 | 0.08 | 0.07 | 0.07 |
| Oman | 0.75 | 0.68 | 0.60 | 0.82 | 0.80 |
| Pakistan | 0.60 | 0.60 | 0.51 | 0.66 | 0.64 |
| Panama | 0.48 | 0.45 | 0.28 | 0.77 | 0.64 |
| Paraguay | 0.50 | 0.40 | 0.40 | 0.90 | 0.80 |
| Peru | 0.43 | 0.33 | 0.25 | 0.74 | 0.72 |
| Philippines | 0.36 | 0.29 | 0.19 | 0.49 | 0.48 |
| Poland | 0.28 | 0.21 | 0.19 | 0.28 | 0.25 |
| Portugal | 0.22 | 0.15 | 0.15 | 0.23 | 0.18/0.14 |
| Russia | 0.40 | 0.35 | 0.30 | 0.37 | 0.27 |
| Saudi Arabia | 0.87 | 0.68 | 0.67 | 1.27 | 0.89 |
| Singapore | 0.26 | 0.15 | 0.15 | 0.59 | 0.32 |
| Slovak Republic | 0.29 | 0.29 | 0.20 | 0.19/0.10 | 0.19/0.10 |
| Slovenia | 0.35 | 0.34 | 0.34 | 0.18/0.16 | 0.16/0.09 |
| South Africa | 0.40 | 0.35 | 0.30 | 0.66 | 0.48 |
| Spain | 0.13 | 0.14 | 0.14 | 0.16 | 0.16 |
| Sri Lanka | 0.80 | 0.60 | 0.60 | 0.90 | 0.89 |
| Sweden | 0.06 | 0.06 | 0.06 | 0.12 | 0.12 |
| Switzerland | 0.14 | 0.14 | 0.14 | 0.08/0.07 | 0.08/0.04 |
| Taiwan | 0.23 | 0.23 | 0.15 | 0.57 | 0.44 |
| Thailand | 0.45 | 0.35 | 0.30 | 0.82 | 0.80 |
| Turkey | 0.38 | 0.33 | 0.27 | 0.32 | 0.30 |
| Ukraine | 0.50 | 0.50 | 0.22 | 0.31 | 0.29 |
| United Arab Emirates | 1.00/0.65 | 1.00/0.65 | 0.14 | 0.49 | 0.32 |
| United Kingdom | 0.11/0.07 | 0.11/0.07 | 0.10/0.06 | n.a. | n.a. |
| Uruguay | 0.43 | 0.33 | 0.19 | 0.97 | 0.95 |
| U.S. | n.a. | n.a. | n.a. | 0.12/0.08 | 0.12/0.04 |
| Uzbekistan | 0.70 | 0.60 | 0.45 | 0.99 | 0.80 |
| Venezuela | 0.40 | 0.32 | 0.23 | 0.82 | 0.80 |
| Vietnam | 1.65/1.00/0.93/0.85 | 0.78 | 0.67 | 1.31 | 1.29 |
| Yugoslavia | 0.38 | 0.34 | 0.30 | 0.28 | 0.27 |

Note: All rates are expressed in US$.

Source: FCC and OFTEL

# FCC and ITU Settlement Benchmarks

Motivated by the annual multi-billion dollar settlements outflow of U.S. carriers, the Federal Communications Commission (FCC) proposed in 1996 a set of "benchmark" or model settlement rates. Beginning in 1999, these benchmarks capped the amount U.S. carriers could pay their foreign correspondents for traffic exchange at rates ranging from $0.15 to $0.23 per minute. The FCC calculated benchmarks based on the price for the three network elements used to provide international phone services, including international transmission facilities, international switching facilities, and national extension facilities (domestic transport and termination).

The FCC adopted the Benchmarks Order in August 1997, with implementation staggered over several years, based on national incomes. Settlement rates to high and upper-middle income countries have already been affected, following the 1999 deadline. As the table below demonstrates, most countries in the upper income bracket have adopted settlement rates at or below benchmarks. Settlement rates for countries that have already met FCC benchmarks are shown in **bold**.

Separate from the FCC's efforts, a Focus Group of the International Telecommunication Union (ITU) issued a recommended set of "indicative target" settlement rates in November 1998. The Focus Group established seven benchmark brackets based on country teledensity, with separate categories established for small island states and least developed countries (LDCs). Adopted in June 1999, the ITU settlement targets were calculated using the average of the lowest 20 percent of published settlement rates for each bracket. Initially, the ITU's proposed rates ranged well outside the FCC's prescribed band—from $0.06 to $0.45 per minute compared to the FCC's $0.15 to $0.23 . However, as the average of the lowest 20 percent is recalculated annually, the current targets ($0.05 to $0.30) are now much lower than when first established, particularly for countries in the low teledensity brackets. The settlement rate targets take effect December 31, 2001, with an extension to 2004 for LDCs.

**FCC Benchmarks and ITU Target Recommendations (U.S. cents)**

| Country | ITU Target Rate 1998 | ITU Target Rate 2000 | FCC Settlement Benchmarks | August 2000 Settlement Rate with U.S. |
|---|---|---|---|---|
| **Upper Income Bracket for FCC Benchmarks: Effective January 1999** | | | | |
| Australia | 6.0 | 4.9 | 15.0 | **15.0** |
| Austria | 12.0 | 10.7 | 15.0 | **14.0** |
| Bahamas | 12.0 | 15.5 | 15.0 | **15.0*** |
| Belgium | 6.0 | 4.9 | 15.0 | **14.0** |
| Denmark | 6.0 | 4.9 | 15.0 | **12.0** |
| France | 6.0 | 4.9 | 15.0 | **10.0** |
| Germany | 6.0 | 4.9 | 15.0 | **10.0** |
| Hong Kong | 6.0 | 4.9 | 15.0 | **7.0** |
| Ireland | 12.0 | 10.7 | 15.0 | **10.0** |
| Israel | 12.0 | 10.7 | 15.0 | **15.0** |
| Italy | 12.0 | 10.7 | 15.0 | **11.0** |
| Japan | 12.0 | 10.7 | 15.0 | **14.0** |
| Kuwait | 16.0 | 14.9 | 15.0 | **15.0*** |
| Netherlands | 6.0 | 4.9 | 15.0 | **7.0** |
| New Zealand | 12.0 | 10.7 | 15.0 | **14.0** |
| Norway | 6.0 | 4.9 | 15.0 | **8.0** |
| Portugal | 12.0 | 10.7 | 15.0 | **15.0** |
| Singapore | 6.0 | 4.9 | 15.0 | **15.0** |
| Spain | 12.0 | 10.7 | 15.0 | **14.0** |
| Sweden | 6.0 | 4.9 | 15.0 | **6.0** |
| Switzerland | 6.0 | 4.9 | 15.0 | **14.0** |
| Taiwan | 6.0 | 4.9 | 15.0 | **15.0*** |
| United Arab Emirates | 12.0 | 10.7 | 15.0 | **14.0*** |
| United Kingdom | 6.0 | 4.9 | 15.0 | **10.0/6.0** |

**FCC Benchmarks and ITU Target Recommendations (continued)**

| Country | ITU Target Rate 1998 | ITU Target Rate 2000 | FCC Settlement Benchmarks | August 2000 Settlement Rate with U.S. |
|---|---|---|---|---|
| **Upper Middle Income Bracket for FCC Benchmarks: Effective January 2000** | | | | |
| Argentina | 16.0 | 14.9 | 19.0 | **19.0*** |
| Barbados | 16.0 | 15.5 | 19.0 | 50.0 |
| Brazil | 19.0 | 15.3 | 19.0 | **19.0*** |
| Chile | 16.0 | 14.9 | 19.0 | 35.0 |
| Czech Republic | 12.0 | 10.7 | 19.0 | **18.0** |
| Greece | 6.0 | 4.9 | 19.0 | **13.0** |
| Hungary | 12.0 | 10.7 | 19.0 | **16.0** |
| Korea, Rep. | 12.0 | 10.7 | 19.0 | 26.0 |
| Malaysia | 16.0 | 14.9 | 19.0 | **19.0*** |
| Mexico | 19.0 | 15.3 | 19.0 | **19.0** |
| South Africa | 19.0 | 15.3 | 19.0 | 30.0 |
| Trinidad | 16.0 | 14.9 | 19.0 | 41.5 |
| Uruguay | 16.0 | 14.9 | 19.0 | **19.0*** |
| **Lower Middle Income Bracket for FCC Benchmarks: Effective January 2001** | | | | |
| Colombia | 19.0 | 15.3 | 19.0 | 33.0 |
| Costa Rica | 16.0 | 14.9 | 19.0 | 28.0 |
| Dominican Republic | 29.0 | 19.1 | 19.0 | **19.0*** |
| Ecuador | 29.0 | 19.1 | 19.0 | 34.0 |
| El Salvador | 29.0 | 19.1 | 19.0 | 27.0 |
| Guatemala | 29.0 | 19.1 | 19.0 | 29.0 |
| Indonesia | 35.0 | 21.9 | 19.0 | 25.0 |
| Jamaica | 19.0 | 15.3 | 19.0 | 35.0 |
| Jordan | 29.0 | 19.1 | 19.0 | 50.0 |
| Panama | 19.0 | 15.3 | 19.0 | 28.0 |
| Peru | 29.0 | 19.1 | 19.0 | 25.0 |
| Philippines | 35.0 | 21.9 | 19.0 | **19.0*** |
| Poland | 16.0 | 14.9 | 19.0 | **19.0*** |
| Russia | 19.0 | 15.3 | 19.0 | 30.0 |
| Thailand | 29.0 | 19.1 | 19.0 | 30.0 |
| Turkey | 16.0 | 14.9 | 19.0 | 27.0 |
| Venezuela | 19.0 | 15.3 | 19.0 | 23.0 |
| **Lower Income Bracket for FCC Benchmarks: Effective January 2002** | | | | |
| China | 29.0 | 19.1 | 23.0 | 50.0 |
| Egypt | 29.0 | 19.1 | 23.0 | 45.0 |
| Guyana | 29.0 | 19.1 | 23.0 | 85.0 |
| Haiti | 45.0 | 29.6 | 23.0 | 50.0 |
| Honduras | 35.0 | 21.9 | 23.0 | 39.0 |
| India | 35.0 | 21.9 | 23.0 | 54.0 |
| Kenya | 45.0 | 29.6 | 23.0 | 55.0 |
| Nicaragua | 45.0 | 29.6 | 23.0 | 36.0 |
| Pakistan | 35.0 | 21.9 | 23.0 | 51.0 |
| Vietnam | 35.0 | 21.9 | 23.0 | 67.0 |

Notes: Rates became compliant with FCC benchmarks in 2000 are noted with an asterisk (*).
ITU target rates are established in Special Drawing Rights (SDRs). Equivalent U.S. dollar values are subject to exchange rate adjustments.

Source: FCC and ITU

# National Interconnection Rates

| | Local Termination (U.S. cents) | | | Regional Termination (U.S. cents) | | | National Termination (U.S. cents) | | | Fixed to Mobile Termination (U.S. cents) |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 | 1998 | 1999 | 2000 | 2000 |
| Argentina | n.a. | 2.35 | 1.10 | n.a. | 2.35 | 1.10 | n.a. | 2.35 | 1.10 | n.a. |
| Australia | 1.62 | 2.15 | 0.82 | 5.30 | 2.18 | 1.42 | 9.90 | 4.00 | 1.65 | n.a. |
| Austria | 2.00 | 1.90 | 0.97 | 2.00 | 1.90 | 1.46 | 2.63 | 2.50 | 2.15 | 22.48 |
| Belgium | 1.23 | 1.11 | 0.78 | 2.33 | 1.87 | 1.22 | 3.26 | 2.67 | 1.58 | 18.00 |
| Canada | n.a. | n.a. | n.a. | 5.33 | 0.78 | 0.51 | n.a. | n.a. | n.a. | n.a. |
| Chile | n.a. | n.a. | 1.79 | n.a. | n.a. | 1.79 | n.a. | n.a. | 1.79 | n.a. |
| China | n.a. | n.a. | 1.50 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Colombia | n.a. | n.a. | 2.82 | n.a. | n.a. | 2.82 | n.a. | n.a. | 2.82 | n.a. |
| Denmark | 1.09 | 1.03 | 0.81 | 2.02 | 1.92 | 1.52 | 2.46 | 2.33 | 1.83 | 17.00 |
| Finland | 1.56 | 1.67 | 1.36 | 1.58 | 1.67 | n.a. | 3.12 | 4.12 | 1.44 | n.a. |
| France | 0.78 | 0.63 | 0.56 | 1.90 | 1.56 | 1.13 | 2.80 | 2.32 | 1.69 | 20.00 |
| Germany | 1.10 | 1.05 | 0.83 | 1.88 | 2.26 | 1.80 | 2.86 | 2.74 | 2.18 | 24.00 |
| Hong Kong | n.a. | 1.65 | 1.65 | n.a. | 1.65 | 1.65 | n.a. | 1.65 | 1.65 | 0.13 |
| Hungary | n.a. | n.a. | 6.61 | n.a. | n.a. | 6.61 | n.a. | n.a. | 6.61 | 3.79 |
| Ireland | 2.44 | 1.08 | 0.98 | 4.61. | 1.67 | 1.41 | 8.75 | 2.36 | 1.93 | n.a. |
| Israel | n.a. | 0.80 | 0.80 | n.a. | 1.30 | 1.30 | n.a. | 2.50 | 2.50 | n.a. |
| Italy | 1.68 | 1.03 | 0.96 | 2.74 | 1.86 | 1.55 | n.a. | 2.69 | 2.19 | 23.00 |
| Japan | 1.81 | 1.74 | 1.54 | 3.73 | 3.31 | 2.38 | n.a. | n.a. | n.a. | 29.99 |
| Luxembourg | 2.23 | 2.34 | 1.43 | 2.23 | 2.34 | 1.43 | 2.23 | 2.34 | 1.43 | n.a. |
| Mexico | n.a. | n.a. | n.a. | 5.32 | 2.61 | 2.61 | n.a. | n.a. | n.a. | 18.00 |
| Netherlands | 1.30 | 1.16 | 0.91 | 1.78 | 1.74 | 1.30 | 2.29 | 2.11 | 1.39 | 18.00 |
| New Zealand | n.a. | 1.43 | 1.38 | n.a. | n.a. | n.a. | n.a. | 6.66 | n.a. | n.a. |
| Norway | n.a. | 1.00 | 0.82 | n.a. | 1.38 | 1.17 | n.a. | 1.63 | 1.75 | 15.60 |
| Peru | n.a. | 2.90 | 1.68 | n.a. | 2.90 | 1.68 | n.a. | 2.90 | 1.68 | 15.62 |
| Portugal | 1.33 | 2.87 | 0.63 | 2.63 | 5.74 | 1.24 | 19.98 | 11.48 | 2.15 | 3.00 |
| Spain | 1.65 | 1.03 | 0.86 | 1.65 | 1.66 | 1.44 | 4.63 | 3.20 | 2.55 | 20.00 |
| Sweden | 1.27 | 0.77 | 0.62 | 1.96 | 1.07 | 0.82 | 2.68 | 1.52 | 1.00 | 2.33 |
| Switzerland | n.a. | n.a. | n.a. | 2.72 | 1.50 | 0.32 | 3.73 | 2.08 | 0.59 | 29.54 |
| U.K. | 0.60 | 0.62 | 0.56 | 0.96 | 0.82 | 0.82 | 1.73 | 1.76 | 1.68 | 20.42 |
| U.S. (Verizon) | n.a. | n.a. | n.a. | 0.79 | 1.20 | 0.97 | n.a. | n.a. | n.a. | 2.64 |

Notes:
All interconnection charges are for peak period.
All rates are established in national currencies. Equivalent U.S. dollar values are subject to exchange rate fluctuation.
Local termination is the lowest level of interconnection, typically giving a carrier access to a single town or part of a city
Regional and national termination are also known as single tandem and double tandem termination.
Regional termination generally gives a carrier access to all subscribers within a metropolitan area or a North American area code.
*U.S. termination fees vary according* to Local Exchange Carrier (LEC). U.S. average for regional termination was 1.05¢ as of July 2000.

Source: National regulatory agencies, OECD, and ITU

# The New Calculus

## A Primer on Interconnection Accounting

### The Local Money Pit

Transmitting international phone calls was once an expensive proposition. But technology and deregulation have pushed down long-haul transmission costs to the point that it is now the beginning and end of a call—were calls are handed to and from a local operator—that incur the greatest expense (at least on competitive routes that are well-served by modern telecom infrastructure). After Selling, General, and Administrative (SG&A) costs, therefore, the majority of call costs on these routes fall outside the direct control of the service provider (see Figure 1. Call Costs from U.S. to U.K. and U.S. to Japan). How, then, can international service providers anticipate their termination and origination costs?

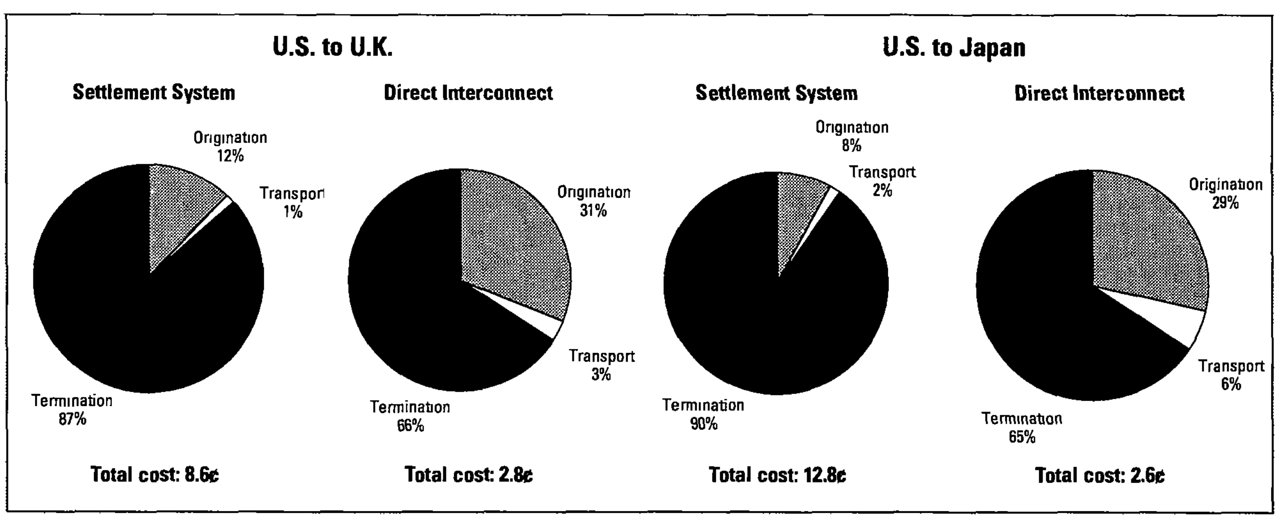
In most markets, the local exchange carrier (LEC) ultimately determines its own network access rates; however, it is often the regulator that prescribes the framework for calculation. In order to make this process efficient, transparent, and responsive to changing market conditions, national regulatory agencies (NRAs) have sought to establish a clear methodology for setting interconnect rates. Most NRAs have worked, in principle, to ensure that fees reflect actual local carrier costs. That may seem fair enough. But the tougher question is: Which "actual" costs should be counted? Should such costs reflect only per minute transmission costs incurred when sending calls over a network? Or should interconnect fees compensate LECs for a wider range of expenses, such as network upgrades and expansion?

Many NRAs are wrestling with these questions, and some have proposed diverging methodologies to deal with them. This article clarifies the differences among interconnection regimes and draws out the assumptions of the underlying methodologies.

### The Old and New Regimes

Interconnect rates compensate local carriers for use of their networks by long-distance operators. Thus, these access charges perform a similar function to the traditional settlement rate system employed by international carriers. There are, however, some important differences. First, under the settlement rate regime, an international carrier theoretically hands off a call at the mid-point of an international circuit, or between "half circuits." The originating carrier then relies upon its terminating counterpart to switch the call onto its domestic long-distance network to the final destination. In contrast, direct interconnection requires the originating operator to carry a call all the way to the national gateway in the country of termination, through a "whole circuit." In the long term, the originating operator may wish to build

**Figure 1. Call Costs from U.S. to U.K. and U.S. to Japan**




Source: TeleGeography research

out its own long-haul network within the country, pushing the point of interconnection closer to the final call destination. Interconnection regimes exist in most countries with competitive markets, where a single operator no longer monopolizes both long distance and local service.

Second, settlement rates are generally one size fits all—no matter where inside a country a carrier sends the call, the rate is the same. On the other hand, interconnect fees tend to be distance sensitive, often divided into three bands. Although definitions vary by country, typical rate classifications are *local* (calls handed off at the local exchange), *single transit* or *single tandem* (calls terminated within the metropolitan area or within a set regional distance), and *double transit* or *double tandem* (calls handed off at the national level). For example, a carrier sending traffic to France would pay France Télécom 1.7¢ per minute to deliver a call from an international gateway in Paris to a business in Marseille. If that same operator carried the call on a leased line all the way to the local switching office in Marseille, it would only pay only a 0.6¢ per minute fee.

Finally, settlement rates tend to be far more expensive than interconnect rates. The settlement rate between Canadian operator Teleglobe and U.S. carriers is $0.10 per minute, whereas the regional interconnect rate in Canada is half of that. Nevertheless, when using direct interconnection, origination and termination fees still account for a huge portion of per minute call costs. In the settlement rates model for originating carriers, termination charges can comprise nearly 90 percent of call costs, edging down to 65 percent when paying direct interconnect fees (again, see Figure 1).

**Methodologies**

Most governments have, in some form, decided that interconnect fees should reflect the actual costs of network usage and development. But what is the best way to do that? Economic theory suggests that interconnection rates should be set to achieve the most efficient level of financing for network maintenance and expansion. If the rate is too high, competitors will have a strong incentive to build their own networks, creating excessive infrastructure. If too low, competitors will have little incentive to build and maintain networks. To strike an efficient balance, regulators have developed methods to establish prices systematically and transparently, and then to update those prices continuously.

Although NRAs employ dozens of different methodologies, most can be categorized into three broad groupings: short run marginal cost (SRMC), fully distributed cost (FDC), and long run incremental cost (LRIC). The latter of the three, LRIC, has been the most widely adopted cost calculation method.

**Short Run Marginal Cost (SRMC)**

Short Run Marginal Cost (SRMC), also known as short run incremental or variable cost, measures the cost of resources required for the production of one more unit of output. In this case, SRMC reflects one additional minute of call time on a local network. SRMC takes into account only "direct" and "current" costs. Direct costs are exclusively related to the particular service (e.g., switches specifically designated to interconnect with long-distance networks). Common or joint costs, which are shared among different activities and services, are not considered. Current costs exclude the

**Figure 2. A Trade Dispute for the 21st Century**

*Although the rules for compensating telcos for the few miles of copper wire that runs between a local switch and their customers may seem a parochial concern, these rules have emerged as a hot global trade issue.*

One long-standing dispute between the U.S. and Japan over Japanese local incumbent Nippon Telephone and Telegraph's (NTT) high interconnection rates was resolved in July 2000. According to the U.S. government negotiators, Japan was protecting state-owned NTT through high switching termination charges; NTT applied the revenue from the high fees toward overseas expansion. In 1999, NTT's local switch termination charges were over 60 percent higher than the world average, and regional switch termination charges were more than 70 percent above the average. In the July agreement, NTT agreed to a schedule of reductions that lowered its regional switch rates 55 percent and local rates 19 percent by 2002.

A similar disagreement—this time between the U.S. and Mexico—heated up just as the U.S.-Japan dispute was cooling off. Telmex, the incumbent local and long-distance operator in Mexico, had made some downward adjustments to its domestic interconnection rates (Mexico does not allow direct international carrier interconnect) since the market was opened to long distance competition in 1998. But the new termination rates (one cent above the world average 1.6¢) still did not align with some U.S.-owned carriers' interpretation of Mexico's market opening commitments made in the 1997 World Trade Organization (WTO) agreement on basic telecom services. As a result, the U.S. government began the first steps to filing a formal complaint with the WTO in July 2000, although the process remained in the "consultation" phase at this writing. If an agreement can not be reached, the U.S. may bring the matter before a WTO panel for judgement. If the panel rules against Mexico, the U.S. may invoke trade sanctions on Mexico.

**Figure 3. EU Best Practices**

The European Union (EU) decided in 1997 to transfer policy making for network interconnection and telecom competition from the domain of Member States to the Community level. As part of this effort, the European Parliament and Council issued a directive on interconnection in telecommunications to promote fair competition, following the liberalization of the European telecommunications market in 1998. Although the directive concluded in favor of a rate system based on long-run incremental cost analysis, it also acknowledged that the establishment of methodological parameters and the research necessary to complete the model could take several years.

In the interim, the EU is using "best practice" rates as a check on excessively high interconnect fees. The process for establishing these rates is simple: the EU Commission collects local, single transit, and double transit interconnect rates from the fifteen member states; fees from the three lowest cost member states in each interconnection band form the range for best current practices. For the year 2000, these rates were drawn from the following countries: France, Sweden, and the U.K. (local interconnection); and, the Netherlands, Sweden, and the U.K. (both single and double transit interconnection). These best practice rates are recommended but not enforced, intended to shape the ongoing debate over interconnection. For the March 2000 amendment to the EU's interconnection recommendations, see: www.ispo.cec.be/infosoc/telecompolicy/en/rec20c0en.pdf.



operator's cost of setting up the network (fixed costs) or for future maintenance, upgrades, and expansion.

Critics of this method argue that this interconnection rate would be too low to maintain any level of growth, because the LEC would not recover enough of its very substantial fixed and network costs. Competitors would not have sufficient incentive to build their own networks, either, because of the low cost at which they can access the incumbent's network. Not surprisingly, SRMC is often trumpeted by long-distance operators in newly-opened markets as the methodology of choice. Despite this support, SRMC has not been applied by NRAs in any markets as of this writing.

**Fully Distributed Cost (FDC)**

Fully Distributed Cost (FDC), also known as fully allocated cost, is much more inclusive than SRMC. Beyond accounting for direct costs, FDC also covers common costs. In addition, FDC often employs historical accounting methods, calculating costs over past expenditures rather than present or future ones. Historical accounting tends to benefit incumbent carriers because rates calculated using past costs are usually higher than those based on current or future costs, as costs overall have continuously declined. One of the major criticisms of FDC is that it encourages operation and investment inefficiency by local carriers, because fees are linked tightly to spending.

When the U.K. introduced a telecom duopoly in 1984 and the system of rate accounting was examined for the first time, the Office of Telecommunications (OFTEL) determined that local calling prices were being subsidized by overpriced long distance rates. Instead of allowing British Telecommunications (BT) to increase its local line rate to better reflect the balance of costs, OFTEL implemented an FDC methodology that allowed BT to recover some of its lost profit through interconnection fees. Then, after local and long distance tariffs had been rebalanced by the late 1990s, OFTEL again shifted its accounting system to what they deemed a more appropriate long term solution: LRIC. This third methodology is described below.

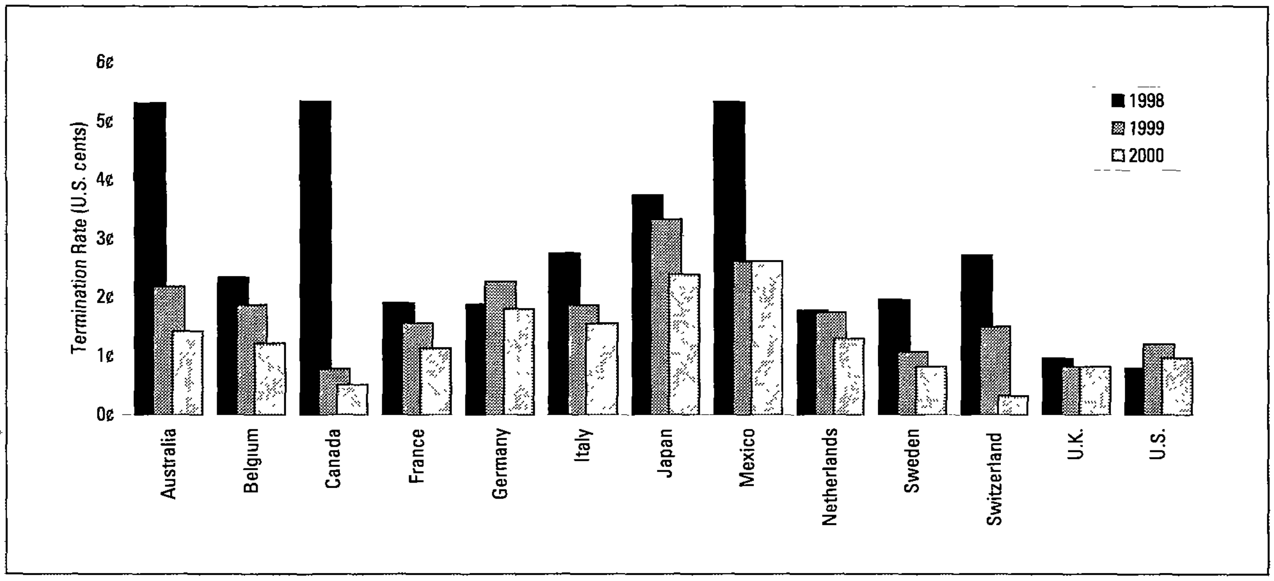
**Long Run Incremental Cost (LRIC)**

Several NRAs have attempted to find a middle ground between SRMC's lack of incumbent cost recovery and FDC's strong compensation for historical costs in the Long Run Incremental Cost (LRIC) methodology. LRIC is similar to SRMC inasmuch as sunk costs—unrecoverable, past, fixed costs to build the network—are not considered. The difference between the two methodologies hinges on the time frame for cost inclusion. While SRMC considers the marginal cost of a minute of traffic based on the network in the short run, LRIC considers the long run possibility of technological improvements and capacity increases. In fact, LRIC defines the "long run" as the period of time in which alterations or expansions to the network can be implemented. Therefore, LRIC includes not only the marginal cost of today's network, but also the marginal cost of developing a network. The methodology, therefore, tends to be friendlier to rate-payers than FDC, but less harsh to incumbents than SRMC.

The basic structure of LRIC allows room for precise adaptation to each market. Models may differ over actual classification of specific direct, current, and potential future costs, as well as definitions of the "long run." Distinct LRIC variations exist as a result—LRAIC (average), TSLRIC (total service), TELRIC (total element)—while all share fundamental principles of long run incremental cost.

This shift from fully distributed cost accounting to LRIC methodologies may explain some of the recent decreases in termination rates (see Figure 4. Regional Termination Rates, 1998-2000). For example, Danish interconnect fees have dropped over 20 percent since the introduction of LRIC in 1999, compared to a six percent drop the previous year. Canadian interconnect rates have also declined over 90 percent since the implementation of an incremental cost methodology in 1998. Across the board, origination and

**Figure 4. Regional Termination Rates, 1998-2000**




Source: TeleGeography research 

termination rates continue to decrease at a faster pace with LRIC implementation than with FDC.

**Conclusion**

As the price of international bandwidth continues to decline, the costs at either end of a call are becoming a more important portion of international service providers' costs. Regulators have only recently begun to scrutinize these costs and develop long term rate-setting policies. Though carriers and regulators agree that rates should be tied to local carriers' actual costs, the precise methodology by which to calculate those costs remains a matter of debate. Today, most countries implement an LRIC strategy to allow for adequate compensation of costs for incumbent local carriers while offering a fair and competitive rate for international service providers.

# Retail Prices for a Three Minute Call

| From/To | Australia | Belgium | Canada | Czech Rep. | Finland | France | Germany | Greece | Hong Kong | Ireland | Italy |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | n.a. | 1.97 | 1.42 | 2.85 | 1.83 | 1.83 | 1.68 | 1.55 | 1.26 | 1.40 | 1.36 |
| Austria peak | 0.86 | 0.81 | 0.86 | 0.65 | 0.81 | 0.81 | 0.65 | 0.86 | 0.86 | 0.81 | 0.65 |
| Austria off-peak | 0.77 | 0.68 | 0.77 | 0.54 | 0.68 | 0.68 | 0.54 | 0.77 | 0.77 | 0.68 | 0.54 |
| Belgium peak | 2.66 | n.a. | 1.33 | 1.99 | 1.33 | 1.00 | 1.00 | 1.33 | 2.66 | 1.33 | 1.33 |
| Belgium off-peak | 2.66 | n.a. | 1.33 | 1.99 | 1.33 | 1.00 | 1.00 | 1.33 | 2.66 | 1.33 | 1.33 |
| Czech Rep. peak | 1.77 | 1.14 | 1.70 | n.a. | 1.20 | 1.14 | 1.07 | 1.20 | 3.35 | 1.20 | 1.14 |
| Czech Rep. off-peak | 1.14 | 0.69 | 1.07 | n.a. | 0.76 | 0.69 | 0.63 | 0.76 | 2.65 | 0.76 | 0.69 |
| Denmark peak | 1.82 | 1.05 | 1.03 | 1.17 | 0.59 | 1.04 | 0.71 | 1.32 | 3.20 | 1.05 | 1.03 |
| Denmark off-peak | 1.40 | 0.81 | 0.71 | 0.94 | 0.48 | 0.68 | 0.46 | 0.95 | 2.91 | 0.85 | 0.65 |
| Finland | 1.90 | 1.27 | 1.27 | 1.27 | n.a. | 1.27 | 1.12 | 1.27 | 3.39 | 1.27 | 1.27 |
| France peak | 1.25 | 0.43 | 0.49 | 0.90 | 0.43 | n.a. | 0.43 | 0.68 | 1.25 | 0.43 | 0.43 |
| France off-peak | 1.12 | 0.42 | 0.51 | 0.86 | 0.42 | n.a. | 0.42 | 0.68 | 1.12 | 0.42 | 0.42 |
| Germany | 0.62 | 0.29 | 0.29 | 0.57 | 0.29 | 0.29 | n.a. | 0.57 | 1.85 | 0.29 | 0.29 |
| Greece | 0.86 | 0.86 | 0.86 | 1.22 | 0.86 | 0.86 | 0.86 | n.a. | 1.22 | 0.86 | 0.86 |
| Ireland peak | 1.91 | 0.85 | 0.65 | 1.08 | 1.08 | 0.85 | 0.85 | 1.08 | 1.91 | n.a. | 1.08 |
| Ireland off-peak | 1.53 | 0.75 | 0.57 | 0.94 | 0.94 | 0.75 | 0.75 | 0.94 | 1.53 | n.a. | 0.94 |
| Italy peak | 2.38 | 0.92 | 0.92 | 1.29 | 0.92 | 0.92 | 0.92 | 0.92 | 2.96 | 0.92 | n.a. |
| Italy off-peak | 2.38 | 0.92 | 0.92 | 1.29 | 0.92 | 0.92 | 0.92 | 0.92 | 2.96 | 0.92 | n.a. |
| Japan peak | 6.43 | 8.14 | 4.07 | 8.14 | 8.14 | 5.49 | 5.49 | 8.14 | 8.14 | 8.14 | 8.14 |
| Japan off-peak | 5.11 | 6.81 | 3.41 | 6.81 | 6.81 | 5.30 | 5.30 | 6.81 | 6.81 | 6.81 | 6.81 |
| Korea, Rep. | 3.00 | 3.56 | 3.92 | 3.56 | 3.56 | 3.53 | 3.53 | 3.56 | 2.62 | 3.56 | 3.53 |
| Mexico peak | 5.49 | 4.85 | 3.49 | 4.85 | 4.85 | 4.85 | 4.85 | 4.85 | 5.49 | 4.85 | 4.85 |
| Mexico off-peak | 3.66 | 3.23 | 2.62 | 3.23 | 3.23 | 3.23 | 3.23 | 3.23 | 3.66 | 3.23 | 3.23 |
| Netherlands peak | 0.56 | 0.31 | 0.31 | 0.76 | 0.61 | 0.34 | 0.27 | 0.87 | 1.03 | 0.66 | 0.44 |
| Netherlands off-peak | 0.56 | 0.31 | 0.31 | 0.76 | 0.61 | 0.34 | 0.27 | 0.87 | 1.03 | 0.66 | 0.44 |
| Poland peak | 2.55 | 1.14 | 2.55 | 1.02 | 1.25 | 1.25 | 1.14 | 1.25 | 4.61 | 1.39 | 1.25 |
| Poland off-peak | 2.55 | 1.14 | 2.55 | 1.02 | 1.25 | 1.25 | 1.14 | 1.25 | 4.61 | 1.39 | 1.25 |
| Portugal | 2.15 | 0.88 | 0.88 | 1.62 | 0.88 | 0.85 | 0.85 | 0.88 | 2.84 | 0.88 | 0.88 |
| Singapore | 1.04 | 1.74 | 0.68 | 3.30 | 1.74 | 1.74 | 1.74 | 2.43 | 1.22 | 2.43 | 1.74 |
| Spain | 2.90 | 0.92 | 1.65 | 1.31 | 0.92 | 0.92 | 0.92 | 0.92 | 2.90 | 0.92 | 0.92 |
| Sweden | 0.94 | 0.35 | 0.29 | 0.94 | 0.28 | 0.35 | 0.29 | 0.54 | 1.96 | 0.54 | 0.54 |
| Switzerland | 0.43 | 0.43 | 0.22 | 1.08 | 0.43 | 0.22 | 0.22 | 0.43 | 1.08 | 0.43 | 0.22 |
| Turkey | 3.57 | 1.39 | 2.08 | 1.39 | 1.39 | 1.39 | 1.39 | 1.39 | 3.57 | 1.39 | 1.39 |
| U.K. peak | 1.88 | 1.09 | 0.91 | 1.48 | 1.48 | 1.09 | 1.09 | 1.36 | 1.88 | 0.88 | 1.36 |
| U.K. off-peak | 1.61 | 1.02 | 0.86 | 1.33 | 1.33 | 1.02 | 1.02 | 1.14 | 1.61 | 0.76 | 1.14 |
| U.S. (WorldCom One) | 0.51 | 0.51 | 0.21 | 1.89 | 0.51 | 0.51 | 0.51 | 0.51 | 1.02 | 0.51 | 0.51 |
| U.S. (WorldCom Basic) | 6.21 | 6.27 | 2.19 | 7.92 | 5.91 | 5.4 | 5.07 | 8.55 | 7.47 | 5.49 | 6.21 |
| U.S. (AT&T One Rate) | 0.51 | 0.87 | 0.21 | 1.89 | 0.87 | 0.51 | 0.51 | 0.51 | 0.45 | 0.51 | 0.51 |
| U.S. (AT&T Basic) | 6.66 | 6.81 | 2.37 | 8.25 | 6.48 | 5.88 | 5.46 | 8.55 | 8.07 | 5.94 | 6.63 |

Notes:
1. All rates are in US$ and exclusive of taxes and were current on August 31, 2000. Peak hours are between 9:00-19:30, Monday-Friday.
2. Rates have been calculated in real time using meter step (rounded up to next meter step for a 3 minute call).
3. Fees are $2 with domestic long distance per month for AT&T One Rate and $3 per month for WorldCom One
4. Rates for calls from the U.S. to Canada and Mexico are from Washington, D.C to Montreal and Mexico City.

| Japan | Korea, Rep. | Mexico | Neth'lands | Poland | Singapore | Spain | Sweden | Turkey | U.K. | U.S. | To/From |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.93 | 1.76 | 2 85 | 1.78 | 2.57 | 1.33 | 2.25 | 1.83 | 2.16 | 1.40 | 1.42 | Australia |
| 0.86 | 0.86 | 1.28 | 0.81 | 0.92 | 0.86 | 0.81 | 0.81 | 0.92 | 0.81 | 0.86 | Austria peak |
| 0.77 | 0.77 | 1.14 | 0.68 | 0.92 | 0.77 | 0.68 | 0.68 | 0.92 | 0.68 | 0.77 | Austria off-peak |
| 2.66 | 3 65 | 4.65 | 1.00 | 1.99 | 2 66 | 1.33 | 1.33 | 1.99 | 1 00 | 1.33 | Belgium peak |
| 2.66 | 3.65 | 4.65 | 1.00 | 1.99 | 2.66 | 1.33 | 1.33 | 1.99 | 1.00 | 1.33 | Belgium off-peak |
| 1.77 | 4.29 | 3.53 | 1.14 | 1.07 | 3.53 | 1.20 | 1.14 | 1.64 | 1.14 | 1.70 | Czech Rep. peak |
| 1.14 | 3.28 | 2.65 | 0.69 | 0.63 | 2.65 | 0.76 | 0.69 | 1.26 | 0.69 | 1.07 | Czech Rep off-peak |
| 2.55 | 4.21 | 4.21 | 0 91 | 0.85 | 2.91 | 1.32 | 0.48 | 1.60 | 0.71 | 1.03 | Denmark peak |
| 2.04 | 3.34 | 3.34 | 0.71 | 0.74 | 2.33 | 0.95 | 0.37 | 1 11 | 0.53 | 0.78 | Denmark off-peak |
| 3.13 | 4 14 | 4 14 | 1.27 | 1.27 | 3.39 | 1.27 | 0 41 | 1.27 | 1.27 | 1.27 | Finland |
| 1.25 | 1.25 | 1.66 | 0.43 | 0.90 | 1.66 | 0.43 | 0.43 | 0.90 | 0.43 | 0.43 | France peak |
| 1.12 | 1.12 | 1.52 | 0 42 | 0.86 | 1.52 | 0.42 | 0.42 | 0.86 | 0.42 | 0.42 | France off-peak |
| 1.85 | 1.85 | 2 42 | 0.29 | 0.57 | 2.57 | 0.29 | 0.29 | 0.57 | 0.29 | 0.29 | Germany |
| 1.22 | 1.22 | 2.01 | 0 86 | 1.22 | 1.22 | 0.86 | 0.86 | 1.05 | 0.86 | 0.86 | Greece |
| 1.91 | 2.74 | 1.71 | 0.85 | 1.08 | 1.91 | 1.08 | 1.08 | 2.06 | 0.34 | 0.65 | Ireland peak |
| 1.53 | 2.74 | 1.54 | 0.75 | 0.94 | 1.53 | 0.94 | 0.94 | 1.78 | 0.32 | 0.57 | Ireland off-peak |
| 2.38 | 2.96 | 3.86 | 0.92 | 1.29 | 2.96 | 0.92 | 0.92 | 1.88 | 0.92 | 0.92 | Italy peak |
| 2.38 | 2.96 | 3.86 | 0.92 | 1.29 | 2.96 | 0.92 | 0 92 | 1.88 | 0.92 | 0.92 | Italy off-peak |
| n.a. | 3.50 | 6.72 | 8.14 | 8.14 | 5.20 | 8.14 | 8.14 | 8.14 | 4.07 | 1.70 | Japan peak |
| n.a. | 2.84 | 5.58 | 6.81 | 6.81 | 4.54 | 6.81 | 6.81 | 6.81 | 3.97 | 1.42 | Japan off-peak |
| 2.22 | n.a. | 4.07 | 3.53 | 3.56 | 2.62 | 3.53 | 3.53 | 3.56 | 2.98 | 1.90 | Korea, Rep. |
| 5.49 | 5.49 | n.a. | 4.85 | 4.85 | 5.49 | 4.85 | 4.85 | 4.85 | 4.85 | 3.09 | Mexico peak |
| 3.66 | 3.66 | n.a. | 3.23 | 3.23 | 3.66 | 3.23 | 3.23 | 3 23 | 3.23 | 2.32 | Mexico off-peak |
| 1.03 | 1 86 | 2 48 | n.a. | 0.87 | 1.28 | 0.44 | 0.36 | 0.92 | 0.25 | 0.21 | Netherlands peak |
| 1.03 | 1.86 | 2.48 | n.a. | 0.87 | 1.28 | 0.44 | 0.36 | 0.92 | 0.25 | 0.21 | Netherlands off-peak |
| 4.61 | 4 61 | 4.61 | 1.14 | n.a. | 4.61 | 1.38 | 1.14 | 1.38 | 1.25 | 2.55 | Poland peak |
| 4.61 | 4.61 | 4.61 | 1.14 | n.a. | 4.61 | 1.38 | 1.14 | 1.38 | 1.25 | 2.55 | Poland off-peak |
| 2.84 | 2.84 | 2.98 | 0.88 | 1.62 | 3.80 | 0.74 | 0.88 | 1.62 | 0.85 | 0.85 | Portugal |
| 1.56 | 2 17 | 3.47 | 1.74 | 3.30 | n.a. | 2.43 | 1.74 | 3.30 | 1.02 | 0.68 | Singapore |
| 2.90 | 2.90 | 2.20 | 0.92 | 1.31 | 2.90 | n.a. | 0.92 | 1.54 | 1.00 | 1.07 | Spain |
| 0.94 | 2.60 | 1.96 | 0.35 | 0.54 | 1.31 | 0.54 | n.a. | 0.94 | 0.29 | 0.29 | Sweden |
| 1.08 | 2.05 | 2 59 | 0.43 | 1.08 | 1.08 | 0.43 | 0.43 | 1.08 | 0.43 | 0 22 | Switzerland |
| 3.57 | 3.57 | 3.57 | 1.39 | 1.39 | 3.57 | 1.39 | 1.39 | n a. | 1.39 | 2.08 | Turkey |
| 2.59 | 4.15 | 4.15 | 1.09 | 1.48 | 2.24 | 1.36 | 1 09 | 2.59 | n.a. | 0.91 | U.K. peak |
| 2.20 | 3.94 | 3.94 | 1.02 | 1.33 | 2.13 | 1.14 | 1.02 | 2.20 | n.a. | 0.86 | U.K. off-peak |
| 0.78 | 0.81 | 1.17 | 0.51 | 1.02 | 1.05 | 0.51 | 0.51 | 1.53 | 0.30 | n.a. | U.S. (WorldCom One) |
| 6.00 | 7.47 | 4.98 | 5.34 | 6.63 | 6.72 | 6.63 | 5.34 | 7.56 | 4.50 | n.a. | U.S. (WorldCom Basic) |
| 0.48 | 0.45 | 1.05 | 0.75 | 0.84 | 0.84 | 0.51 | 0.60 | 1.35 | 0.30 | n.a. | U.S. (AT&T One Rate) |
| 6.39 | 7.98 | 6.24 | 5.79 | 6.93 | 7.26 | 7.14 | 5.79 | 8.07 | 4.77 | n.a. | U.S (AT&T Basic) |

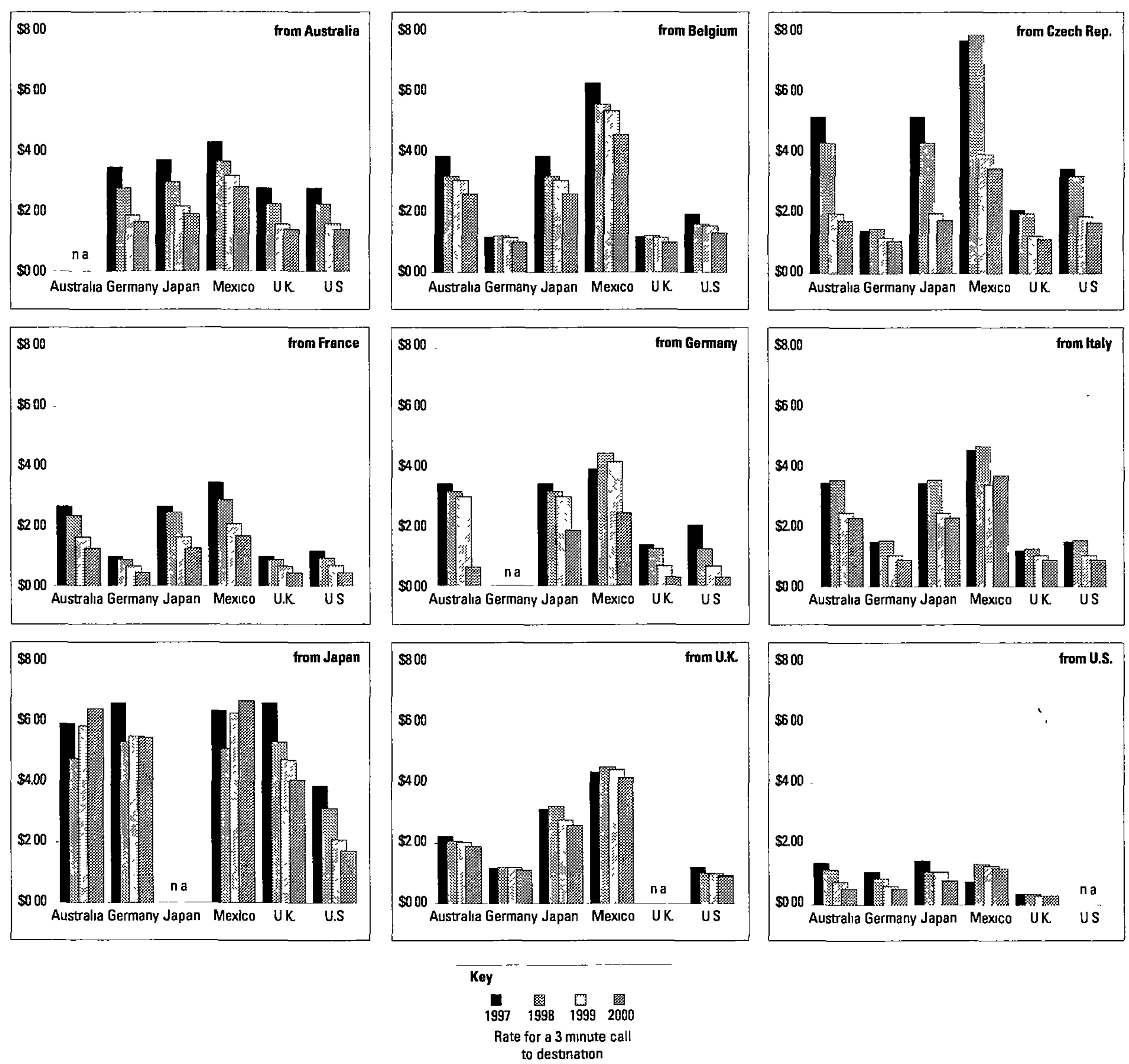
Source: Tarifica - a unit of The Phillips Group, 3rd Floor, 19 Thomas More St., London E1 9YW, U K
Tel +44 20 7423 4500 • Fax +44 20 7423 4501 • Email: consult@tarifica.com • www.tarifica com

Every effort has been made to ensure that this pricing data is up-to-date and accurate However, Tarifica can not be held responsible for any losses arising from use of the data

Source for U S. rates TeleGeography research

# Retail Pricing Trends, 1997-2000

**Figure 1. Retail Tariffs for Selected Countries**




Note: All rates are for peak calling and are expressed in US dollars.

Source: Philips Tarifica and TeleGeography research

# Retail and Wholesale Rates: PSTN versus VoIP

| | PSTN Rates | | VoIP Rates | |
|---|---|---|---|---|
| Country | Retail | Wholesale | Retail | Wholesale |
| Argentina | 0.52 | 0.23 | 0.25 | 0.14 |
| Australia | 0.17 | 0.09 | 0.08 | 0.03 |
| Austria | 0.17 | 0.09 | 0.08 | 0.04 |
| Bahamas | 0.37 | 0.27 | 0.21 | 0.09 |
| Belarus | 0.63 | 0.32 | 0.30 | 0.20 |
| Belgium | 0.17 | 0.08 | 0.08 | 0.03 |
| Brazil | 0.38 | 0.19 | 0.21 | 0.14 |
| Canada | 0.07 | n.a. | 0.04 | 0.03 |
| Chile | 0.45 | 0.13 | 0.11 | 0.05 |
| China | 0.59 | 0.22 | 0.21 | 0.07 |
| Colombia | 0.52 | 0.19 | 0.22 | 0.13 |
| Cyprus | 0.62 | 0.24 | 0.26 | 0.13 |
| Czech Republic | 0.63 | 0.19 | n.a. | 0.18 |
| Dominican Republic | 0.44 | 0.15 | 0.23 | 0.09 |
| Finland | 0.17 | 0.11 | 0.08 | 0.05 |
| France | 0.17 | 0.08 | 0.08 | 0.03 |
| French Polynesia | 1.54 | 0.38 | 0.66 | 0.19 |
| Germany | 0.17 | 0.08 | 0.08 | 0.03 |
| Ghana | 0.68 | 0.29 | 0.49 | 0.21 |
| Guyana | 0.17 | n.a. | 0.20 | 0.11 |
| Hong Kong | 0.34 | 0.08 | 0.08 | 0.03 |
| India | 0.66 | 0.53 | 0.55 | 0.49 |
| Indonesia | 0.53 | 0.28 | 0.36 | 0.19 |
| Iran | 0.85 | 0.58 | 0.95 | 0.48 |
| Israel | 0.28 | 0.12 | 0.08 | 0.06 |
| Japan | 0.26 | 0.09 | 0.08 | 0.04 |
| Malaysia | 0.44 | 0.15 | 0.19 | 0.06 |
| Mexico | 0.39 | 0.19 | 0.19 | 0.12 |
| Netherlands | 0.17 | 0.08 | 0.08 | 0.03 |
| New Zealand | 0.17 | 0.09 | 0.08 | 0.03 |
| Pakistan | 0.75 | 0.58 | 0.78 | 0.46 |
| Peru | 0.52 | 0.33 | 0.31 | 0.17 |
| Poland | 0.34 | 0.21 | 0.29 | 0.12 |
| Russia | 0.47 | 0.28 | 0.21 | 0.12 |
| Saudi Arabia | 0.70 | 0.52 | 0.82 | 0.39 |
| Singapore | 0.35 | 0.13 | 0.15 | 0.04 |
| South Africa | 0.53 | 0.31 | 0.30 | 0.20 |
| Spain | 0.17 | 0.12 | 0.08 | 0.03 |
| Sri Lanka | 1.13 | 0.63 | 0.81 | 0.26 |
| Switzerland | 0.17 | 0.09 | 0.08 | 0.03 |
| Taiwan | 0.33 | 0.12 | 0.11 | 0.06 |
| Turkey | 0.51 | 0.24 | 0.17 | 0.17 |
| Ukraine | 0.48 | 0.31 | 0.20 | 0.13 |
| United Arab Emirates | 0.55 | 0.30 | 0.40 | 0.18 |
| United Kingdom | 0.10 | 0.07 | 0.08 | 0.02 |
| Venezuela | 0.35 | 0.26 | 0.26 | 0.18 |
| Vietnam | 0.89 | 0.78 | 0.97 | 0.65 |
| Yugoslavia | 0.84 | 0.28 | 0.42 | 0.20 |

Note: *Rates are for calls from the United States*

Source: PSTN retail rates: WorldCom One; VoIP retail rates: deltathree com PC-to-Phone. Wholesale rates reflect two major international carriers' rates as of September 2000.

# Follow the Money

## Network-to-Network Payments for Internet Telephony and Other IP Traffic Streams

*As the Internet diverts more international telephone traffic from the existing carrier-to-carrier system for settling accounts, there is a growing interest in new ways to share the network costs of global Internet communications. This article profiles compensation arrangements—clearinghouses and paid transit—used today by networks providing cross-border Internet telephony. It also looks at several factors (e.g., Internet billing software) that are likely to affect the adoption of new internetwork compensation schemes. The article suggests that the current financial pressure on major Internet service providers and long distance carriers alike may accelerate implementation of new compensation models.*

**Introduction**

The bloom is off the rose. For decades, international phone calls provided a large source of high-margin revenue for telephone operators worldwide. No more. In a few short years, open markets, abundant new transmission capacity, and the rise of the Internet have driven long distance call prices closer to their cost, especially for wholesale providers. This has led to hard times for well-established companies; many new carriers have fared much worse (see Figure 1. The Death of Distance).

Even AT&T, the largest U.S. telco, has not been immune from the stock market's revaluation of the long distance business. By June 2000, *The Financial Times* reported that AT&T's share price actually reflected a negative value for its long distance unit after taking account of the company's cable TV, wireless, and other assets. Similarly, in August 2000, CS First Boston concluded that if WorldCom were broken up, its consumer long distance business—still the bulk of WorldCom's revenue—would only be worth $5 billion out of a $60 billion total valuation.

In the 1990s, the pressure on the margins for international calls came chiefly from innovative least-cost routing arrangements that worked within the existing settlement system (callback and traffic refile). [1] These practices sharply eroded the wholesale termination fees or settlements paid by one telephone operator to another for completing international calls. Today, one of the greatest pressures on international settlements comes from Internet telephone and fax services; they threaten to bypass the settlement system altogether.

International telephone companies appear to be caught between two worlds, neither of which is viable. On the one hand, despite the Internet's allure, the bulk of most operators' phone traffic (at least outside Western Europe and North America) is still subject to the accounting rate system, and the payments the operators receive from foreign correspondents remain a significant revenue source. For example, according to the ITU's study, *Challenges to the Network*, in 1998, net settlement revenue from international telephone services totaled over $125 million for the Dominican Republic, Poland, Egypt, Lebanon, Vietnam, and Pakistan; net revenues were approximately $500 million or more for China, the Philippines, India, and Mexico. For carriers serving these countries, Internet telephony is a clear economic threat.

On the other hand, even in developing countries, most operators acknowledge the rough consensus that has been forged among the world's telecom engineers: over the next decade, the Internet's packet switched protocols will provide a common global platform for almost all communication services. The migration of voice traffic from dedicated, long-haul transmission facilities for switched telephony to multi-purpose packet-based data networks is no longer a question of "if" but "when." [2] Hence, while the Internet may be a near-term revenue threat to long distance services, in theory, it holds out the promise of new revenues from other products.

For a start, Internet telephony may offer telcos an entrée to various unified-messaging services by offering a common means for sending real-time and stored messages (e.g., voicemail, email, and fax). And that is just the beginning. Over the next few years, the Net also may provide operators an opportunity to move up the value chain by sharing the revenue from multi-media and e-commerce services (e.g., music, films, games, and shopping). At least that is the theory.

The closer technology gets to bringing this vision to the market, the greater the interest in new network-to-network payment schemes. As with telephone service, the scale necessary to provision Internet services is expensive, and it requires the cooperation of numerous other networks. In the telephone

## Figure 1. The Death of Distance: International Carrier Bankruptcies and Distress Sales

**Who:** Cherry Communications **What:** Bankruptcy
**When:** 1997
**Why:** In 1996, Cherry was a top U.S. international reseller with 10 percent of the market (over 650 million minutes). But poor cost controls, "shady" selling practices, and a large number of uncollectible accounts put it into bankruptcy. It was then bought by World Access, Inc., a company partly owned by WorldCom, which has since bought several other distressed carriers.

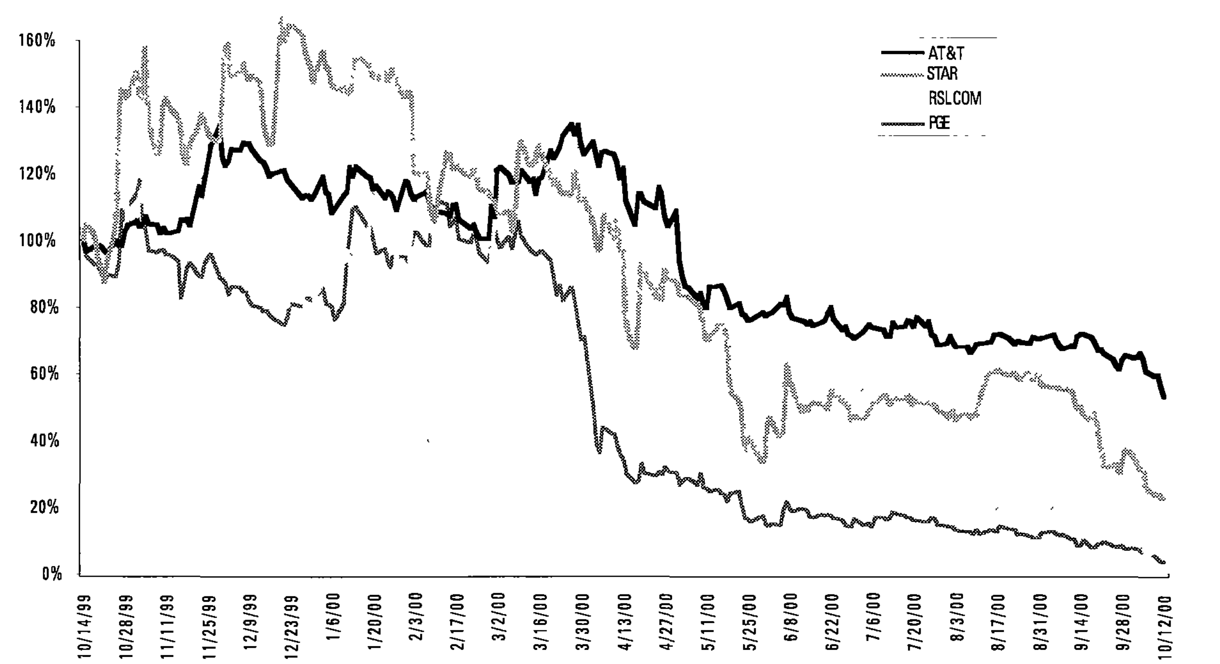
**Who:** Telegroup **What:** Bankruptcy
**When:** February 1999
**Why:** As a pioneering call-back operator, Telegroup had few peers. Revenues rose from $270,000 in 1990 to $337 million in 1997, allowing a $40 million IPO. But Asia's economic crisis dampened the appetite for calls billed in U.S. dollars, just as the company was spending heavily to build out its global network. In June 1999, Primus Telecommunications bought Telegroup's U.S. business out of bankruptcy for $72 million.

**Who:** STAR Telecommunications **What:** Distress Sale
**When:** February 2000
**Why:** Once a stock market favorite (in the spring of 1998, STAR's shares were up over 400 percent from the 1997 IPO), by mid-1999 STAR was long on capacity and short on cash. And, despite a booming traffic base (over two billion minutes in 1999), half from its PT-1 pre-paid card affiliate, the pressure on call margins was unrelenting. STAR sold receivables to raise cash and then later agreed to be bought by World Access, with PT-1 sold off to Canadian-owned Counsel Communications.

**Who:** GST Telecommunications **What:** Bankruptcy
**When:** May 2000
**Why:** GST focused on the western United States and called itself an "Integrated Communications Provider," offering Internet and local access services. But most of its revenues (and investments) were linked to its long distance and international calling business. And pricing pressure never allowed the company to earn enough to fund its ambitious network construction plans.

**Who:** Pacific Gateway Exchange **What:** Asset Sales
**When:** Spring 2000
**Why:** With backing from Japan's KDD, Pacific Gateway Exchange (PGE) was often touted as a sure bet to capitalize on "emerging global telecom opportunities." It specialized in trans-Pacific routes and, buoyed by its rapid growth, went "long" on numerous undersea cable systems. Yet as per-minute margins fell and growth slowed, PGE found its cable portfolio more of a liability than an asset, especially as cheaper capacity came online. The market began to lose faith and, in March 2000, the company restated its 1999 earnings. A flurry of stockholder actions followed, driving PGE's share price below $5 a share (it had reached $62 in 1998). To keep afloat, PGE sold much of its cable capacity to Metromedia Fiber Network and is currently refocusing on international data and VoIP services.

**One-Year Index of International Carrier Stock Prices**




Source: Company reports and U.S. Securities and Exchange Commission (SEC) world, however, most operators receive significant payments from other networks in exchange for providing end-to-end service. Not so for the Internet. As explained more fully in Part II, neither of the prevailing inter-network compensation models for the Internet—peering (where no money changes hands) and transit (where payments are one-way)—provides an obvious replacement for the bilateral revenue sharing arrangements which now prevail in the telephone industry. [3]

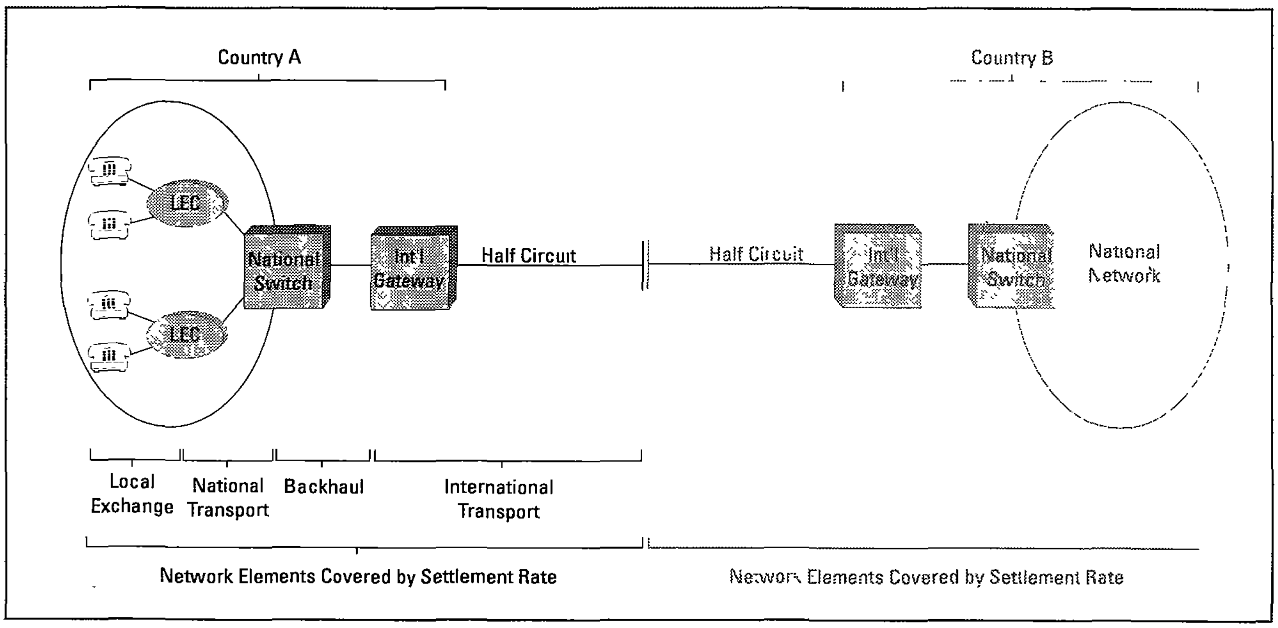
In these circumstances, the greater an operator's reliance on network-to-network compensation payments, the greater the concern about the transition to Internet-based services. This concern has grown during the last year as the stock markets have begun to write down the capital value of almost every company which provides long-haul telecommunication services (again, see Figure 1).

Put bluntly: How will the costs of handling two-way traffic on IP networks be recouped where the great majority of service providers are downstream ISPs which make net outpayments to upstream networks? From end-user charges alone? Or advertising? Or non-network services?

Similarly, in tomorrow's Internet-based world, who will bear the cost of implementing much needed cross-network Quality of Service (QoS) standards for telephony and other applications? And, where network traffic flows are asymmetrical—the *sine qua non* of the public Internet—what is the incentive for smaller networks to make new investments when most of the money flows to their larger correspondents?

The remainder of this article is organized into three main sections. Part II briefly reviews the existing settlement systems for international telephone operators and contrasts that with the prevailing inter-network compensation schemes among global ISPs. Part III looks in more detail at emerging inter-network payment arrangements for Internet telephony and, to a lesser extent, for other IP-based services. The article concludes with

**Figure 2. How the Accounting Rate System Works for International Telephony**




1. What is an accounting rate? The accounting rate is a bilaterally agreed per minute rate for carrying public switched telephone network traffic between two carriers (A and B) in different countries. This is the wholesale rate of the call from beginning to end.
2. Carriers use the accounting rate to settle accounts with one another for handling traffic in both directions. The carrier originating the greater number of minutes in an agreed period (typically, one month) pays out funds to the other carrier in an amount equal to the number of surplus minutes multiplied by one-half the accounting rate (known as the settlement rate).
3. For example, if in a given period carrier A sends 100 minutes to carrier B, and carrier B sends 150 minutes to carrier A, then carrier A has a surplus of 50 minutes.
4. Assume now that the accounting rate is $0.30 per minute. Multiplying this 50-minute surplus by one-half the accounting rate, carrier B pays to carrier A an amount equal to 50 x $0.15 or $7.50.

Source: Adapted from *Direction of Traffic 1994*, TeleGeography/ITU.

a look at some of the factors which are likely to advance or retard new network compensation schemes for IP services.

## II. From Settlements to Transit

### A. Settlements

The classic paradigm for sharing the cost of international telecommunications is based on joint ventures for switched telephony. Two Public Telephone Operators (PTOs), one from country A and one from country B, agree to exchange traffic and each PTO covers the cost of provisioning and maintaining a circuit to a half-way point that links their two networks. To cover the provisioning costs, the two operators pay each other one-half of an agreed wholesale charge, known as an accounting rate, for each minute of traffic the other terminates. At the same time, each operator retains the freedom to set the end-to-end retail charge for traffic originating on its own network.

Inter-operator settlements are based on net traffic balances. Thus, on any given route, the operator originating more traffic than it terminates pays out funds to its correspondent (see Figure 2. How the Accounting Rate System Works for International Telephony).

Despite the fact that long-haul transmission costs have fallen rapidly since the mid-1990s, a PTO that receives more traffic than it sends has an obvious incentive to keep its accounting rate high so as to maintain incoming settlement payments. High, yes, but not so high that it encourages too much traffic bypass; that would be self-defeating. Thus, in the face of alternative call routing techniques (third country refile, ISR, "leaky" corporate branch exchanges, and mobile networks), most operators have been gradually forced to reduce their settlement rates or face a growing loss of traffic and revenues. [4]

In richer countries, settlement rates have come under even greater pressure because the majority of international traffic is now data, not voice, and a large portion of that data stream is Internet traffic. Consequently, even though most of the revenues that carriers receive for use of their international networks still come from retail charges and settlements related to voice, more and more of the bandwidth and switching costs are attributable to data. And, unless these data/Internet costs are recovered from the retail charges assessed on Internet customers or from network connection charges, voice subscribers will be subsidizing them.

So let us now take an initial look at how international operators are typically compensated for hauling Internet traffic. We will concentrate here only on the network-to-network payments involved, leaving end-user charges aside. At the network or wholesale level, two types of payment models currently predominate: peering and transit. To put these models in context, a short digression is useful on the Internet's global structure.

From a service provider's perspective, the Internet looks something like a river system. On the Internet, the headwaters are formed by thousands of small, often local, networks. They route their customer's traffic to the rest of the Net via hundreds of tributary networks which, in turn, connect to the rest of the world via a top tier of Amazon-sized backbone networks (see Figure 3. Market Shares of Internet Backbone Providers). In June 2000, the U.S. Department of Justice (DOJ) provided a useful overview of this architecture when it sought to block two of the top tier backbone networks—WorldCom and Sprint—from merging and thus gaining undue market power vis-à-vis other backbone networks.

**Figure 3. Market Shares of Internet Backbone Providers**

| | *Boardwatch* | | *DataCommunications* | | U.S. Department of Justice Study | |
|---|---|---|---|---|---|---|
| Rank | Provider | Market Share | Provider | Market Share | Provider | Market Share |
| 1 | WorldCom | 21% | WorldCom | 37% | WorldCom | 37% |
| 2 | Sprint | 13% | n.a. | n.a. | Sprint | 16% |
| 3 | Cable & Wireless | 8% | Cable & Wireless | 13% | n.a. | n.a. |
| 4 | AT&T | 6% | AT&T | 12% | n.a. | n.a. |
| 5 | Verio | 5% | Genuity | 12% | n.a. | n.a. |
| Total | | 53% | | 74% | | 53% |

Notes: *Boardwatch* rankings are based on number of transit relationships with other ISPs as of December 1999. *Data Communications* rankings are based on the routing tables of the 500 most trafficked web sites as of June 1999. U.S. Department of Justice study is based on March 2000 data.

Source: *Boardwatch Magazine, Data Communications Magazine*, and the U.S. Department of Justice © TeleGeography, Inc. 2000

## Figure 4. Time to Pay Up? ITU-T Recommendation D.(iii) International Internet Connections

ITU-T Recommendation D.50—perhaps better known as draft D.(iii)—was adopted in April 2000 by representatives of the world's telecom ministers in Geneva. The text appeared to be a model of economic diplomacy:

> *"It is recommended that administrations negotiate and agree to bilateral commercial arrangements applying to direct international Internet connection whereby each administration will be compensated for the costs that it incurs in carrying traffic that is generated by the other administration." [1]*

But this rather anodyne text—that the costs of Internet transmission capacity used by two parties for bilateral service be shared among them—soon triggered a fierce debate. On the one side was the U.S. government and major U.S. international carriers, most of which are also U.S. Internet Backbone Providers (IBPs). They saw the draft International Telecommunication Union (ITU) Recommendation D.(iii) as an attempt to impose a traffic-based settlement system on the Internet akin to the "discredited" accounting rate regime used for international telephony. That is the worst kind of regulatory meddling, said the Americans, and it would stifle the ability of Internet Service Providers (ISPs) to negotiate their own interconnect terms—terms that have thus far led to a rapid build-out of global bandwidth, fostered broad Internet connectivity, and stimulated the necessary investment to scale the core backbone networks in the U.S. to accommodate Internet transit traffic from around the world.

Not so, said D.(iii)'s proponents, led by Australia and other Asia-Pacific nations. [2] We are not "asking that the telephony model be adopted" for the Internet but are only "proposing that principles such as 'non-discrimination', 'transparency' and 'cost-based' be applied to all services...."

First, its proponents argued, D.(iii) eschews government intervention; it seeks to rely on commercial negotiations. Second, it is pro-competitive and would encourage new ISPs worldwide because non-U.S. ISPs must now subsidize the top tier of largely U.S.-based IBPs. How is that? Off-shore ISPs typically pay the full cost of the international transmission capacity to the U.S. even though, once provisioned, the capacity is made available—without charge—to U.S.-based ISPs to send Internet traffic in the opposite direction to off-shore ISPs and their customers.

One result is that non-U.S. ISPs face disproportionately high international "transit" or interconnect costs which must be recouped from their customers. That raises the costs of local Internet access, said D.(iii)'s advocates, and also deters new entrants in poorer and middle income countries.

At best this is half true, replies the U.S. Yes, U.S. IBPs require off-shore ISPs to acquire their own transmission facilities if they wish to connect in the U.S., but many IBPs have off-shore points of presence (PoPs). And non-U.S. ISPs are free to build or buy their own U.S. backbones if they wish; the market for Internet backbone services is wide open. Witness, for example, NTT's acquisition of Verio, a major U.S. ISP, though this deal apparently was subject to unprecedented terms by U.S. law enforcement officials.

In addition, said the U.S., draft Recommendation D.(iii) is insufficiently inclusive. It singles out international leased line costs and fails to consider cost-sharing for Internet facilities generally (e.g., for domestic links, hubs, web sites, maintenance).

The fight over cost-sharing for global Internet access continued in May 2000 at the Cancún, Mexico, meeting of telecom ministers from the Asia-Pacific Economic Cooperation (APEC) group. After extensive debate, the following terms were appended to a proposed action program for review by APEC's economic ministers at their November 2000 meeting in Brunei:

- Governments need not intervene in private business agreements on International Charging Agreements for Internet Services achieved in a competitive environment, but where there are dominant players or *de facto* monopolies, governments must play a role in promoting fair competition.
- Internet Charging Agreements between providers of network services should be commercially negotiated and, among other issues, reflect:
  - The contribution of each network to the communication;
  - The use by each party of the interconnected network resources; and,
  - The end-to-end costs of international transport link capacity.

In Cancún, as in Geneva, U.S. telecom officials derided the need for government oversight of the Internet's privately owned global infrastructure, absent the existence of any dominant players. However, the very next month, American antitrust officials contended that the private sector could not be trusted to safeguard the Internet's global architecture. The U.S. Department of Justice (DOJ) went to court to block the merger of America's two largest IBPs, WorldCom and Sprint, because a combined company would control 53 percent of U.S. Internet traffic—five times that of the next largest IBP. According to the DOJ, that would have given the merged entity the incentive and ability to impair rival ISPs by raising their costs and/or degrading the quality of interconnections. [3]

Back to the ITU. In October 2000, after a 10-day meeting in Montreal, the ITU's World Telecommunication Standardization Assembly (WTSA) adopted a compromise version of Recommendation D.(iii) based on text brokered by Canada and the Netherlands. [4] Adopted by consensus, with the U.S. and Greece taking reservations, the ITU now recommends that:

continued on next page

**Figure 4. (continued)**

*"administrations involved in the provision of international Internet connections negotiate and agree to bilateral commercial arrangements enabling direct international Internet connections that take into account the possible need for compensation between them for the value of elements such as traffic flow, number of routes, geographical coverage and cost of international transmission among others."*

**Notes:**

[1] In ITU parlance, administration means a telecommunications operator or Recognized Operating Agency (ROA). According to Australia, a prime advocate of Recommendation D.(iii), the term ROA "includes any operator of facilities that provides public access and connection to the communication infrastructure and address space of the global Internet." See "Australia Recommendation D.(iii)," Document 84-E, September 2000, WTSA-2000, available at www.itu.int/itudocr/itu-t/wtsa/docs/index.html (registration required).

[2] For background, see "Asia-Pacific Telecommunity Study Group 3 Proposed Recommendation Diii", Document 81-E, September 2000, WTSA-2000. For the U.S. position, see Documents 49-E [Substantive Issues] and 52-E [Procedural Issues]. All documents available at the ITU URL referenced in Note 1 above.

[3] See www.usdoj.gov/atr/cases/f5000/5051.htm.

[4] For details, see "Draft Report of Committee 6," Document 149-E, WTSA-2000, and "Report of Committee 6," Document 160-E, WTSA-2000.



As the DOJ explained, "Because the Internet comprises thousands of separate networks, direct interconnections [among these networks] would be impractical. Instead, the Internet has developed a . . . structure in which smaller networks are interconnected with one of the few large Internet 'backbone' networks, which operate high-capacity long-haul transmission facilities and are interconnected with each other." Thus, in a typical Internet session, "an ISP sends data from one of its customers to the large network that the ISP uses for backbone services, which in turn sends the data to another backbone network, which then delivers it to the ISP serving the end user to whom the data is addressed."

The small number of Internet backbone providers (IBPs) at the top of this food chain all sell transit service to substantial numbers of ISPs and sell dedicated Internet access directly to corporate customers or other enterprises. Tier One IBPs have large, high capacity national and international networks, and typically maintain private peering relationships with all other Tier One IBPs on a settlement-free basis.

Smaller IBPs, often referred to as Tier Two or Tier Three IBPs, also may sell transit to ISPs (or IBPs) and sell dedicated Internet access to end-users. However, as the DOJ explains, these Tier Two or Tier Three IBPs typically purchase transit from, rather than peer with, one or more Tier One IBPs and/or rely substantially upon exchanging traffic at "inferior" (and those are the DOJ's words) public interconnection facilities. Any lower tier IBP that must purchase significant connectivity thus operates "at substantial cost disadvantages compared to Tier One IBPs" which rely upon peering.

Let us now return to the economics of peering and transit, following which we shall consider how these schemes may affect the flow of funds for VoIP and other specific IP services.

**Peering**

As noted above, peering exists mostly between ISPs with like-sized networks (e.g., between the handful of global IBPs and among smaller Tier Three networks). Among peers, no money is exchanged. Payment comes in the form of reciprocal network use: I'll terminate your traffic if you terminate mine. These reciprocal obligations are not service-specific. That is, peers terminate VoIP and other traffic indifferently.

There are some caveats. Peers only agree to accept traffic from each other if that traffic is destined for their network customers (i.e., end-users) or for a network buying transit services from them. Peers will not hand off or "transit" traffic for each other. And each peer typically pays for one-half of the cost of the leased lines necessary to connect its network to the other.

In the mid-1990s, as differences among ISPs grew—for example, in terms of customer base and network infrastructure—universal peering fell out of favor. ISPs with more extensive transmission networks began charging smaller ISPs and some hosting facilities (e.g., web server farms) for the right to route traffic over their networks to reach end-users. This arrangement is generally known as transit. [5]

**Transit**

Transit agreements typically involve a standard monthly interconnection fee based upon the line speed a customer requires plus a traffic-sensitive fee for use of additional capacity. For these transit fees, the user gets full Internet connectivity (see Figure 7. Band-X Routed IP Pricing).

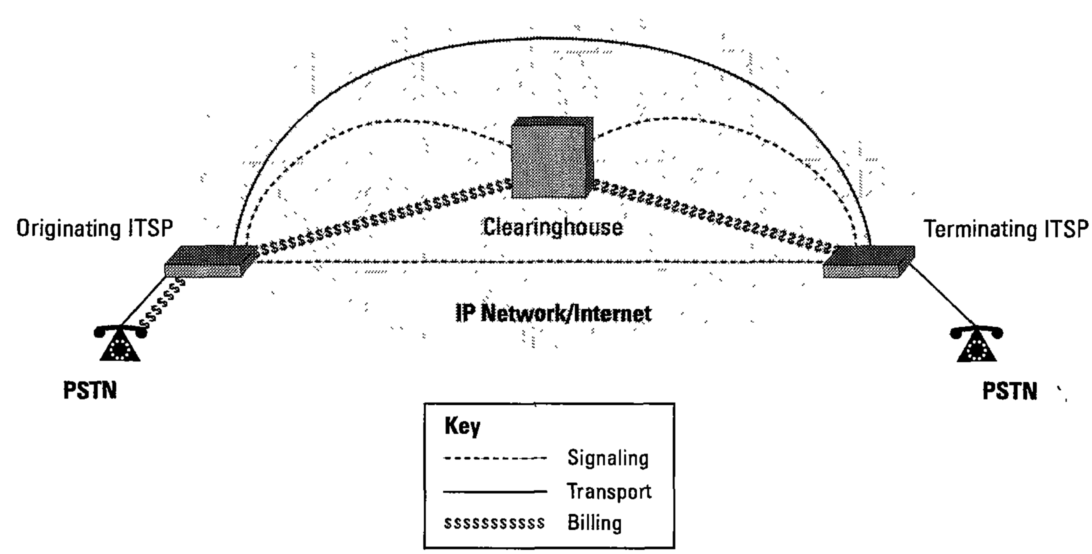
Few question the economic rationale for the current system of transit charges—larger networks provide more value. But like the accounting rate system for switched telephone traffic, it tends to be self-reinforcing. The larger an IBP's network, the more it may be able to dictate access terms for downstream networks. And the greater a network's ability to acquire potential competitors, the greater the barrier to entry for newcomers.

In these circumstances, it may not be surprising that U.S. and European Union regulators have had to step in repeatedly in the 1990's to keep the top tier of Internet service providers competitive: network effects make larger horizontal combinations economically compelling. In addition, the market power of the largest IBPs may allow them to shift significant facility costs for cross-border access onto downstream networks—a matter which is of special concern to non-U.S. ISPs (see Figure 4. Time to Pay Up? ITU-T Recommendation D.(iii) International Internet Connections).

There is no mistaking the privileged position Tier One IBPs have within the sector. In mid-2000, for example, when GTE spun off its Tier One IBP, Genuity, the company explained the importance of maintaining Genuity's position this way in its stock prospectus:

"Any significant loss to market share . . . could cause the loss of our status as a Tier One Internet backbone provider, which would make our services significantly less attractive to existing and potential customers and would likely result in a significant loss of revenues. In addition, the loss of . . . Tier One [status] . . . would adversely affect our ability to maintain our free private peering relationships with other Tier One [IBPs]. Currently these relationships allow us to have direct, cost-free exchange of traffic with other Tier One Internet backbone

**Figure 5. VoIP Clearinghouse Payment Flows**




1. Both originators and terminators of traffic pay an initiation fee to the clearinghouse that usually includes a metering software-licensing fee and a charge for facilitating the initial connection to the clearinghouse, which includes training of personnel.
2. Both originators and terminators provision their own connections to either an IP network designated by the clearinghouse or to the public Internet. The choice is based on quality and cost.
3. Originators pay the advertised rate for termination to the location of their choice. See Figure 6. Clearinghouse Terms for VoIP Traffic Termination for sample rates.
4. The clearinghouse takes a portion of the rate from an originator. Industry clearing rates differ, and rates between certain customers of the same clearinghouse differ as well. The range is anywhere from five to 17.5 percent. The primary element affecting the clearing rate is volume; the more traffic an originator sends to a clearinghouse, the lower the clearing rate.
5. The clearinghouse then arranges for payment to the terminator for its services. Using an average clearing rate of 11 percent for a three minute call to Russia, here is how the money flows:

   a) The originator pays $0.36 for a three minute call to Russia placed through the clearinghouse.

   b) The clearinghouse gets the clearing fee of 11 percent or approximately $0.04.

   c) The terminator receives $0.32.

Source: TeleGeography research

providers and allow us to avoid the congestion of public peering points when directing traffic to users connected to those other Internet backbones. If we are unable to maintain these free peering relationships our operating costs will increase and our results of operations will suffer."

**B. Settlements vs. Transit**

There is actually less difference than one might think between the settlement systems now used for compensating international telephone carriers and the compensation systems that characterize the Internet. They are both generally based on the amount of the traffic handed off from one network to another—measured for the telephone network in minutes; for the Internet in megabytes. And, on both systems, where the volume of traffic flowing in each direction is more or less in balance, the effective rate of exchange—whether from peering or netting settlement payments—is zero.

The difficulties begin when traffic flows are not balanced or where autonomous systems are unequal in size; consequently, a clamor for compensation results. Here, the two regimes diverge significantly:

- On the telephone network where traffic is unbalanced, the net flow of payments tends to be in the same direction as the net traffic flow. In other words, on the international telephone network, the carriers of most calls pay a landing fee to the terminating service provider to deliver their messages.

- On the Internet, however, especially the World Wide Web, the net flow of payments, notably for transit, is in

## Figure 6. Clearinghouse Terms for VoIP Traffic Termination

Sample Terms and Conditions

1. Quality of Service (QoS) – All members connected to clearinghouse are ranked by quality for each termination route. Rankings are based on such criteria as packet loss, network availability, 24x7 network operations center support, availability of backup routing and hardware (e.g., second gateway up and running).
2. Seller's Obligations – All members must license clearinghouse metering software and pay one-time joining fee. Terminating partners to a clearinghouse must submit to PoP-by-PoP network audits to certify and regularly authenticate quality rating. All rankings are published on clearinghouse member web site. In addition, total bandwidth capacity information will be published on member web site.
3. Buyer's Obligations – Must license clearinghouse software and pay one-time joining fee, and submit to credit check (usually a presentation of audited financials and letter of credit or deposit). A deposit of two or three times highest-planned usage is usually required. Comply with monthly settlement cycle.
4. Clearinghouse's Obligations – Handles all related settlements, billing and administration. Guarantees payment to terminating partners for traffic routed via clearinghouse. No guarantees either express or implied as to the quality of any given route.
5. Interconnection Options – Members should connect directly to the clearinghouse's backbone for optimum quality ranking (although high-quality indirect connections may also merit top ranking).
6. Facilities Needed – All members must provide connection to clearinghouse network and provision their own IP gateway. Data collection and metering software also must be installed in members' network.
7. Liabilities/Damages – Members are liable to any physical damages they inflict on clearinghouse members' equipment. Some clearinghouses also limit their liability by requiring members to state that they have legal authority to operate in their respective territories. Additional warranties may apply based on specific contracts between members and the clearinghouse.
8. Dispute Resolution – With metering software deployed on the originator's network, the clearinghouse network and the terminator's network, there are three points at which traffic is metered, allowing members to double check invoices. Any billing disputes are handled through the clearinghouse.
9. Duration – Negotiable. Also, since routing specifications are left in the control of member networks, originators can re-route traffic flexibly and for any reason.

**Sample Termination Rates by Route (Sept. 2000)**

Cost of transit via clearinghouse includes a one-time joining fee and cost of connection to the clearinghouse backbone. Call termination costs are based on 3-minute calls for different service grades. Prices expressed in US$ and includes a clearing fee:

| | |
|---|---|
| Australia | $0.031 |
| China | $0.116 |
| Czech Republic | $0.125 |
| India | $0.501 |
| Indonesia | $0.183 |
| Italy | $0.039 |
| Korea, Rep. | $0.046 |
| Philippines | $0.136 |
| Russia | $0.118 |

Source: Adapted from Concert Global Clearinghouse

**Figure 7. Band-X Routed IP Pricing**

| | Price per Month | | | | | | |
|---|---|---|---|---|---|---|---|
| **Seller** | **1 Mbps** | **2 Mbps** | **4 Mbps** | **8 Mbps** | **10 Mbps** | **45 Mbps** | **155 Mbps** |
| A | $1,105 | $1,301 | $3,396 | $6,792 | $8,316 | $33,945 | n.a. |
| B | $939 | $1,879 | $3,757 | $7,514 | $8,671 | $33,815 | $71,676 |
| C | n.a. | $1,662 | $3,400 | $6,800 | $8,309 | $31,160 | $85,862 |
| D | $289 | $578 | $1,156 | $2,312 | $2,890 | $9,754 | $33,598 |
| E | $361 | $668 | $1,734 | $3,468 | $4,335 | $15,022 | n.a. |
| F | $361 | $723 | $1,445 | $2,890 | $3,613 | $16,257 | $55,997 |
| G | $578 | $723 | $3,179 | $6,214 | $7,514 | $33,960 | n.a. |
| H | $723 | $1,301 | n.a. | n.a. | n.a. | n.a. | n.a. |
| | **Price per Megabit** | | | | | | |
| A | $1,105 | $650 | $849 | $849 | $832 | $754 | n.a. |
| B | $939 | $939 | $939 | $939 | $867 | $751 | $462 |
| C | n.a. | $831 | $850 | $850 | $831 | $692 | $554 |
| D | $289 | $289 | $289 | $289 | $289 | $217 | $217 |
| E | $361 | $334 | $434 | $434 | $434 | $334 | n.a. |
| F | $361 | $361 | $361 | $361 | $361 | $361 | $361 |
| G | $578 | $361 | $795 | $777 | $751 | $755 | n.a. |
| H | $723 | $650 | n.a. | n.a. | n.a. | n.a. | n.a. |

Note: Sellers offering transit via Band-X post their rates anonymously and are identified only by letters (e.g., A-H). Rates are for transit originating at Band-X's London PoP and have been converted from UK£ to US$.

Source: Band-X Ltd., September 2000 © TeleGeography, Inc. 2000

the opposite direction to the net traffic flow. On the Internet, smaller ISPs with less traffic (customers) pay larger ISPs with more traffic (customers) for transit. And though they have a little upstream traffic, most users pay the originating ISP a fee to cover the cost of sending large volumes of web traffic downstream to them.

The international telephone regime tends to promote the flow of resources from more developed (large traffic) to less developed (small traffic) networks, in large part because richer countries make more calls to poorer ones than vice-versa. Yet, it also tends to subsidize inefficient national monopolies that send less traffic than they receive. The Internet tends to support bottom-up, user-driven growth. But current Internet compensation schemes provide incentives for routing more and more traffic and resources to the largest and most efficient service providers, encouraging increasing horizontal concentration of control.

## III. Compensation Schemes for NextGen Carriers

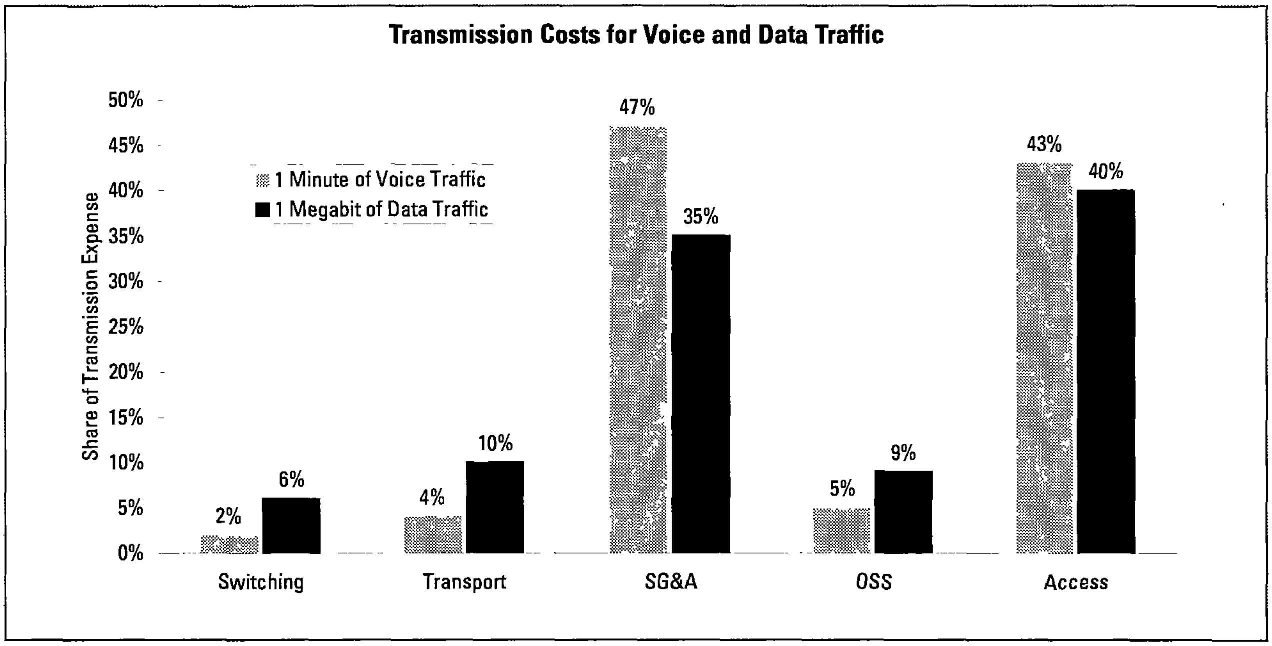
With the foregoing review of peering and transit relations in mind, let us turn now to the specific network-to-network compensation schemes which apply when phone calls are routed via the Internet. First, some definitions. Internet telephony commonly refers to a variety of services based on the terminals used (computer or telephone), the form of long-haul transmission (IP or other packet protocol), and the location of the interface or gateway between the Internet and the public switched telephone network (PSTN) (whether on the phone company's premises or the ISP's). Here, however, we will use Voice-over-Internet Protocol (VoIP) and Internet telephony to refer interchangeably to any voice communications routed over the Internet or an IP-compatible network for some portion of its transmission, without regard to the end-users' terminals. In other words, as used here, VoIP is the provision of voice telephony in packet form over an IP network.

This broad definition seems appropriate because inter-network compensation and payment flows concern almost all types of VoIP players—small ISPs and big ones, legacy telcos as well as private network operators—and it is with this issue that we are primarily concerned.

### A. Traffic Clearinghouses

At this writing, VoIP clearinghouses provide the only widely available option for most ISPs that wish to recoup a portion of their network costs from other networks for delivering VoIP traffic. [6] Though the details vary, all are based on a similar model, namely, the provision of a centralized billing mecha-

**Figure 8. WorldCom Costs for Transporting U.S. Long Distance Voice and Data Traffic**




Source: WorldCom, Inc. 

nism for originating VoIP providers and secured payment for terminating ISPs (see Figure 5. VoIP Clearinghouse Payment Flows). In so doing, the clearinghouse provides the bridge—often physical as well as financial—between one VoIP provider and another. By working through a clearinghouse, an ISP can obtain compensation for terminating VoIP calls to its customers without negotiating an interconnection agreement with the hundreds of widely dispersed ISPs in other countries whose customers may originate such calls. As a facilitator, clearinghouses generally are provider-independent. This can be particularly important for those houses which provide multiple termination options by route. Independence also is desirable to ensure impartial monitoring of the quality of each participating ISP; members must be afforded the ability to switch terminating partners on a non-discriminatory basis if they are not satisfied with their current termination options.

What about the finances? Clearinghouses typically charge a per-call "clearing fee" or commission of five to 15 percent per call, which is usually paid by the originating provider based on the termination price of the call. Clearinghouse participants set their own termination rates. These rates typically include the cost of a PSTN interconnection (i.e., the last-mile cost), but typically exclude an international PSTN settlement charge because the traffic is routed across borders via IP networks. To boost margins, however, rates posted at a clearinghouse may only be 20 to 30 percent below the prevailing international settlement rate. A VoIP provider's net revenue will depend on the total number of minutes it handles by route multiplied by the termination rate, minus its costs and minus the termination payments it makes to other clearinghouse members.

### B. Transit Services

In contrast to clearinghouses where network compensation typically flows in both directions, that is, to the sending and receiving ISPs and carriers, transit payments are by definition one-way—from the customer to the vendor. And while VoIP clearinghouses offer originating and terminating networks a defined split of the revenue associated with each call or session, the actual per call cost of paid transit is embedded in the overall charge.

Few, if any, ISPs buy or sell transit to support VoIP services alone. Transit is a generic, service-independent offering. Yet, that does not make a comparison of clearinghouse and transit economics "apples" and "oranges." On the contrary, it is precisely because ISP transit charges cover "apples" (VoIP) and oranges, grapefruits, kiwis, etc. (XoIP) traffic that it is worthwhile trying to break out that portion of the transit charge which might be reasonably assigned to VoIP traffic. Transit rates for VoIP, however, reflect end-to-end delivery on an IP network, excluding the last mile. In contrast, as noted above, clearinghouse rates typically reflect the last-mile access costs of PSTN termination.

Transit charges are typically billed monthly based upon the size of the daily traffic stream which is regularly delivered for transit. The price may vary significantly based upon location of the network connection point(s), length of the contract, the transit capacity desired, and the agreed level of network per-

## Figure 9. The Missing Link: IP Billing Systems

At an operational level, the challenge of inter-network compensation is less about money than software—installing the right applications on network devices so that any user's traffic, whether a corporate customer or another network operator, can accurately be metered, profiled, and billed in real time.

Without this type of IP business software, inter-network payments may never progress beyond the rough justice which now exists with peering and transit. Likewise, absent new software, ISPs will have little ability to move from flat-rate to service-specific prices for VoIP and other value-added products.

The core of any IP traffic billing system is a mechanism for gathering customer usage data. The second critical element involves mediation software that processes the data and converts it into a billable record. Today's IP billing systems generally can be distinguished by their approach to these tasks.

Most of the current billing vendors—leaders include Amdocs Ltd., Belle Systems A/S, Convergys Corporation, Kenan (a Lucent subsidiary), Portal Software, Savera Systems, and XACCT Technologies—typically create billing records based upon log files generated by network routers, gateways, and application servers, or by using software probes (for example, generated by RMON (ReMOte Network) diagnostic tools) to profile IP traffic streams. Cisco's NetFlow software can provide similar information based upon an analysis of incoming packets received by a router but cannot identify the particular applications involved. These data collection techniques are used to compile session-specific information for a user. The resulting billing records are similar to the call detail records (CDRs) generated by telco switches—records which also can provide the basis for carrier-to-carrier settlements in the telephone world.

An even more sophisticated set of Internet monitoring and billing tools has been developed by NARUS, Inc. (www.narus.com). The NARUS technology, known as Semantic Traffic Analysis (STA), enables a service provider to detect and analyze all of its IP data streams in real time without mining log files or using RMON probes. STA relies upon network appliances with proprietary software which are connected at key locations in the service provider's network. The software is able to extract packet header and payload information from each packet, and thus can reconstruct any user's sessions in real time. Needless to say, the granularity of this data provides the basis for extraordinarily detailed traffic analysis and billing options. NARUS markets these applications separately through its IP Billing Mediation and Intelligence product lines.

The application of new IP billing technologies is likely to be enhanced in the next few years by the work of the Internet Protocol Detail Records (IPDR) group, a cross-industry forum, founded by Dr. Jerry Lucas. It aims to standardize the format for exchanging usage information on IP networks. In June 2000, the group published its first technical specification. It proposes rules for ordering the relationship between the IP network devices which generate usage data and the business support systems (BSS), such as billing and fraud detection software, which must work with this data. The new specification also relies upon XML (Xtensible Markup Language) to define several sample records for billing VoIP, streaming video, and e-commerce services. The specification is available from www.ipdr.org.

For Lucas, standardized IPDRs have become a quest. The big business event of the 21st century, says Lucas, will come when "two carriers use IPDR for inter-carrier clearing [and] financial settlements." That may take time. "The toughest nut to crack in the billing industry is moving billing to center stage in carrier CEO thinking," adds Lucas. However, every ISP's future is at stake: "The corporate marching order has to be 'We can't beat the competition without IPDR.'"



formance, which is typically written into a Service Level Agreement (SLA).

For transit originating in the U.S., typical flat rate charges in mid-2000 for a 45 Mbps connection were $13,000 to $23,000 per month, depending upon the average throughput. Prices offered by non-U.S. IBPs vary significantly. One public benchmark for transit pricing is Telstra Big Pond Direct Internet Access (see telstra.com.au/bigpond/direct/pricinga2.htm). As of October 2000, Australian transit pricing for a 512 Kbps connection was A$8,400 for less than 40 percent utilization and A$0.29 per megabyte received thereafter.

The great majority of ISPs (and large corporate users) still purchase upstream transit services directly from Tier One or Two backbone providers. However, comparison shopping can be quite difficult as IBPs typically require users to keep the terms confidential; after all, IBPs do not consider themselves "common carriers" and have no obligation to publicly tariff their services. They also may price discriminate, subject only to general competition laws. Also, because the access points for competing IBPs may be geographically disparate, any customer wishing to shift its business to a new provider may face significant transaction costs.

For these and other reasons, London-based bandwidth exchange Band-X launched an Internet transit exchange in 1999. [7] The Band-X routed service consists of a PoP through which downstream networks can gain access to transit routes offered by various sellers. Similar to the clearinghouse for voice minutes, Band-X routed allows buyers to select between multiple anonymous sellers, allowing quality and price to be their guide. (For a detailed discussion of Band-X's

IP routed service, please see the case study in the "Primer on Bandwidth Exchanges" in this report.)

Band-X believes that its exchange-based transit contracts enable ISPs to provision incrementally, thus permitting shorter lead time for handling new customers or services, and also reducing the inventory cost of holding bandwidth on reserve. Band-X also maintains that the build-out of transit exchange globally will give many regional ISPs the ability to provide global connectivity without necessarily transiting U.S. backbones.

With this overview of transit in mind, let us once again try to "follow the money" for VoIP service. As noted, many ISPs carry VoIP traffic outside the clearinghouse system by simply bundling it with other IP traffic streams for onward delivery via their standard transit contracts. The cost per call can be astonishingly low.

For instance, according to Philip Mutooni, a product manager with iBasis, a reasonable working assumption is that a 1Mbps transit service purchased from a Tier One IBP could handle an average of 100 to 150 Internet telephone calls per minute, assuming roughly 10 Kbps is allocated per call and standard encoding schemes are used. From the previous discussion, we know that a mid-range estimate for 1Mbps transit is $500 per month. Thus, taking the low end of Mutooni's assumption, for $500 a month an ISP could theoretically transit 100 VoIP calls a minute 24 hours a day, making the average cost per call less than $0.00001 per minute (although actual costs would be higher because the network would not be fully utilized all month long). [8] It is numbers like these that may help to explain why the stock market has recently marked down the value of legacy long distance carriers so sharply (recall Figure 1).

Two final points about transit and network-to-network compensation. Though the cost of transiting a few thousand minutes of VoIP traffic may be financially trivial, overall transit costs can still be significant for downstream ISPs, as are the in-payments, of course, for the upstream IBPs. Further, it may be misleading to classify all downstream (or upstream) ISPs alike.

Mid-tier ISPs may buy upstream global connectivity from a Tier One player but, in turn, offer value-added services (e.g., web hosting and caching) to smaller regional players, employing their upstream capacity to provide connectivity to their downstream customers. Many off-shore ISPs find themselves in this position, for example, offering in-region transit, termination and colocation services to "foreign" ISPs or web content providers, while simultaneously buying transit from Tier One backbones. On closer look, therefore, the flow of money associated with transit services may not be as black and white as is commonly supposed.

### C. Does Inter-Network Compensation Really Matter?

Let's step back and take stock. We began by pointing to the economic threat the Internet poses to large international operators, as switched traffic bypasses the settlement system, and then looked at the limited opportunities for alternative network-to-network payments for international VoIP operators. The result: as with other Internet services, most global VoIP players must rely primarily on end-user charges to cover their costs. To which many readers may say: "We know that. But so what?"

Have we got the premise wrong? That is, do ISPs really need a new network-to-network compensation model to accommodate large volumes of VoIP and new "value-added" Internet services? Or will current arrangements and, in particular, end-user charges plus paid transit suffice?

There are several outstanding issues to resolve before we can answer these questions. To be equitable, network settlements should be cost-based. But costs are a moving target. Core transmission and switching costs for many ISPs are falling by perhaps 30 to 50 percent a year (as they are for long-haul telephone operators) and are now only a small percentage of end-to-end costs. [9] Selling, General, & Administrative (SG&A) costs plus last-mile (local access) expenses are now the key to competitive success for long-haul data and voice networks alike, and ISPs should not expect settlements to cover most of that (see Figure 8. WorldCom Costs for Transporting U.S. Long Distance Voice and Data Traffic).

Settlements are impractical, say the skeptics. Why? There is no agreed way to allocate most ISPs' incremental (or even fixed) costs to VoIP and other specific services. Contrast the extensive costing models developed for telephone services (see "The New Calculus: A Primer on Interconnection Accounting" in this report). Moreover, Internet services are too fluid, as is the quality—another measurement problem. In any case, the transaction costs for implementing a defensible cost model would likely outweigh the benefits. If ISPs think they have a "free rider" problem with other networks, they should find an engineering fix and, if they can't, they should get their end-users to pick up the tab or limit the access of any "resource hogs."

This argument has a second variant: settlement schemes are premature because we don't have the right tools yet. There are but a few software packages available for metering and billing service-specific IP streams. ISPs are testing different vendors but, as yet, there is no agreement on the key components which would make industry-wide settlements (e.g., call data records for VoIP) viable (see Figure 9. The Missing Link: IP Billing Systems).

And, even assuming common billing records are agreed, the industry will also need a standard protocol for an ISP in one

## Figure 10. Network Choke Points: Telcos vs. IP Backbone Providers

| Source | Incumbent International Operations | Tier One Internet Backbone Providers |
|---|---|---|
| Transmission Facilities | Incumbent typically owns only submarine cable landing stations and available backhaul to domestic network; it also may own cable capacity on preferential terms. | Unrivaled customer base makes top 4 or 5 Internet Backbone Providers (IBPs) essential facility for downstream service providers. Position of IBPs may be enhanced through bundled offering of international private line (IPL) facilities for access by "off-shore" customers. |
| Interconnection | Mandated by laws to ensure non-discriminatory terms and conditions for competitors. | Unregulated. Favorable terms for "peer" networks; others must pay transit charges. Private peering arrangements typically provide better Quality of Service (QoS) than public exchange points. |
| Traffic Management | Enhanced services require access to intelligent network (e.g., network databases, service control points) and may not be resold to competitors. | Top IBPs may use network reach to set *de facto* QoS and billing standards. Traffic filtering/metering for QoS/billing as well as caching technologies could be used to favor affiliated media sites. |
| Numbering | Control of telephone numbering plans (e.g., for mobile phone numbers) and historical lack of local number portability has enhanced incumbent's position. | Scarcity of IP addresses and limited portability of addresses may "lock in" major customers and reduce competition. |

Source: TeleGeography research



part of the world to swap the records with its counterpart in another region to ensure timely payment. That is why clearinghouses all require their users to sign onto a standard billing package; large equipment vendors that are developing QoS software for installation on corresponding networks do the same. Once these products prove themselves, the argument goes, new payment models may be feasible.

The market is working, the argument continues. IP phone traffic is growing rapidly. To date, ISPs have afforded the circuits and routers for VoIP and other much more bandwidth-intensive services (e.g., Napster for swapping MP3 audio files). VoIP players have raised large sums in the equity markets, with players such as iBasis, ITXC and Net2Phone going public in 1999. In addition, with large cash infusions from legacy players, such as AT&T, it appears the VoIP market will continue to grow, whether a network-to-network compensation scheme is hammered out in the immediate future or not.

So, do the skeptics have the better of this argument? Or will network-to-network compensation schemes be an integral part of tomorrow's Internet?

Let's start with the "falling costs" argument. The cost of bandwidth and routers is declining, to be sure, but ISP expenses may still be rising, largely because the Net is getting more bandwidth-intensive per customer. [10] The pace of equipment and transmission cost declines, in other words, may not be keeping pace with increases in end-user demand. If this is the case, the cost issue is real and one felt most keenly by overseas ISPs in Asia where the bandwidth market is less competitive. Moreover, non-U.S. ISPs typically must pay the full cost of the links that connect them to the U.S. backbone even though, once provisioned, the links are used in both directions (recall Figure 4).

And cost concerns are not limited to "off-shore" ISPs. It is no secret that profits in the ISP business are scarce: very few ISPs (apart from AOL) operate in the "black" and all the major VoIP companies operate at significant losses. So too, apparently, do the Net's main backbones. In June 2000, John Sidgmore, WorldCom's CEO, told the SuperComm trade show in Atlanta that despite 1999 revenues of $34 billion (excluding the company's Brazilian carrier, Embratel) with $11 billion of that from its data and Internet divisions, WorldCom's data networking business was still not profitable on a stand-alone basis. [11]

Genuity's 2000 stock prospectus, which offered perhaps the most detailed financial information yet on the backbone industry, told a similar story. Internet access and transport provisions accounted for more than $600 million, or close to 90 percent of Genuity's total revenue in 1999. However, operating expenses exceeded $1.35 billion. Hence, if Tier One IBPs, such as WorldCom and Genuity, cannot break even under the current scheme—and these players receive the lion's share of transit payments—no wonder the downstream players are hurting.

On to the last argument: billing tools. This is something of a chicken-and-egg situation. Without much wider agreement on the importance of inter-network compensation, metering and billing may seem like a wasted effort. But without these tools, no network-to-network compensation scheme is practical. The tools are coming if only because networks need to better manage their own customers' demands (e.g., to deter bandwidth "hogs"). And, once ISPs deploy the software needed to more accurately profile and bill for the network load that each customer imposes, doing the same for other networks—in effect, large customers—is likely to follow.

Some fear that the tools necessary for real time monitoring of network workloads could lead to new choke points on the Net (see Figure 10. Network Choke Points: Telcos vs. IP Backbone Providers). It is said, for example, that larger networks could use new metering and traffic management software to enhance rather than to reduce their market power. On the other hand, if such tools are made widely available (e.g., from independent third-party suppliers), they may well allow any ISP to make a much better assessment of the costs and benefits of interconnection. Indeed, traffic monitoring and billing tools could be the Internet's best hope for building a sustainable provisioning model when telephone bit streams are but a smaller and smaller part of the overall data flow.

One final point: market failures can be hard to detect, like errors of omission, especially if the main impact is far away (e.g., in poor countries where backbone costs are still a barrier to entry). Likewise, when capital is plentiful and someone else is paying for the corporate overheads, the "it isn't broke" argument only goes so far; wait for the next market down draft. The major IBPs are all losing money, and the market cap of most long distance telecom providers is at a three-year low (again see Figure 1).

But the real problem with the "it isn't broke" argument is that it tends to ignore what has made the Internet so valuable to date—its ubiquity and open, end-to-end access for new services. Absent some new approaches to network cost-sharing, there are likely to be at least three consequences: (1) a more limited and slower regional build-out of the Net; (2) less competitive markets; and (3) the increasing rise of private intranets—gated communities—with higher interconnect fees and QoS for mission-critical corporate, e-commerce and, yes, entertainment services, while the public Internet—the global commons—becomes poorer, more congested and unreliable. [12] Indeed, a two-tier Internet already exists in many respects. That may not be all bad. Not everyone wants or wishes to pay for a telephone system QoS, and private intranets (corporate firewalls) can co-exist with the public Internet. But we should be under no illusions regarding the direction in which our legacy compensation schemes for IP traffic are taking us, or the consequences for the public Internet.

And if you are not persuaded by principle alone, consider the bottom line. The investors who continue to sell off Internet backbone and long distance telco stocks alike may just have a message for the industry: show us a sustainable business model for hauling long distance IP traffic—whether based on inter-network payments or otherwise—or we will continue to put our money elsewhere.

*This essay was written by Gregory C. Staple, the founder of TeleGeography, Inc. Mr. Staple is currently an editorial advisor to TeleGeography and a partner in the Washington, D.C., law firm of Vinson & Elkins L.L.P. The author serves as U.S. regulatory counsel to Telstra Corporation Ltd. and certain other international telecommunication service providers; however, the views expressed here are his own. The author gratefully acknowledges the assistance of Trista Schroeder in preparing this work. Mr. Staple may be reached by email at gstaple@velaw.com.*

**Notes:**

[1] See, e.g., Gregory C. Staple, "A Primer on International Simple Resale," *TeleGeography 1996/67*.

[2] Some incumbent operators—notably AT&T Jens in Asia—have sought to steal a match on the competition by providing VoIP service first. This is happening even in developing countries. For example, in June 2000, the Telephone Organization of Thailand (TOT) won regulatory approval for a new VoIP service.

[3] The absence of analogous payment schemes is due, in part, to the absence of direct connection or privity between most of the originating and terminating networks which comprise the public Internet. It also stems from the Internet's U.S.-centric origins (which generally gave U.S. ISPs the upper hand in setting connection terms), and the asymmetric nature of much Internet traffic (e.g., to and from web sites). For a full history of the Net's financial architecture, see the Internet primer *Hubs and Spokes: A TeleGeography Internet Reader* (TeleGeography, Inc., 2000).

[4] Some entrepreneurs have reportedly taken this to extraordinary lengths by, for example, installing tens of rack-mounted mobile phones to provide domestic PSTN access for international telephone services. Even in developing countries, the mobile service market usually is competitive, and mobile operators may be only too happy to provide additional phones, provided the user pays the connection charge. That allows a business customer to mix in its inbound international traffic with the mobile operator's other traffic stream for PSTN interconnection, thus reducing its visibility to the incumbent operator. Also, the mobile operator generally does not have an international service and, hence, has no interest in protecting existing settlement revenue.

[5] The evolution of peering and transit relationships is reviewed at greater length in M. Kende, "The Digital Handshake: Connecting Internet Backbones," OPP Working Paper No. 32, Office of Plans and Policy, FCC (September 2000) available at www.fcc.gov/opp/workingp.html. See also the discussion of peering terms in *The Internet's*

continued on next page

**Notes (continued):**

*Coming of Age*, National Research Council (October 2000) available at books.nap.edu/catalog/9823.html.

[6] Though clearinghouses are important so far as internetwork compensation is concerned, they play a much smaller role in terms of the international VoIP market as a whole, accounting for approximately 15 percent of global VoIP traffic. The bulk of such traffic is now handled by wholesale VoIP carriers such as ITXC, iBasis, and deltathree.com, which may also share a portion of their revenues with ISP affiliates that terminate traffic in countries where the wholesale carrier lacks a presence. In 1998, when AT&T and BT first announced the Concert joint venture, which would pool their international networks and migrate traffic onto a new IP-based global backbone, it was speculated that this novel venture would pioneer new correspondent agreements and settlement schemes for the carriers which have international operating agreements with BT and AT&T. For example, it was suggested that Concert might offer existing BT correspondents a common U.K.-U.S. termination rate or a set of regional rates based on the cost of transmitting traffic via Concert's IP cloud.

[7] Full disclosure: TeleGeography, Inc. became an independent subsidiary of Band-X Ltd. in September 2000.

[8] Calculated as follows: $500/(60 minutes x 24 hours/day x 30 days/month x 100 calls/minute).

[9] An instructive and up-to-date review of the price-performance improvements in network switching and transmission facilities can be found in a September 2000 industry study co-authored by McKinsey & Company and J.P. Morgan: "Backbone! How Changes in Technology and the Rise of IP Threaten to Disrupt the Long-Haul Telecom Services Industry."

[10] See K.C. Coffman and A.M. Odlyzko, "Internet Growth: Is There a 'Moore's Law' for Data Traffic?" Preliminary version, July 11, 2000, available at www.research.att.com/~amo/doc/networks.html.

[11] WorldCom's public reports do not break out profitability by market segments, however. For example, the company's Securities and Exchange Commission (SEC) Form 10Q for April-June, 2000, states: "Communication services are generally provided utilizing the Company's network facilities, which do not make a distinction between the types of services. As a result, the Company does not allocate line costs or assets by segment."

[12] See, e.g., Jonathan Angel, "Toll Lanes on the Information Superhighway," *Network Magazine*, February 2000, available at www.networkmagazine.com.

# Facilities

# MANs: The Golden Mile

## What is a MAN?

Fundamentally, Metropolitan Area Network (MAN) is just a fancy term for an intracity communications system. A MAN connects the major communications nodes of a city, including Central Office switches, telehouses, Internet exchange points, and corporate business centers. In the overall network hierarchy, MANs lie between the long-haul and access networks (see Figure 1. No MAN is an Island).

In the past decade, a shortage of MAN bandwidth emerged as network build-out near the edge did not keep up with the supply boom on long-haul networks. To make things worse, demand from end-users—both for international and intracity connections—has increased at an astounding rate.

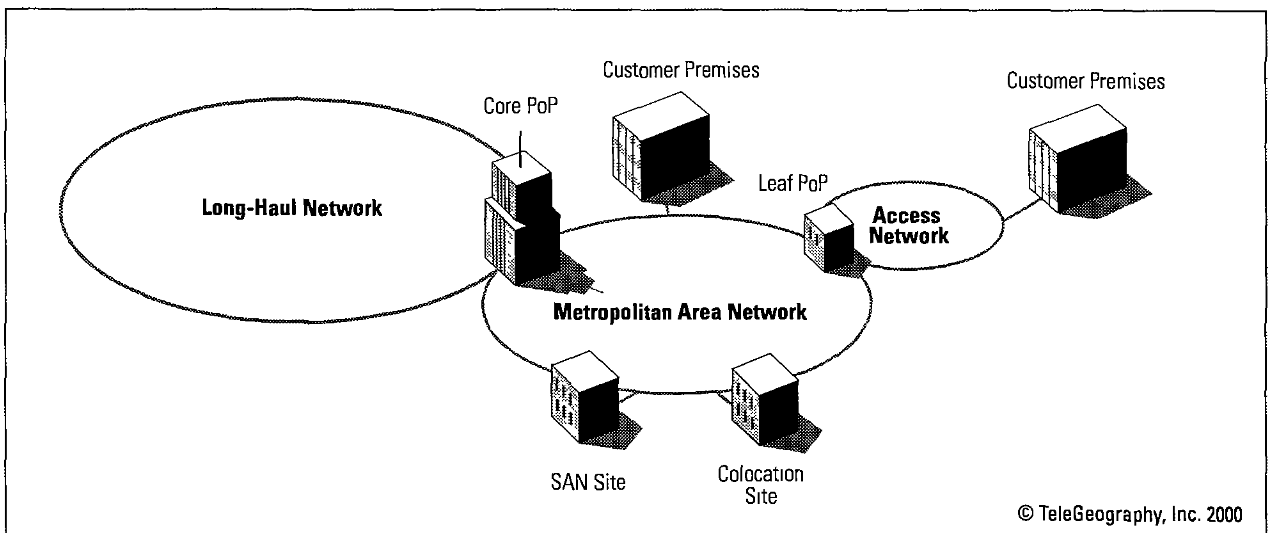
This shortage has sparked a MAN building boom—first in the U.S. and then in Europe. Asia has not been too far behind, with new networks laid in Hong Kong, Tokyo, Sydney, and other places. In most international business cities, at least three (and often more) networks are being constructed, creating a unprecedented capacity infrastructure filled with many hundreds of fiber pairs.

To the uninitiated, MAN deployment may seem simple because the distances involved are insignificant in comparison to crossing an ocean or sending radio signals into outer space. As many have discovered, however, building a MAN is very complex. In this article we present the MAN as both an element of an international communications system and a network of its own.

## Who Needs a MAN?

Even though MANs have never been isolated networks, it makes even less sense today to see them as discrete centers of demand. On the one hand, major bandwidth consumers need seamless links between their city nodal points in the

**Figure 1. No MAN is an Island**




From a network topology perspective, MANs are networks that connect access networks and long-haul networks. Most MANs are designed as a ring, although larger MANs may be shaped as a series of rings within rings.

From a geographical perspective, what constitutes a metropolitan area is less clear. In the U.S., some sprawling metropolitan areas would be considered regions elsewhere. At the same time, there are regions such as the Randstad in the Netherlands, which are characterized by some builders (such as MFN) as a single contiguous market, if not exactly a metropolis. The Randstad region, one of Europe's most important concentrations of commercial activity, includes Amsterdam, the burgeoning business parks around Schiphol Airport, Hilversum, Utrecht, The Hague, and Rotterdam. Other equally important conurbations include Düsseldorf, Dortmund, Essen, and Cologne in Germany, and the area inside the M25 ring road around London.

Source: TeleGeography research

metropolitan area and the global network. On the other, the MAN is increasingly an extension of many corporate networks as those companies store and retrieve information from sites located on metropolitan area networks, rather than private ones.

MANs have been built and operated by incumbent operators, municipal authorities, local entrepreneurs, and global super-carriers alike. For many international carriers, the main justification for building MANs has been that they could not get the high capacity they needed any other way. Until last year, incumbent telcos in some cities did not offer capacity above 2 Mbps, and many telcos still do not offer any capacity above 155 Mbps. When long distance networks are running at 10 Gbps or more, that simply isn't enough. Moreover, some incumbents still take up to six months to deliver very high-speed lines in the metro area. Even for lithe new carriers, getting bandwidth to buyers can take a long time.

As a result, the desire to achieve point-to-point "bandwidth on demand" capabilities has driven the creation of "virtual pooling points" to speed up provisioning. A virtual pooling point is not a single telehouse or colocation site, but rather all the important, yet disparate, nodes in a metro area strung together in a single addressable system. The collection of nodes represents all the major sources and destinations of traffic within a city; for many international players, the construction of this type of MAN is the main objective.

**Optical Technology and the MAN**

In long-haul networks, "fiber exhaust" was solved using dense wavelength division multiplexing (DWDM) equipment. Before DWDM, a fiber pair could carry a maximum of four channels of traffic on four different light frequencies at up to 2.5 Gbps each—a total of 10 Gbps. DWDM enables carefully tuned lasers to deliver 40 or more closely spaced light signals (often called "wavelengths" or "lambdas") per fiber pair. Typical current DWDM configurations include 40 x 2.5 Gbps; 80 x 2.5 Gbps; 32 x 10 Gbps; and, 96 x 10 Gbps. The commercial state of the art is 960 Gbps per fiber pair though much higher figures have been achieved in laboratories.

Could DWDM be used in metro networks as well? Although almost all metro networks are based entirely on optical fiber, important differences between metro and long-haul networks make metro DWDM solutions problematic.

First, a high degree of uniformity exists in the long-haul network. This is not the case in the metro space. Because metro networks are much closer to the ultimate end user, they must carry a wide mix of lower speed channels, including voice channels at every node. These include dedicated private lines (64 Kbps to 622 Mbps), voice circuits (64 Kbps), ISDN circuits (64 Kbps to 2 Mbps), packetized frame relay and cell-based ATM traffic, transparent LAN (Ethernet) service, and private SONET rings. In long-haul networks, in contrast, traffic has already been converted to identical high speed channels.

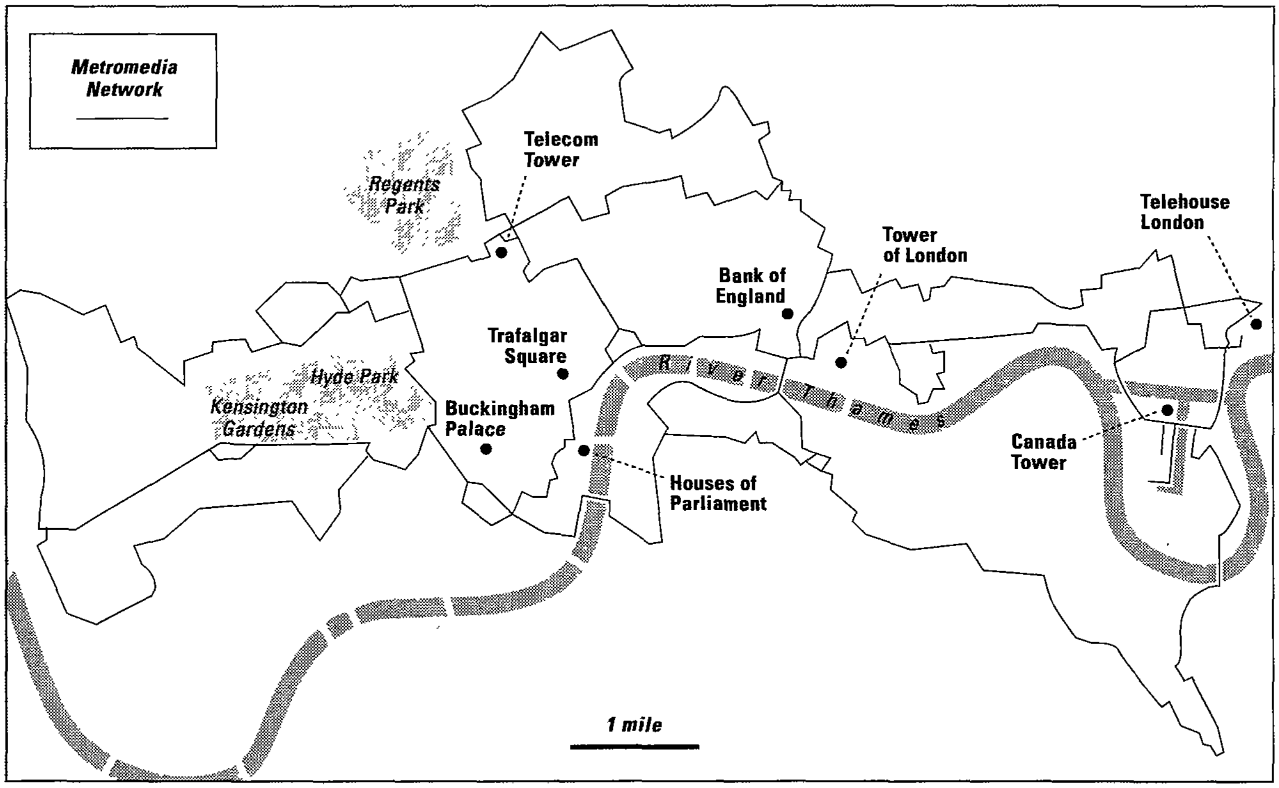
Second, DWDM equipment is very expensive and inefficient for short distance links. To start, an optical network using DWDM requires lasers that cost four to five times as much as those on non-DWDM systems. DWDM equipment also consumes a large amount of space and power—two commodities that are becoming a critical constraint in many cities. One recent estimate suggested that it would cost a long-haul carrier $100,000 per annum to house DWDM equipment in a single metro site. And finally, unlike long-haul networks, metro networks tend to have many nodes because they must add and drop off traffic at many points along the network. Until optical multiplexing equipment matures, each add-drop node in the metro network needs to also provision space for optoelectronic conversion equipment that compensates for signal losses created by presently deployed technology—an expensive proposition indeed. Optical add/drop multiplexers and wave filters may help address these problems in time.

One intermediate solution is to use dark fiber with fewer channels of WDM traffic on it (four instead of forty channels of DWDM) and lease more dark fiber when the need arises. With suppliers like Metromedia Fiber Networks (MFN) deploying on average 864 fibers per cable in U.S. cities and 432 in European ones, this approach is a viable option. However, metro network design will continue to be difficult in cities where fiber is abundant in some areas but scarce in others. Ultimately, the choice between WDM and DWDM options is determined in part by the scale of demand. If significant demand is expected, the benefits of investing in expensive DWDM equipment may outweigh the costs of incrementally adding more fibers, terminals, and regenerators in a less expensive WDM option.

**Designing the MAN**

Further complicating MAN deployment is the issue of architectural standard. Traditionally, most MANs have been designed using either SONET (Synchronous Optical NETwork) or its close cousin SDH (Synchronous Digital Hierarchy). SONET and SDH are self-healing network architectures that prevent interruption in service by rerouting traffic almost instantaneously in the event of a fiber cut. A ring topology, however, requires provisioning for the maximum bandwidth required in the network on every segment irrespective of the actual load on the segment. Furthermore, half of the network remains idle for restoration purposes.

**Figure 2. Metromedia Fiber Network—London Area Map**




Map by TeleGeography, Inc. © TeleGeography, Inc. 2000

Note: Map depicts approximate year-end 2000 route, which is subject to change. Metro rings are not shown in this map.

The ring topology was originally developed for fixed-bandwidth, circuit-switched traffic—that is, voice, rather than data traffic. Given the "hub and spoke" nature of data traffic flows, however, many have written off SONET rings in favor of "mesh" networks, which are better suited for point-to-multipoint data traffic flows. But SONET and SDH are far from dead; the next generation of Ethernet standards has incorporated many of their features. (The 10 GigE alliance, which is developing 10 Gbps Ethernet, has created two versions of the standard—one for LANs and one for WANs. The first commercial products to use these standards should be available by the end of 2000.) The wide acceptance that SONET currently enjoys suggests a network evolution with a gradual transition from SONET rings to meshed networks.

Different solutions also exist in the type of fiber most suited for the metro space. This year Corning launched a new fiber called MetroCor, which uses less expensive transmission lasers and has the mind-boggling characteristic of dispersion that actually improves with distance—that is, the pulses of light become narrower. Hence, regenerators are unnecessary in 400 km-long network segments—a key design objective for MAN builders. Lucent, on the other hand, has pioneered AccuRibbon fiber, which packs up to 864 fibers in a single narrow cable that can also be mass-spliced at node points—a significant cost savings for metro builders squeezing large fiber counts in narrow underground ducts.

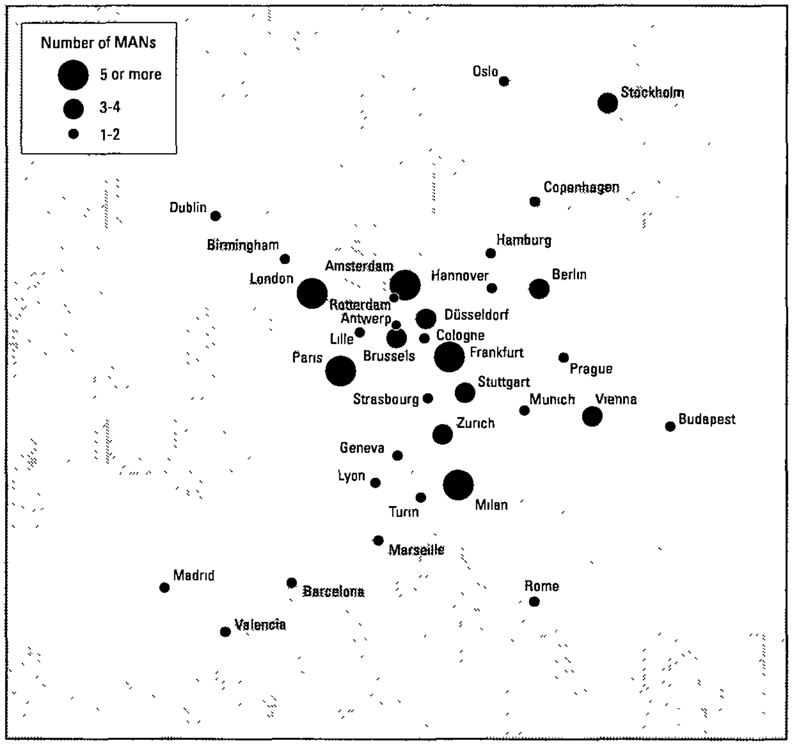
### Underground Regulation and the MAN

In addition to technology choices, market regulation is another complex issue facing MAN deployment. In principle, markets are open in Western Europe, the U.S., and many Asian countries. MAN entrepreneurs ought to be able to power up the bulldozers and move right in. In practice, though, it's far from simple.

The regulatory environment for constructing MANs varies widely from one city to another, especially rules for digging the streets. According to companies such as MFN, building in cities is "an order of magnitude" more complicated than building intercity networks, largely because of rights of way issues. For example, MFN had to negotiate with over 50 rights-of-way (ROW) owners to build their MAN in New York.

In some cities, municipal monopolies have been created to avoid the continuous disruption of torn-up streets. Service

**Figure 3. Pan-European MAN Deployment**




Source: TeleGeography research, company reports

Note: MAN count to December 2000.



In 1995, only two Metropolitan Area Network builders existed in Western Europe. Today, as many as six different builders compete for the same customers in a number of cities across this region. Many of these players have also built or bought capacity on intercity rings to interconnect their MANs.

The figure to the left illustrates the target cities of nine pan-European metro builders (metro builders which are building MANs in more than one country in Western Europe). These builders are: Carrier 1, COLT Telecom, Global Crossing, Global Metro Networks, GTS, Level 3, Metromedia Fiber Network, and Viatel.

The figure does not include those metro networks being constructed by local municipalities or city-carriers, such as NetCologne (Cologne), MetroWeb (Milan), and CompleTel (Paris).

providers seeking to build MANs in these cities must then lease dark fiber or ducts built by the monopolies. These municipal bodies include StokAB in Stockholm and Sippera, which holds a franchise in the Parisian business district of La Defense.

Elsewhere, regulations restrict when and how a company may dig. Tokyo utilities, for example, may only dig the streets for a few weeks in each year. In other cases, the local authorities may require providers to share ducts, or at least to harmonize digs, as is general practice in several Italian cities. In some French cities, close relationships exist between the local city authority and ducts owners, making it difficult for third parties to get permission to dig.

At the other extreme almost no restrictions exists in cities such as London. Licensed telecommunications carriers have the right under "Code Powers" to dig up the streets wherever and as often as they like.

Recently, the European Commission has stepped in to bring order to the inconsistent street digging laws in Europe. In its 1999 Policy Review on telecommunications rules, the European Commission referred specifically to rights-of-way and said that changes might be made if builders were unfairly obstructed. "There is some evidence to suggest that the current rules are not providing new entrants with adequate and timely access to rights of way," it said. A recent ruling suggested that incumbent telcos must make spare ducts available to third parties. Later, in August 2000, the European Commission announced that it had begun proceedings against Luxembourg because the local city authority had refused Coditel, a Belgian telecommunications provider, the right to lay fiber in the city. The case is still pending at this writing.

**Where are the MANs?**

As in the long-haul market, MAN builders follow the money. The first cities to attract competitive build-out in the early 1990s were international financial centers, especially New York, London, Chicago, Paris, and Frankfurt, where as many as nine separately owned fiber cable infrastructures are now in the ground. Other global business and financial cities soon followed (see Figure 3. Pan-European MAN Deployment).

So invariable is this approach to selecting MAN deployments that market entrants have divided the world's cities informally into a series of tiers, and strategists tend to talk about "first-tier," "second-tier," and "third-tier" cities. Most business strategists identify about 30 to 40 cities among

## Figure 4. Where are the First-Tier Cities?

One of the most systematic attempts to classify and rank major cities has been made at Lougborough University, home of the Globalization and World Cities Study Group and Network (GaWC—see www.lboro.ac.uk/departments/gy/research/gawc/rb/rb5.html).

Researchers at GaWC developed a methodology that ranks major world cities into four groups, each of which contains several sub-groups. The first three groups appear herein.

The GaWC ranking is based not on population but on the city's perceived significance in the global economic system. The theory argues that world cities are most easily identified by the relative availability of "advanced producer services," four categories of which are used in the GaWC schema: accounting, advertising, banking, and law. GaWC aggregated and scored public information on the concentration of firms in these areas to create its ranking.

Like any other theoretical scheme, the GaWC top cities ranking does not correspond precisely to the MAN builder target cities list. Although a shared industry perception that a city is 'first' or 'second' tier may factor into a decision to build a MAN, other factors are important. These include its geographic location relative to the rest of the network and to other telecommunications traffic sources, the local regulatory situation, and a whole range of market data, such as household Internet penetration. Hence, some European cities that don't appear on the GaWC listing are, nevertheless, extensively cabled or connected because they happen to sit between other major cities, or because the local regulatory environment is favorable, or both. Examples include Stuttgart in Germany and Strasbourg in France. Others such as Warsaw, which is on the GaWC ranking, remain relatively untouched by MAN fever.

**The World According to the GaWC**

| Alpha World Cities: | Beta World Cities: | Gamma World Cities (Europe only): |
|---|---|---|
| London | San Francisco | Amsterdam |
| Paris | Sydney | Barcelona |
| New York | Toronto | Berlin |
| Tokyo | Zürich | Budapest |
| Chicago | Brussels | Copenhagen |
| Frankfurt | Madrid | Düsseldorf |
| Hong Kong | Mexico City | Geneva |
| Los Angeles | São Paolo | Hamburg |
| Milan | Moscow | Munich |
| Singapore | | Prague |
| | | Rome |
| | | Stockholm |
| | | Warsaw |

Source: Globalization and World Cities Studies Group



the first-tier, with up to several hundred worldwide in the second-tier, and many hundreds of towns and cities in the third (see Figure 4. Where are the First-Tier Cities?).

First-tier cities are the biggest sources of and destinations for traffic. Some estimates suggest, for example, that well over 60 percent of pan-European traffic is routed via four major cities: London, Frankfurt, Paris, and Amsterdam. Similarly in the U.S., estimates suggest that over 80 percent of data traffic terminates in 25 first-tier cities. Powerful concentrations around one city also exist. Though statistics are sparse, some network analysts believe that well over one-quarter of corporate network traffic in France originates in Paris and as much as a half of Greek traffic comes from Athens. In other countries, especially Germany, and to a lesser degree Italy, traffic is much more widely distributed because commercial activity is more widely dispersed.

Moreover, these first-tier cities tend to attract and generate even more traffic over time. In a liberalized market where cities compete for traffic, those that already have strong competitive infrastructures tend to win a significant share of new traffic. This, in turn, attracts communications-intensive companies to locate near to these major nodes, resulting in even more entrepreneurial MAN build-out. Small wonder, therefore, that competitive MAN activity is largely concentrated in these first-tier cities.

MAN deployment is beginning to disperse, however. In the U.S., for example, Brooks Fiber (acquired by WorldCom in 1998) built networks in over 90 second-tier commercial cities in the U.S. and earned a very high valuation because it was the only player in town other than the incumbent telco. In Europe, no company has emulated that approach precisely, but several players are now building in second tier cities such as Lyon, Hannover, and Birmingham. As always, however, economically less-developed regions and countries may have a long wait before MAN build-out reaches their cities.

### Who is Building the MANs?

MANs come in many shapes and sizes and usually reflect characteristics of their builders (see Figure 5. The Urban Jungle). For example, full-service global telcos often have the most intricate MANs because they need to connect corporate customers directly. Wholesale carriers' carriers tend

**Figure 5. The Urban Jungle**

| Type of Company | Market Orientation | Network and Technology | Examples | Main products |
|---|---|---|---|---|
| Incumbent telco | Legally obligated to connect any metropolitan company or household; MANs serve all traffic and customer needs | Very extensive, reaching almost all buildings in the city; often based on 'legacy' technologies | BT, Verizon, Deutsche Telekom | Retail and value-added products; may choose not to sell dark fiber, but in some cases legally obligated to offer both dark fiber and ducts |
| Full-service global telco | Offers complex services for multinationals and other large organizations | Extensive; mostly based on own fiber and ducts (though this may change) | COLT, WorldCom | Retail and value-added products; will not sell dark fiber |
| Municipal monopoly | Leases fiber or ducts to licensed carriers | Fairly extensive; based on ownership of rights-of-way, ducts and fiber | StokAB (Stockholm), Sippera (Paris La Defense) | Dark fiber |
| City carrier | Acts mainly as wholesaler to other carriers | Scope is variable; almost all build complex networks in commercial areas; tend to own multiple ducts; fiber of varying age | NetCologne (Cologne) MetroWeb (Milan) CompleTel (Paris) | Dark fiber, bandwidth, as well as enhanced services |
| Metro carriers' carriers | Wholesales fiber; mainly to other carriers, but also to enterprises | Focuses on key nodes and commercial districts; deploys multiple ducts and state of the art cable and fiber | MFN, Global Metro Networks | Dark fiber |
| Long-distance carriers' carrier | Mostly builds MANs for own needs; may bundle metro capacity in some contracts | Simple MANs focusing on major nodes such as high-level switching nodes, telehouses and Internet NAPs; may lease dark fiber and deploy DWDM; may lay cables | GTS | Bandwidth, IP transit, wholesale minutes; some will sell dark fiber; some offer ducts |
| 'New wave' corporate MAN builder | Offers very low cost bandwidth for metro corporations and to connect 'tall shiny buildings' (sometimes known as a B-LECs) | Major commercial district initially; leased dark fiber; DWDM; gigabit Ethernet routers | Cogent | 10 Mbps/1 Gbps |

Source: TeleGeography research © TeleGeography, Inc. 2000

to have quite extensive networks and to lay a lot of fiber and multiple ducts because their customers tend to lease dark fiber. Retail and wholesale long distance carriers often build skeletal MANs that simply link five to ten major telecommunications nodes or server farms on one or two leased dark fibers.

Not all carriers can be neatly buttonholed: Level 3, for example, is primarily a long distance player but is building fully cabled MANs, rather than leasing dark fiber locally. Level 3 competes not only with long distance carriers, but also with metro network operators such as MFN. Carrier1 has gone further, leasing ducts in its Amsterdam network to other carriers to pay for the construction of its own network.

What is clear is that different types of MANs will continue to exist. Buyers of capacity need to weigh the relative advantages and disadvantages of each type of MAN design and the business models of its builders.

**Choosing Your MAN**

There are currently several different product options of varying complexity:

**Dark fiber.** Now becoming widely available in first-tier cities, dark fiber is generally sold on long leases of 10 or 15 years, which has its caveats. First, the buyer needs to be realistic about the likely commercial lifetime of the fiber, given that most of the components in the system have a lifetime of less than five years. Second, while most dark fiber leases are priced per meter per annum, they also include an annual operations and maintenance charge. Depending on specific lease provisioning details—whether charges are fixed or variable, for example—such charges can become a significant cost (for more on bandwidth leases, see *International Bandwidth 2000*).

**Wavelengths.** Recently available in major markets, wavelengths are usually sold at 2.5 Gbps increments. IP over WDM is widely seen as a desirable solution for customers who are data-centric and carry mostly IP traffic. However, the management of wavelengths in metropolitan networks continues to be an area of controversy and ongoing experimentation.

**Dedicated Channels or Private Lines.** Dedicated circuits are a widely available and mature service, usually provided on short leases at speeds from 64 Kbps up to 622 Mbps. In cities where the only provider is the incumbent, it can still be very difficult to get any service above 2 Mbps, but as competitors build out, this situation will change quickly.

To some degree, the type of buyer determines the product choice. Large telcos and ISPs increasingly want to buy dark fiber, because they have enough bandwidth demand to justify the up-front cost and the expertise to equip and manage the network. Moreover, it is somewhat easier to control costs in a dark fiber network, since the cost of upgrading the network will almost certainly be lower than the cost of additional leased bandwidth. Wavelengths are also attractive for this kind of buyer.

Smaller, inexperienced carriers and corporate end-users, on the other hand, tend to prefer to lease fixed SONET or SDH bandwidth. However, the larger and more sophisticated multinational end-users are starting to lease dark fiber. MFN says that while the number of end-user customers (including the New York Public Library and Chase Manhattan Bank) is small, it is also growing rapidly.

In addition to the various product options above, other differentiating factors include the following:

**Proximity.** If a MAN doesn't connect directly to the buyer's building or the service provider's colocation facility, it had better come pretty close. The further away from the MAN, the more money and time it will require to get a leased line from the incumbent telco.

**Service Level Agreements.** Metro networks are particularly vulnerable to breaks. Buyers need to know about the level of redundancy employed on routes and critical components, especially if the network does not use standard SONET/SDH ring technology.

**Provisioning times.** Difficulties in forecasting demand are driving on-demand bandwidth provisioning. Clearly if it is necessary to dig to the buyer's building, provisioning will take weeks or months. But even where a buyer is already connected into the fiber, a request that entails complex routing may still take weeks to fulfill because engineers may need to visit many sites to manually fit the necessary equipment. Understanding the network configuration and what is required to add bandwidth, allow buyers to anticipate provisioning lead-time.

**Bundled telehouse space.** Bundled offers can be very attractive to users in cities where colocation space is a premium.

**Paying for Your MAN**

Anecdotal evidence from buyers suggests that prices for metropolitan capacity are still not falling nearly as fast as long-haul pricing. In general, metro prices are falling by around 20 percent a year in Europe, against 50 percent a year in the more competitive parts of the long-haul market. As a result, the effective gap between long-haul and metro pricing continues to widen.

Broad variations in pricing exist between cities. Some companies claim that the price of dark fiber varies from a low of one dollar per meter per year in some German cities to as much as four dollars per meter per year in Paris, while some non-utility providers may be charging up to eight dollars per fiber pair. In some cases, providers add an Operation and Maintenance (O&M) charge, which will typically be two to three percent of the lease price per year.

As in the long-haul market, new entrants are creating innovative pricing schemes to attract customers. For example, MFN allows customers with requirements in several cities to sign a general frame contract that entitles them to draw from a "bank" of fiber when they need it in the cities where demand emerges first. Like other providers, MFN also discounts quite steeply for volume.

Pricing schemes also vary by type of service. Wavelengths and SDH channels tend to be priced by distance, by the size of the channel, and the number of connected nodes. Fixed SDH channels, available at 155 Mbps (and in some cases 622 Mbps) cost around $50,000 per year in European cities. However, the variation in pricing levels and methodology is so wide and so heavily customized that price points are difficult to determine. Some more extreme models, don't charge by distance, except for the final "drop" to the customer site(s) in the form of a one-off connection charge, rather than an annual leasing charge.

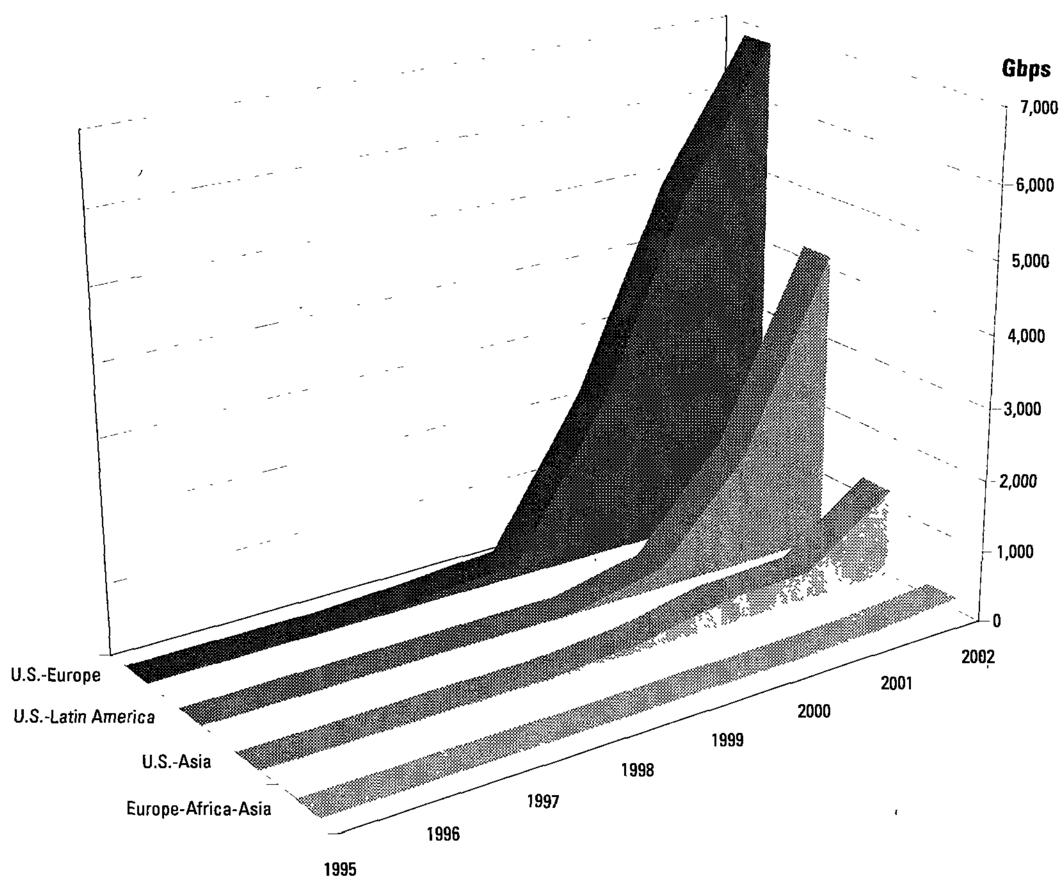
**Conclusion**

Metropolitan area networks, like the cities they serve, are complex, expensive to build and are often difficult to manage. The problems they present for network planners and designers are more formidable than those of long-haul networks.

Yet it is generally agreed that MANs are going to be one of the most dramatic areas of development in telecommunications over the next two to three years. MANs perform a vital role in collecting, aggregating and grooming traffic for transmission onto international networks and in delivering services to end-users. Effectively implemented, they will be important catalysts and generators of international bandwidth demand.

# Submarine Cable Systems

**Figure 1. Transoceanic Submarine Cable Capacity**




**Aggregate Capacity (Gbps)**

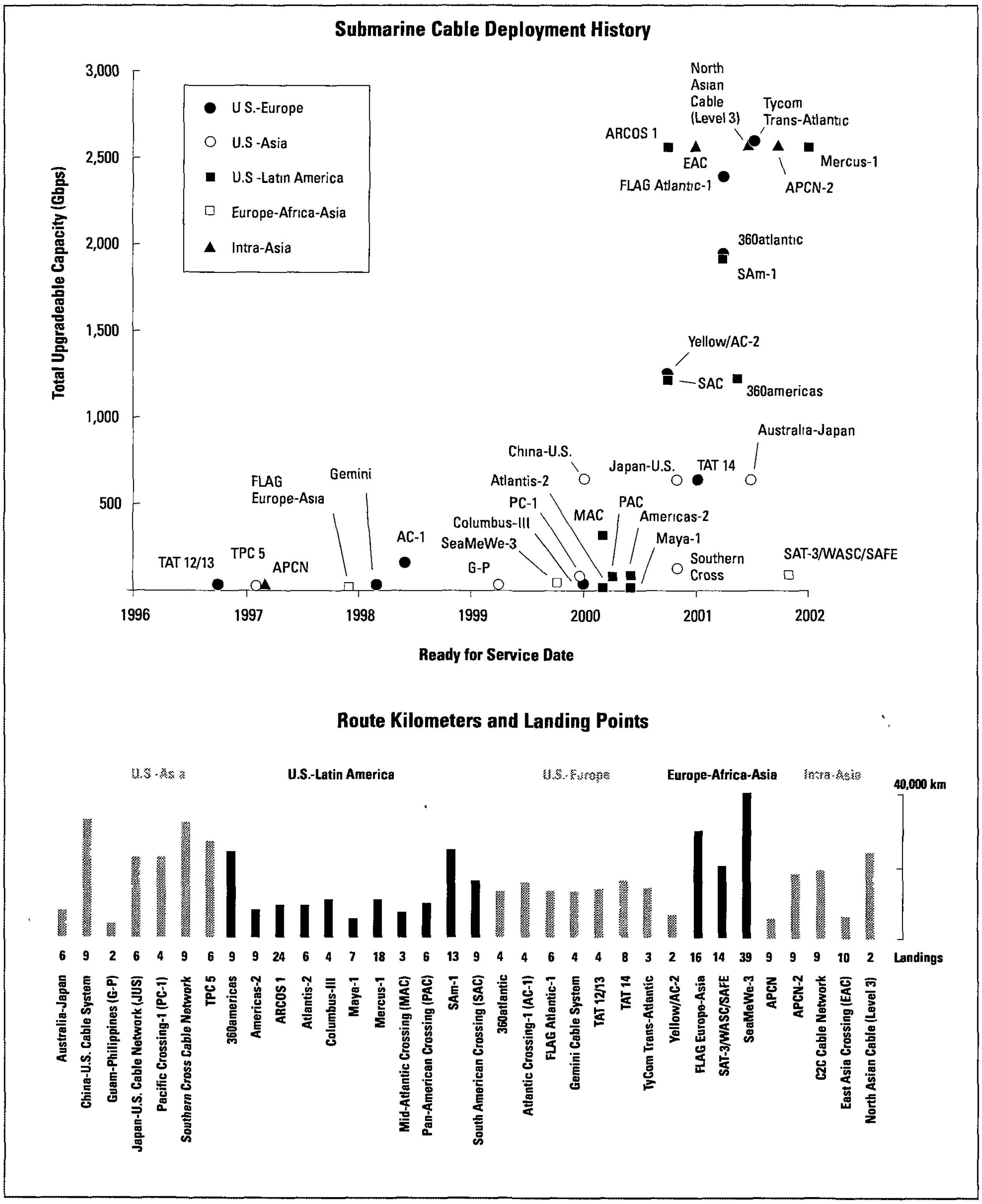
| | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|
| U.S.-Europe | 23.0 | 23.0 | 23.0 | 83.0 | 178.0 | 2,157.4 | 4,917.4 | 6,822.4 |
| U.S-Latin America | 4.3 | 10.6 | 10.6 | 10.6 | 15.6 | 275.6 | 1,595.6 | 4,165.6 |
| U.S.-Asia | 4.1 | 4.1 | 14.1 | 14.1 | 104.1 | 344.1 | 384.1 | 1,224.1 |
| Europe-Asia | 1.1 | 1.1 | 11.1 | 11.1 | 31.1 | 31.1 | 71.1 | 171.1 |
| Total | 32.5 | 38.8 | 58.8 | 118.8 | 328.8 | 2,808.2 | 6,968.2 | 12,383.2 |

Source: TeleGeography research



Note: Capacity figures denote lit capacity at the end of a particular year. Projected capacity is based on reported initial capacity of systems during the year they are scheduled to be ready for service and assumes that cable systems with announced DWDM upgrade schedules will upgrade to one-half potential capacity by year-end 2002.

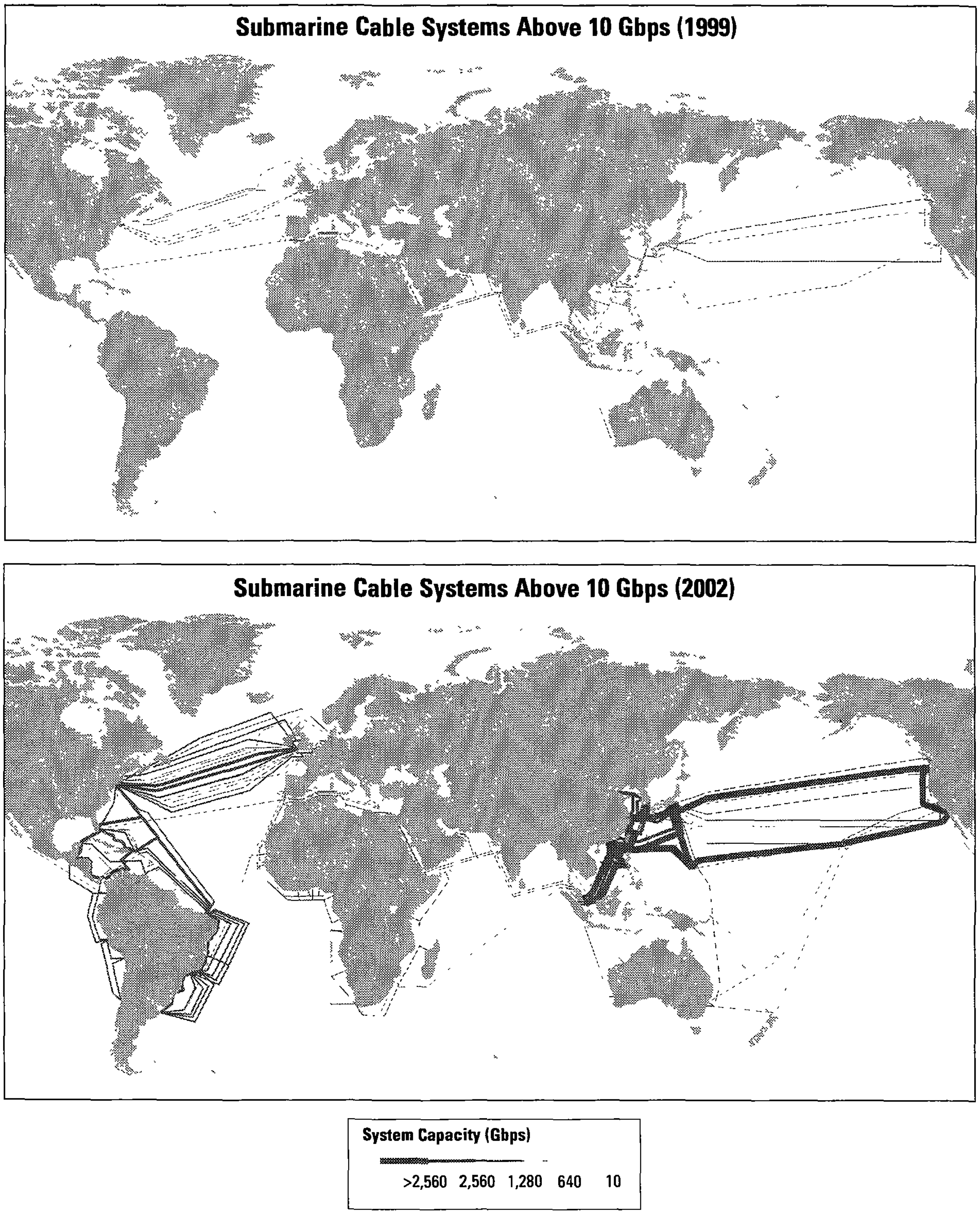
## Figure 2. Submarine Cable Deployment Trends




Note: Included cables have a capacity of 10 Gbps or more and will be ready for service by year-end 2001. The C2C Cable Network is omitted from the top figure because its announced maximum capacity of 7,680 Gbps, more than twice of any previously announced cable, would exceed the scale of the figure.

Source: TeleGeography research

## Figure 3. Major Submarine Cable Growth




Note: Figure includes systems with a capacity of 10 Gbps or more and are in-service at year-end 2002. Cables have been scaled to their maximum upgradeable capacity.

*Source: TeleGeography research*

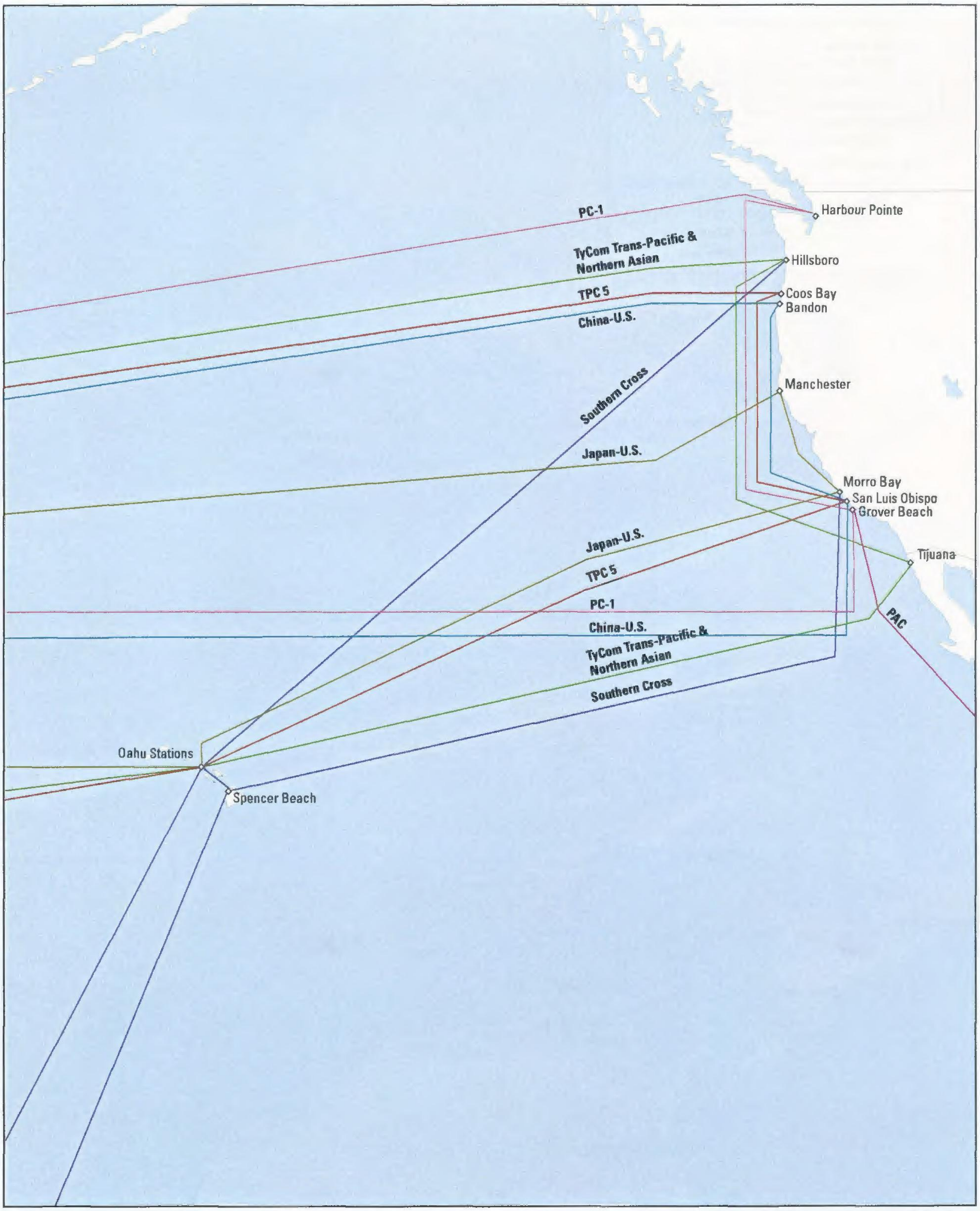
## Figure 4. Major Submarine Cable Systems by Region

| | Ready for Service (RFS) | Fiber Pairs | Bit Rate | Channels | Maximum Capacity (Gbps) | Length (km) | Construction Cost (US$ Millions) |
|---|---|---|---|---|---|---|---|
| ***Europe-Africa-Asia*** | | | | | | | |
| Africa ONE | 4Q 2002 | 4 | 10 | 16 | 640 | 32,000 | 1,900 |
| FLAG Europe-Asia | November 1997 | 2 | 2.5 | 2 | 10 | 28,000 | 1,500 |
| SAT-3/WASC/SAFE | October 2001 | 2 | 2.5 | 16 | 80 | 18,900 | 796 |
| SeaMeWe-3 | September 1999 | 2 | 2.5 | 8 | 40 | 38,000 | 1,173 |
| ***Intra-Asia*** | | | | | | | |
| APCN | February 1997 | 1 | 5 | 4 | 20 | 5,234 | 550 |
| APCN-2 | September 2001 | 4 | 10 | 64 | 2,560 | 17,000 | 1,000 |
| C2C Cable Network | December 2001 | 8 | 10 | 96 | 7,680 | 18,000 | 2,000 |
| East Asia Crossing (EAC) | December 2000 | 4 | 10 | 64 | 2,560 | 17,700 | 1,280 |
| North Asian Cable (Level 3) | June 2001 | 4 | 10 | 64 | 2,560 | 6,000 | n.a. |
| ***U.S.-Latin America*** | | | | | | | |
| 360americas | 2Q 2001 | 4 | 10 | 32 | 1,280 | 22,500 | 940 |
| Americas-2 | May 2000 | 4 | 2.5 | 8 | 80 | 7,350 | 365 |
| ARCOS 1 | September 2000 | 4 | 10 | 64 | 2,560 | 8,600 | 400 |
| Atlantis-2 | February 2000 | 1 | 2.5 | 8 | 20 | 8,500 | 230 |
| Columbus-III | December 1999 | 2 | 2.5 | 8 | 40 | 10,000 | 236 |
| Maya-1 | May 2000 | 3 | 2.5 | 2 | 15 | 4,962 | 152 |
| Mercus-1 | December 2001 | 4 | 10 | 64 | 2,560 | 10,000 | 950 |
| Mid-Atlantic Crossing (MAC) | February 2000 | 2 | 10 | 16 | 320 | 6,700 | 415 |
| Pan-American Crossing (PAC) | March 2000 | 2 | 2.5 | 16 | 80 | 9,000 | 280 |
| SAm-1 | March 2001 | 4 | 10 | 48 | 1,920 | 23,000 | 900 |
| South American Crossing (SAC) | September 2000 | 4 | 10 | 32 | 1,280 | 15,000 | 800 |
| ***U.S.-Europe*** | | | | | | | |
| 360atlantic | March 2001 | 4 | 10 | 48 | 1,920 | 12,200 | 630 |
| Atlantic Crossing-1 (AC-1) | May 1998 | 4 | 2.5 | 16 | 160 | 14,521 | 750 |
| FLAG Atlantic-1 (FA-1) | March 2001 | 6 | 10 | 40 | 2,400 | 12,250 | 1,200 |
| Gemini Cable System | February 1998 | 2 | 2.5 | 6 | 30 | 12,115 | 600 |
| TAT 12/13 | September 1996 | 2 | 5 | 3 | 30 | 12,766 | 750 |
| TAT 14 | December 2000 | 4 | 10 | 16 | 640 | 15,000 | 1,500 |
| TyCom Trans-Atlantic | July 2001 | 4 | 10 | 64 | 2,560 | 13,000 | 650 |
| Yellow/AC-2 | September 2000 | 4 | 10 | 32 | 1,280 | 6,000 | 800 |
| ***U.S.-Asia*** | | | | | | | |
| Australia-Japan | July 2001 | 2 | 10 | 32 | 640 | 7,000 | 450 |
| China-U.S. Cable System | January 2000 | 4 | 2.5 | 8 | 80 | 30,800 | 1,400 |
| Guam-Philippines (G-P) | March 1999 | 2 | 2.5 | 4 | 20 | 3,600 | 100 |
| Japan-U.S. Cable Network (JUS) | October 2000 | 4 | 2.5 | 64 | 640 | 21,000 | 1,000 |
| Pacific Crossing-1 (PC-1) | December 1999 | 4 | 10 | 16 | 640 | 21,000 | 1,200 |
| Southern Cross Cable Network | November 2000 | 3 | 2.5 | 16 | 120 | 30,000 | 900 |
| TPC 5 | January 1997 | 2 | 5 | 2 | 20 | 25,000 | 1,240 |
| TyCom Trans-Pacific & Northern Asia | July 2002 | 8 | 10 | 64 | 5,120 | 32,000 | n.a. |

Notes: This table includes submarine cable systems that are currently in operation as of October 2000 or will be ready for service by year-end 2002. Regional submarine cable systems and systems that have a capacity of less than 10 Gbps have been omitted. Technical configuration denotes maximum upgradeable capacity.

Source: TeleGeography research

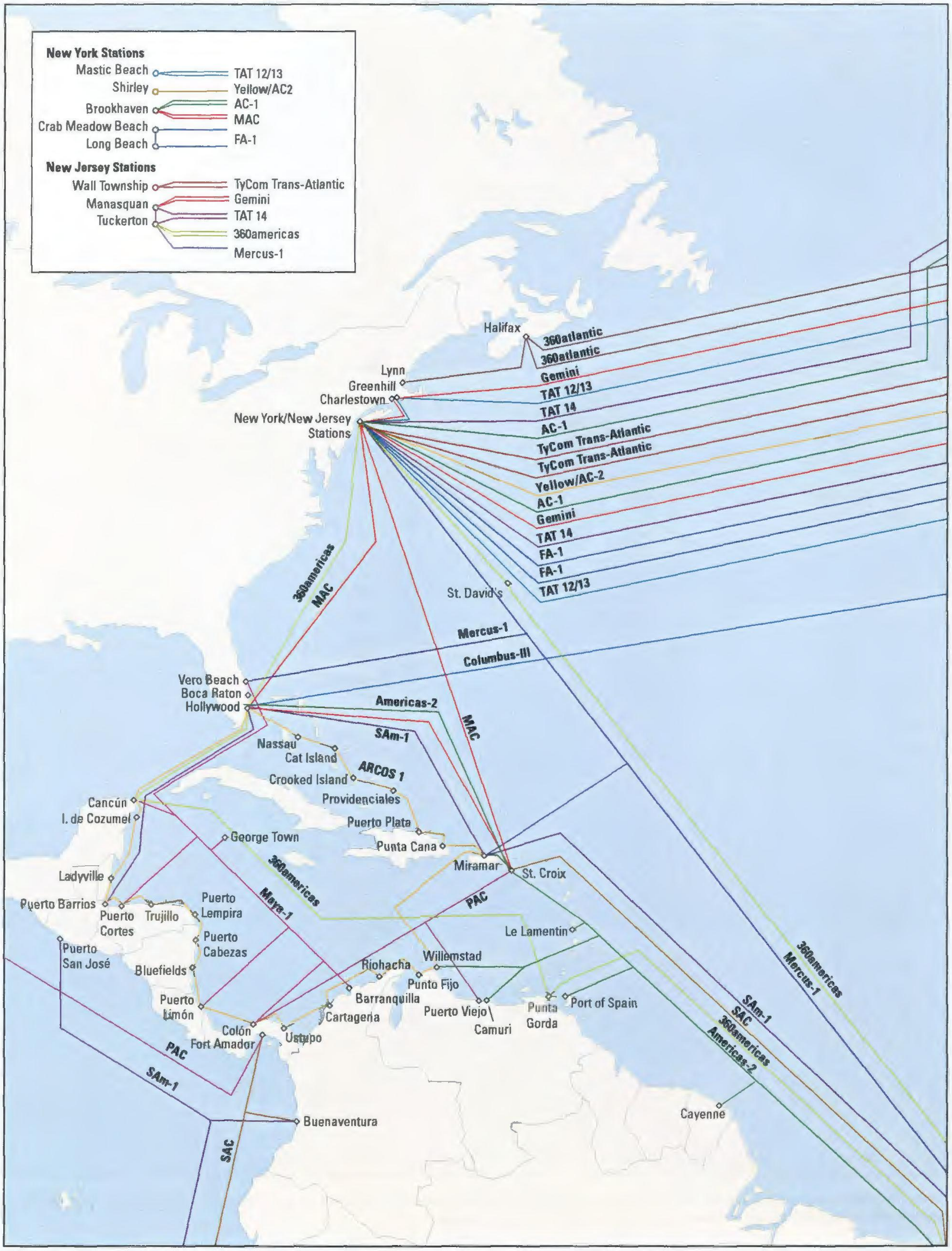
## Figure 5. Map of Major Submarine Cables in the United States (Pacific Coast)




Note: The following maps include submarine cable systems in operation as of October 2000 and those that will be ready for service by year-end 2002. Regional submarine cable systems and systems that have a capacity of less than 10 Gbps are omitted.

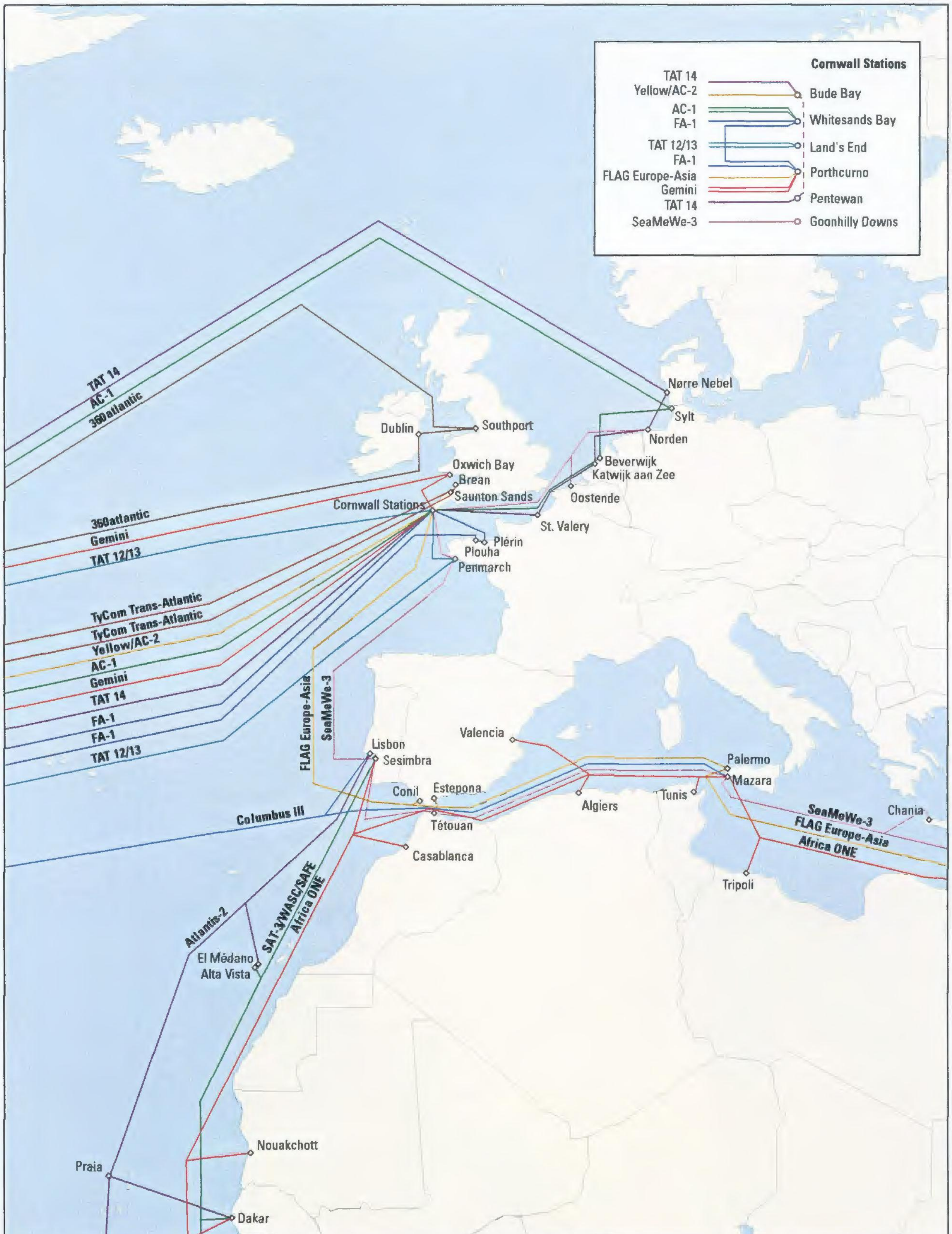
Source: TeleGeography research, FCC filings, and company reports

## Figure 6. Map of Major Submarine Cables in the United States (Atlantic Coast) & the Caribbean




Note: Please refer to the note on Figure 5 for an explanation of this map.

## Figure 7. Map of Major Submarine Cables in Europe

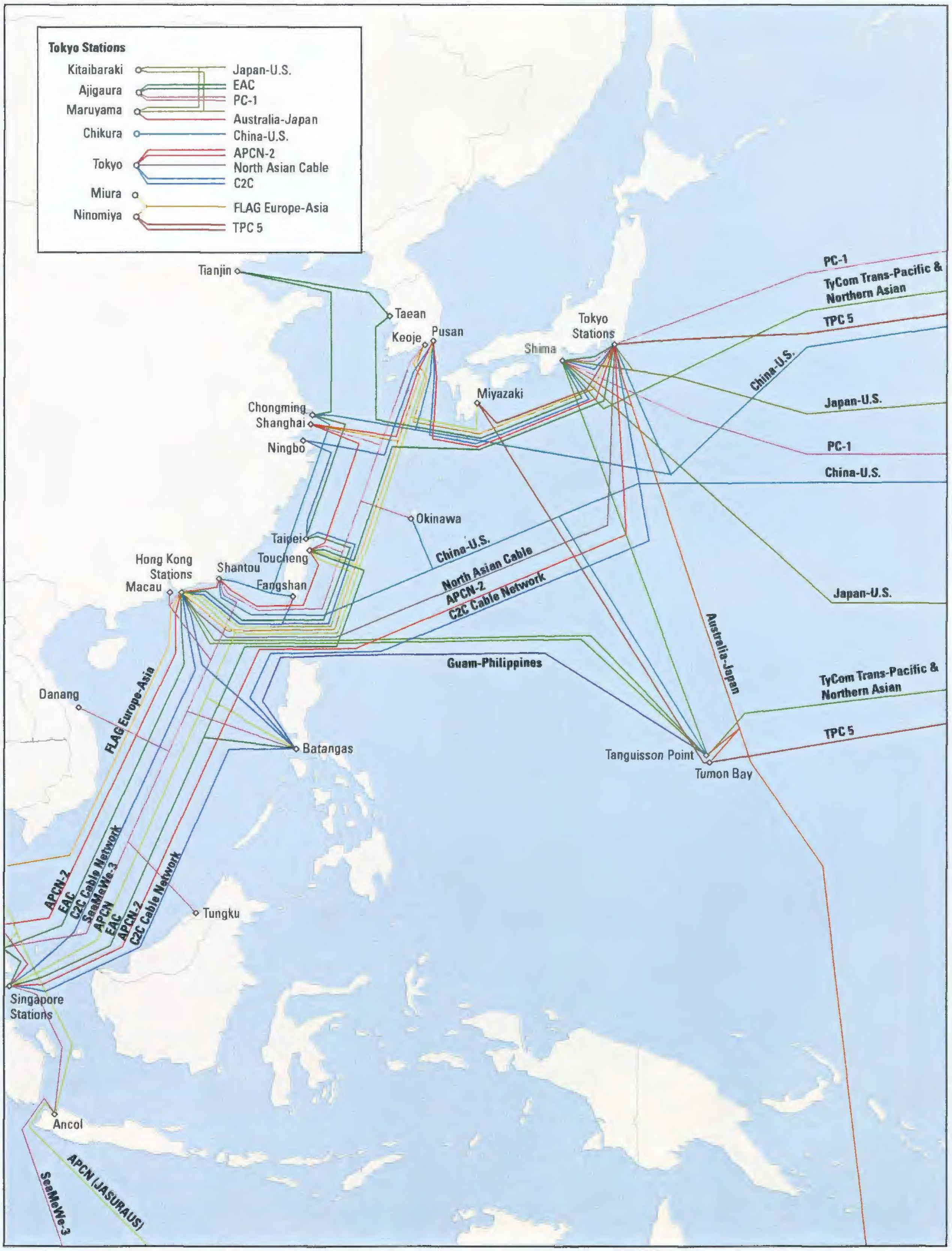



Note: Please refer to the note on Figure 5 for an explanation of this map.

## Figure 8. Map of Major Submarine Cables in Latin America and the Caribbean

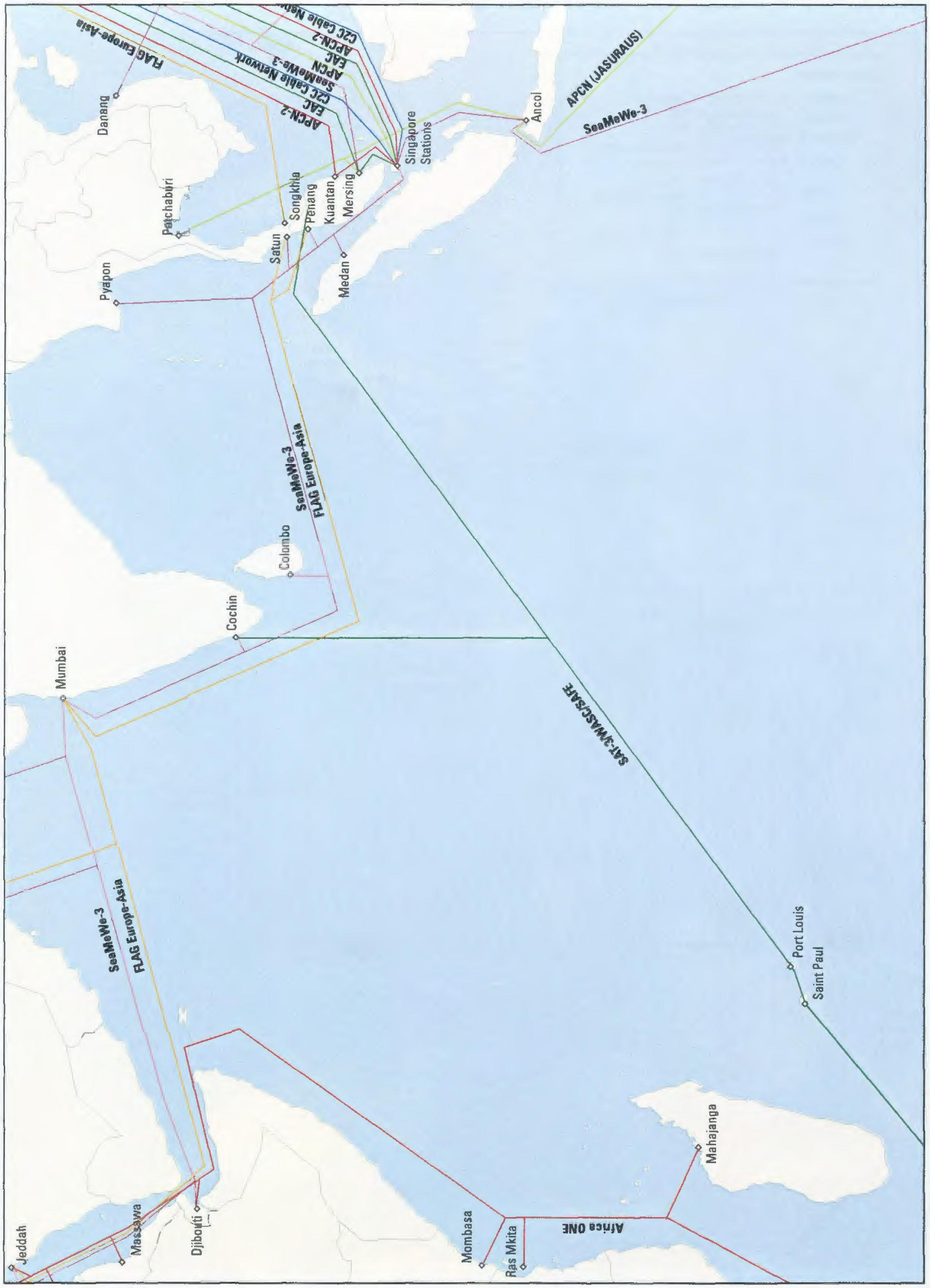

Note: Please refer to the note on Figure 5 for an explanation of this map.

## Figure 9. Map of Major Submarine Cables in East Asia




Note: Please refer to the note on Figure 5 for an explanation of this map.

# Figure 10. Map of Major Submarine Cables in Central Asia



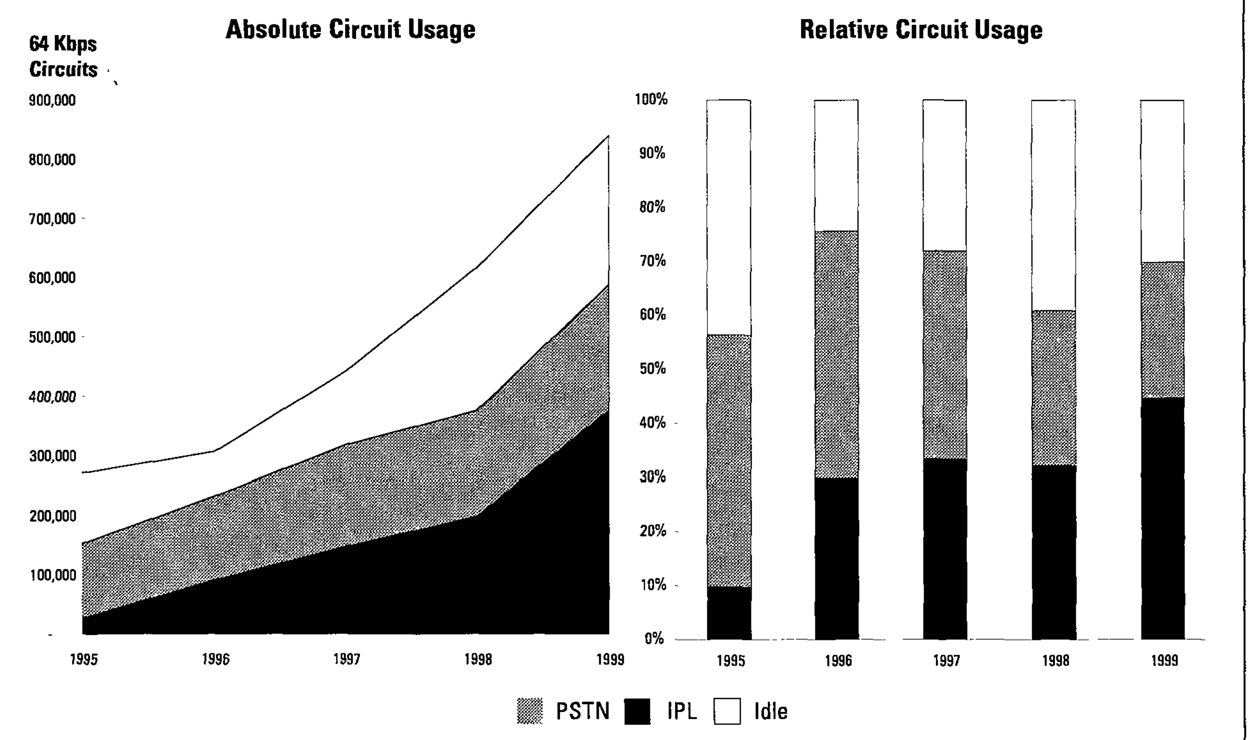

Note: Please refer to the note on Figure 5 for an explanation of this map.

# International Circuit Usage by U.S. Carriers

Each year the U.S. Federal Communications Commission (FCC) releases aggregate circuit usage statistics based on reports filed by the three largest U.S. facilities-based carriers (AT&T, WorldCom, and Sprint). Although the rapid entry of new carriers reduces the relative representation of the top three carriers each year, the statistics are still useful for baseline comparisons along two axes. First, the data illuminate year-to-year growth trends in overall cable and satellite connectivity. Second, the statistics break down how much capacity is used for public switched telephone network (PSTN) traffic, international private lines (IPLs), as well as how much capacity is reported "idle" each year.

Although private lines can carry voice traffic, the circuit usage statistics provide a rough proxy to determine the balance of voice and data traffic on international networks connecting to the U.S. Assuming that increased IPL circuit deployment represents increased data traffic flows, the voice/data "crossover"—the point at which data traffic exceeded voice—occurred sometime in 1998. Over the past five years, the PSTN's share of used capacity dropped from 83 to 36 percent. If the trend continues, public telephone lines may contribute only 15 percent of used capacity by 2005.

**Figure 1. International Circuit Usage Summary, 1995-1999**




64 Kbps Circuit Usage

| | IPL | PSTN | Idle | Total Available |
|---|---|---|---|---|
| 1995 | 26,497 | 126,150 | 118,343 | 270,990 |
| 1996 | 91,362 | 140,518 | 74,762 | 306,642 |
| 1997 | 147,408 | 170,717 | 123,751 | 441,876 |
| 1998 | 198,369 | 177,049 | 241,052 | 616,470 |
| 1999 | 375,503 | 212,243 | 252,232 | 839,978 |

Source: FCC

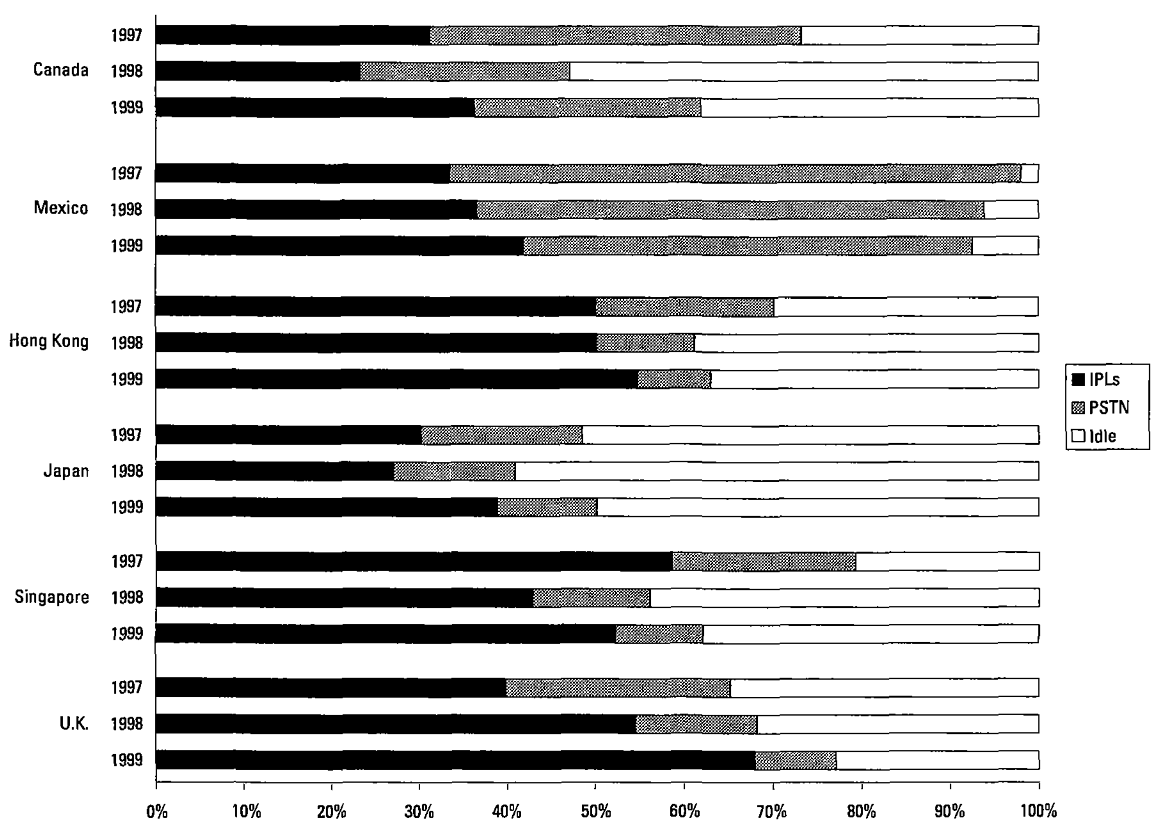
## Figure 2. International Circuit Usage for Selected Routes, 1997-1999

**U.S. Carrier 64 Kbps Circuit Usage**

| | | For Private Lines | For Public Switched Network | Total Circuits In Use | Idle Circuits | Total Available |
|---|---|---|---|---|---|---|
| Canada | 1997 | 37,383 | 50,343 | 87,726 | 32,178 | 119,904 |
| | 1998 | 53,302 | 54,719 | 108,021 | 120,961 | 228,982 |
| | 1999 | 103,546 | 72,999 | 176,545 | 108,901 | 285,446 |
| Mexico | 1997 | 19,155 | 36,935 | 56,090 | 1,148 | 57,238 |
| | 1998 | 24,463 | 38,301 | 62,764 | 4,080 | 66,844 |
| | 1999 | 41,523 | 50,259 | 91,782 | 7,414 | 99,196 |
| Hong Kong | 1997 | 3,058 | 1,221 | 4,279 | 1,825 | 6,104 |
| | 1998 | 4,685 | 1,027 | 5,712 | 3,623 | 9,335 |
| | 1999 | 6,218 | 924 | 7,142 | 4,199 | 11,341 |
| Japan | 1997 | 10,087 | 6,149 | 16,236 | 17,178 | 33,414 |
| | 1998 | 11,907 | 6,098 | 18,005 | 26,042 | 44,047 |
| | 1999 | 21,998 | 6,401 | 28,399 | 28,120 | 56,519 |
| Singapore | 1997 | 1,617 | 570 | 2,187 | 571 | 2,758 |
| | 1998 | 1,959 | 608 | 2,567 | 1,999 | 4,566 |
| | 1999 | 3,412 | 638 | 4,050 | 2,473 | 6,523 |
| U.K. | 1997 | 23,008 | 14,662 | 37,670 | 20,118 | 57,788 |
| | 1998 | 47,410 | 11,818 | 59,228 | 27,671 | 86,899 |
| | 1999 | 101,298 | 13,695 | 114,993 | 34,100 | 149,093 |

Note: Data based on year-end FCC circuit status reports filed by AT&T, WorldCom, and Sprint, for circuits originating in the continental U.S. as well as Puerto Rico, Guam, and other U.S. territories. "Idle" circuits are owned by a carrier at year end but not in use. The FCC estimates that 25-30 percent of total submarine cable capacity landed in the U.S. is controlled by foreign carriers and thus not reported here. Also, up to 100 percent of used capacity goes unreported because it is reserved for restoration purposes only.

**Circuit Usage and Idle Capacity, 1997-1999**




Source: FCC

## Figure 3. International Circuit Usage by Region, 1997-1999

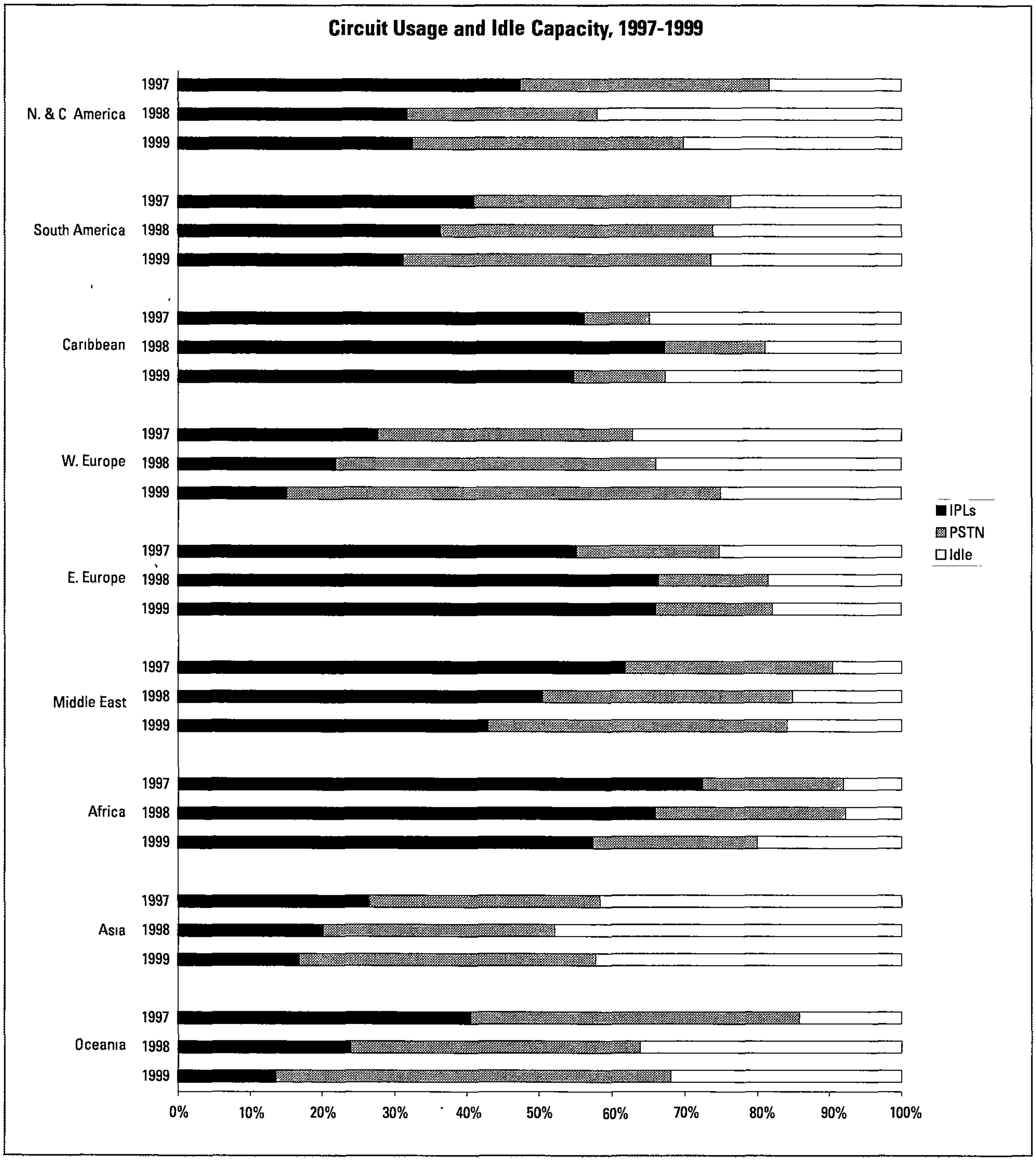
**U.S. Carrier 64 Kbps Circuit Usage**

| | | For Private Lines | For Public Switched Network | Total Circuits In Use | Idle Circuits | Total Available |
|---|---|---|---|---|---|---|
| N. and C. America | 1997 | 64,230 | 88,989 | 153,219 | 34,504 | 187,723 |
| | 1998 | 78,601 | 94,952 | 173,553 | 126,197 | 299,750 |
| | 1999 | 144,257 | 125,328 | 269,585 | 116,683 | 386,268 |
| South America | 1997 | 5,928 | 6,900 | 12,828 | 3,986 | 16,814 |
| | 1998 | 7,958 | 7,716 | 15,674 | 5,536 | 21,210 |
| | 1999 | 10,823 | 7,953 | 18,776 | 6,752 | 25,528 |
| Caribbean | 1997 | 1,034 | 6,478 | 7,512 | 4,006 | 11,518 |
| | 1998 | 1,439 | 7,026 | 8,465 | 1,977 | 10,442 |
| | 1999 | 1,622 | 7,063 | 8,685 | 4,223 | 12,908 |
| W. Europe | 1997 | 43,784 | 34,476 | 78,260 | 46,245 | 124,505 |
| | 1998 | 69,051 | 34,133 | 103,184 | 52,937 | 156,121 |
| | 1999 | 153,806 | 38,777 | 192,583 | 64,386 | 256,969 |
| E. Europe | 1997 | 1,326 | 3,742 | 5,068 | 1,719 | 6,787 |
| | 1998 | 1,004 | 4,418 | 5,422 | 1,231 | 6,653 |
| | 1999 | 1,161 | 4,791 | 5,952 | 1,298 | 7,250 |
| Middle East | 1997 | 1,432 | 3,096 | 4,528 | 479 | 5,007 |
| | 1998 | 1,920 | 2,807 | 4,727 | 844 | 5,571 |
| | 1999 | 2,808 | 2,934 | 5,742 | 1,085 | 6,827 |
| Africa | 1997 | 699 | 2,608 | 3,307 | 292 | 3,599 |
| | 1998 | 1,080 | 2,712 | 3,792 | 320 | 4,112 |
| | 1999 | 1,036 | 2,630 | 3,666 | 917 | 4,583 |
| Asia | 1997 | 23,545 | 19,567 | 43,112 | 30,830 | 73,942 |
| | 1998 | 30,563 | 19,262 | 49,825 | 45,915 | 95,740 |
| | 1999 | 48,513 | 19,932 | 68,445 | 50,170 | 118,615 |
| Oceania | 1997 | 5,430 | 4,861 | 10,291 | 1,690 | 11,981 |
| | 1998 | 6,753 | 4,023 | 10,776 | 6,095 | 16,871 |
| | 1999 | 11,477 | 2,835 | 14,312 | 6,718 | 21,030 |
| Totals | 1997 | 147,408 | 170,717 | 318,125 | 123,751 | 441,876 |
| | 1998 | 198,369 | 177,049 | 375,418 | 241,052 | 616,470 |
| | 1999 | 375,503 | 212,243 | 587,746 | 252,232 | 839,978 |

Note: Data based on year-end FCC circuit status reports filed by AT&T, WorldCom, and Sprint, for circuits originating in the continental U.S. as well as Puerto Rico, Guam, and other U.S. territories. "Idle" circuits are owned by a carrier at year end but not in use. The FCC estimates that 25-30 percent of total submarine cable capacity landed in the U.S. is controlled by foreign carriers and thus not reported here. Also, up to 100 percent of used capacity goes unreported because it is reserved for restoration purposes only.

Source: FCC

**Figure 4. Idle Circuits of U.S. Carriers by Region, 1997-1999**




Note: Data based on year-end FCC circuit status reports filed by AT&T, WorldCom, and Sprint, for circuits originating in the continental U.S. as well as Puerto Rico, Guam, and other U.S. territories. "Idle" circuits are owned by a carrier at year end but not in use. The FCC estimates that 25-30 percent of total submarine cable capacity landed in the U.S. is controlled by foreign carriers and thus not reported here. Also, up to 100 percent of used capacity goes unreported because it is reserved for restoration purposes only.

Source: FCC

# International Communications Satellites

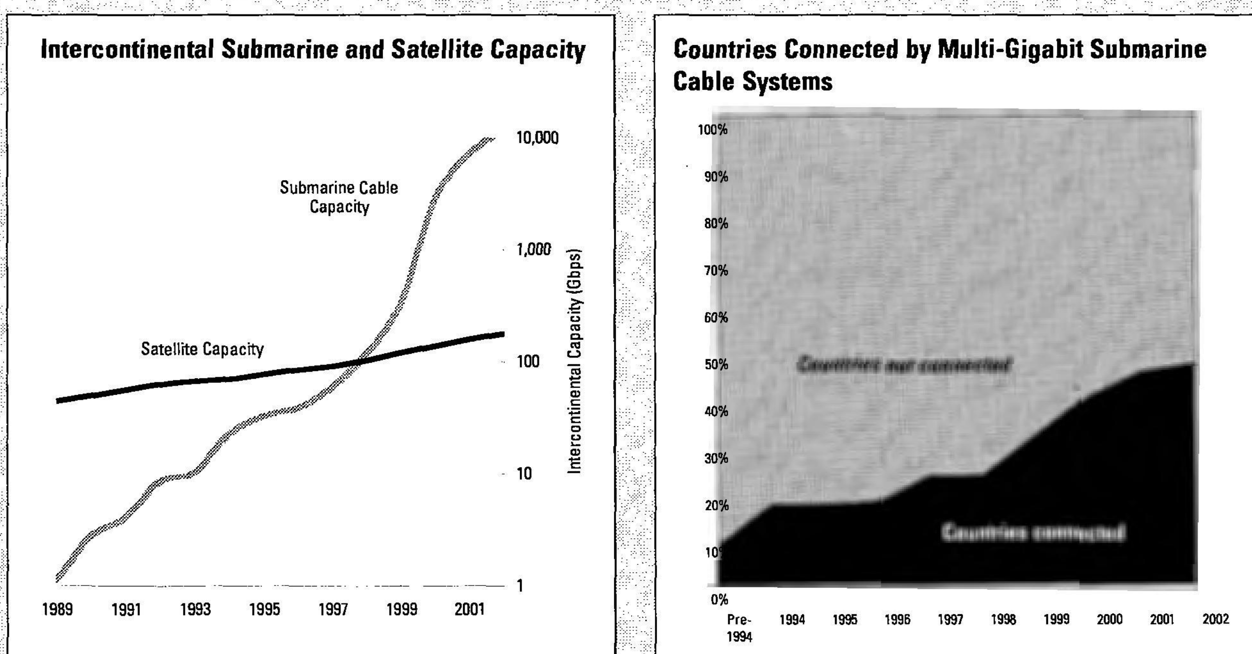
Early Bird entered service in 1965 as the first geostationary satellite launched to carry intercontinental telephone traffic. By the following decade satellites became the dominant means of providing all kinds of international telecommunications. That dominance only began to fade—and slowly at first—when the first of the new generation of fiber optic submarine cables was deployed in the late 1980s. By 1994, trans-Atlantic fiber was carrying more voice traffic than trans-Atlantic satellites.

It is clear that, on very busy point-to-point routes, fiber-optic submarine cables are superior to satellites. Although the quality of voice conversations is appreciably better on fiber, the primary reason for the decline of satellites' central role is price. The cost of submarine cable bandwidth on some trans-Atlantic routes is one-tenth that of comparable satellite capacity. And the gulf between cable and satellite bandwidth pricing is bound to widen in the coming years. Whereas most fiber bandwidth suppliers forecast price declines of 25 to 50 percent per year for the next three years, satellite bandwidth suppliers anticipate declines of no more than five to ten percent per year.

Recently, the explosion of fiber optic capacity has even eroded satellites' traditional role in submarine cable restoration. In previous years, carriers could lease capacity on satellites as an emergency backup when cable faults occurred. Yet submarine cable bandwidth now far exceeds total satellite capacity (see Figure 1. The Big Picture). Indeed, a single cable system, such as the 2.4 Tbps FLAG Atlantic-1, will soon dwarf all the world's satellite capacity combined—by at least one order of magnitude. Suppliers of these state of the art cable systems must rely on network ring architectures or other cables for restoration; satellites no longer present a viable option.

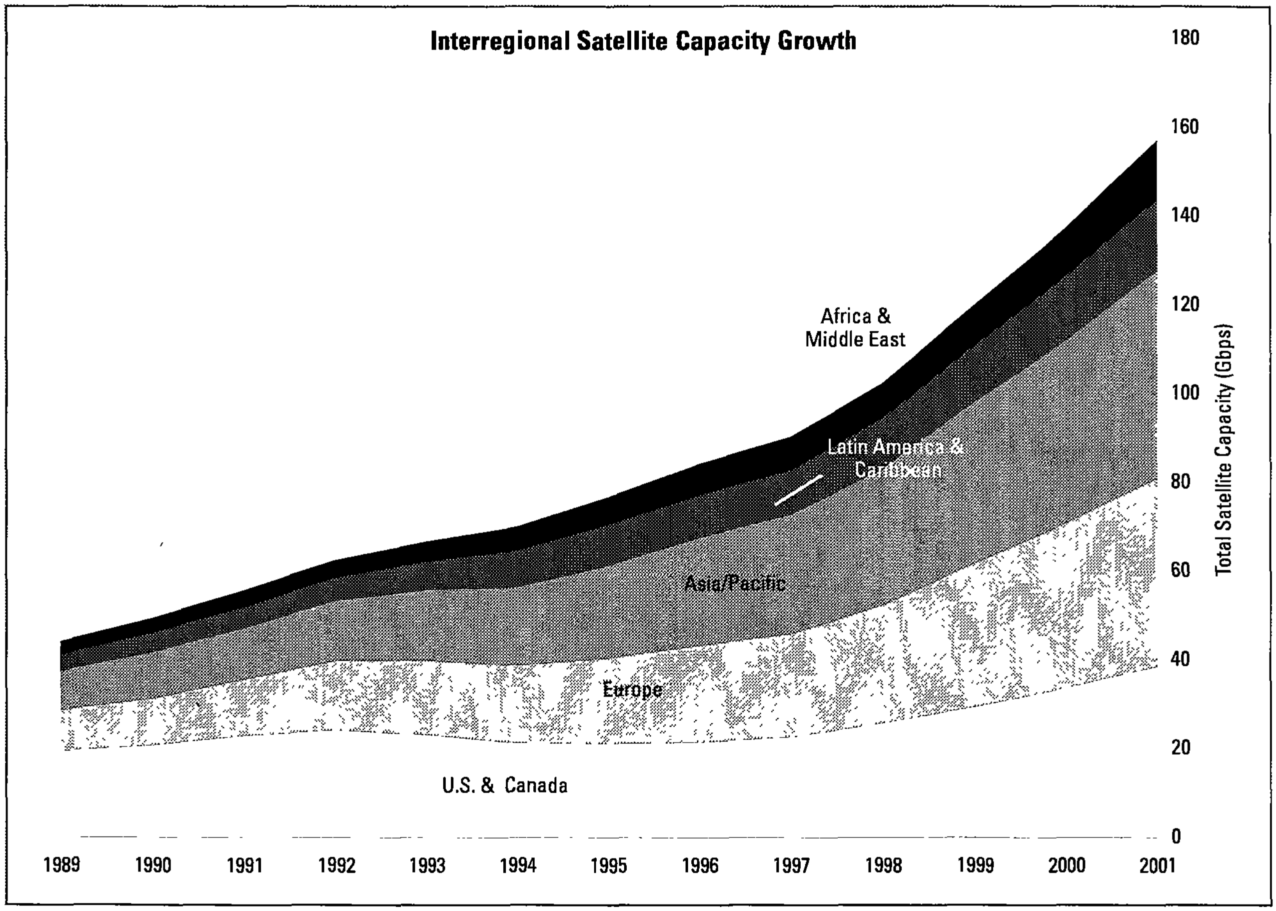
The technological and competitive revolution transforming long-haul networks is also leading a strategic business realignment among satellite owners. For example, when the world's largest satellite operator, Intelsat, spun off five of its satellites in a 1998 private venture, their primary target was the video services market. Most of New Skies' capacity is dedicated to video transmission for broadcasters. Likewise, Intelsat's first privately-backed competition, PanAmSat, collects more than three quarters of its revenue from video. Although Intelsat's business is still dominated by traditional telephone trunking services, much of its new commercial activity focuses on video services and Internet services.

**Figure 1. The Big Picture**




Source: TeleGeography research and Euroconsult

**Figure 2. Interregional Satellite Capacity, 1989-2001**




Note: Satellite capacity used for interregional voice and data services accounts for 12 percent of capacity shown above. Capacity figures assume that a pair of 36 MHz equivalent transponders will yield approximately 40 Mbps of transmission capacity.

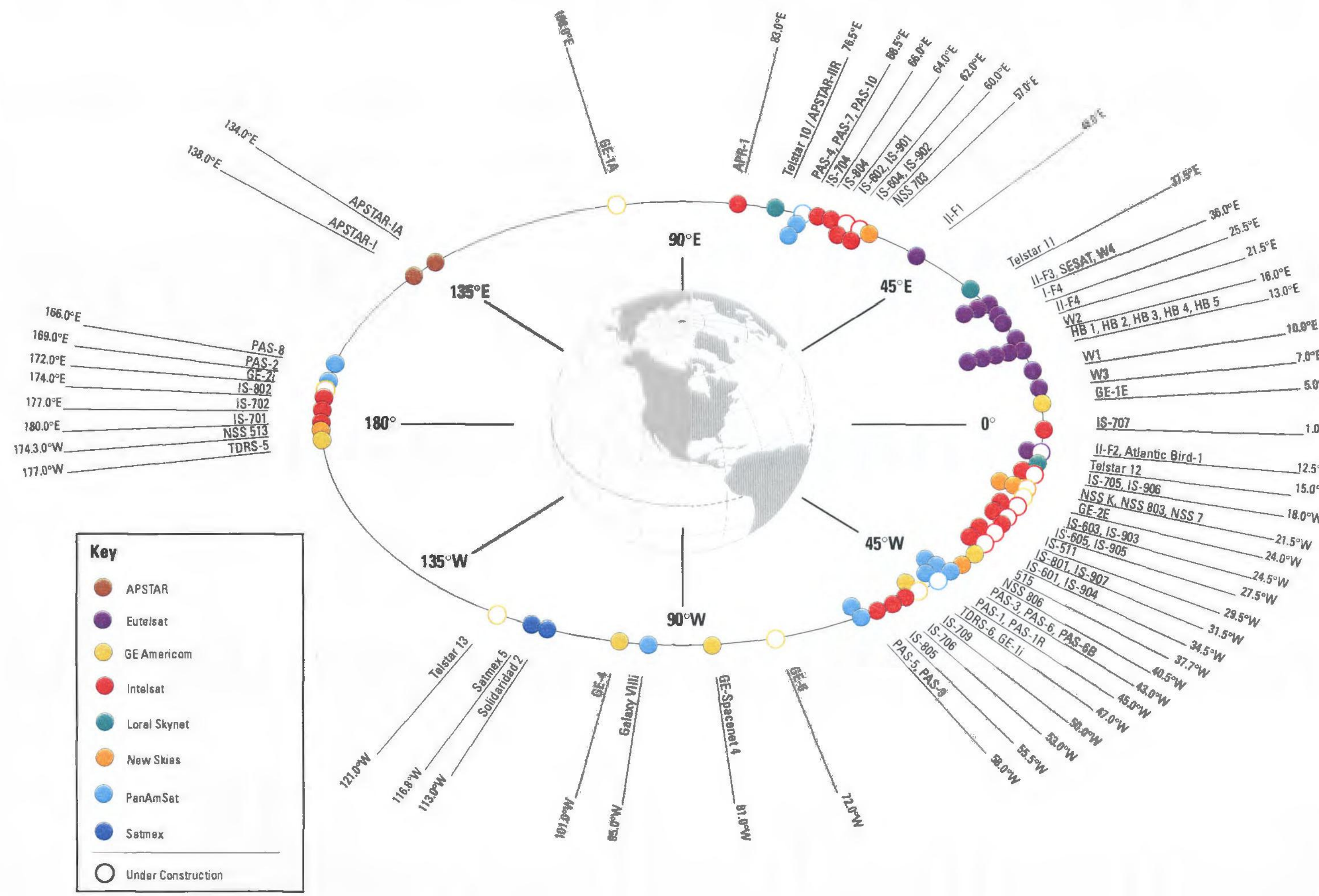
Source: Euroconsult



Although the prevalent model in the geostationary satellite business has shifted considerably over the last decade, satellites still matter in the international bandwidth regime. First, satellites are crucial on routes under-served by fiber optic infrastructure. This is important to telecom companies, ISPs, and corporate networkers seeking connectivity to this surprisingly large segment of the world's population (see Figure 1). Second, unlike fiber, satellite capacity is readily available in asymmetric configurations. This application is ideal for ISPs connecting to Internet hubs, where traffic is largely going in one direction—from content-rich web sites to downstream end-users. Finally, due to this same asymmetry, satellites are actually better suited for some applications. While this is clear in the case of one-way television broadcast services, the same logic applies to certain Internet applications, including the "multicast" of newsfeeds and caches of recently accessed web content.

*Adapted from "International Bandwidth 2000," TeleGeography's guide to supply and demand of international telecommunications capacity.*

**Figure 3. Major International Telecommunications Satellites in Geostationary Orbit**




Notes: Satellite orbits not to scale. Geostationary Earth Orbit (GEO) satellites orbit 35,785 km above the equator. Satellites that have been announced but have not specified an orbital slot have been omitted from this diagram. See Figure 4 for a list of major GEO satellites.
Design adapted from *"Global Marketplace 98,"* Merrill Lynch. Source: TeleGeography research, *International Satellite Directory*, and company reports

## Figure 4. Major International Telecommunications Satellites in Geostationary Orbit

| | | | | Transponders (36 Mhz) | | |
|---|---|---|---|---|---|---|
| | | Orbital Slot (°E) | Launch Date | C-Band | Ku-Band | Bus |
| ***Atlantic Ocean*** | | | | | | |
| GE Americom | GE-1E | 5.0° | November 1997 | - | 24.0 | n.a. |
| Eutelsat | W3 | 7.0° | May 1999 | - | 48.0 | Spacebus |
| Eutelsat | W1 | 10.0° | 3Q 2000 | - | 48.0 | Spacebus |
| Eutelsat | HOT BIRD 1 | 13.0° | March 1995 | - | 16.0 | Spacebus |
| Eutelsat | HOT BIRD 2 | 13.0° | November 1996 | - | 18.3 | Eurostar |
| Eutelsat | HOT BIRD 3 | 13.0° | September 1997 | - | 18.8 | Eurostar |
| Eutelsat | HOT BIRD 4 | 13.0° | February 1998 | - | 18.8 | Eurostar |
| Eutelsat | HOT BIRD 5 | 13.0° | October 1998 | - | 23.0 | Eurostar |
| Eutelsat | W2 | 16.0° | November 1998 | - | 48.0 | Spacebus |
| Eutelsat | II-F4 | 21.5° | July 1999 | - | 23.0 | Spacebus |
| Eutelsat | I-F4 | 25.5° | September 1987 | - | 20.0 | B. Aero |
| PanAmSat | PAS-5 | 302.0° | August 1997 | 24.0 | 24.0 | HS-601 |
| PanAmSat | PAS-9 | 302.0° | July 2000 | 24.0 | 24.0 | HS-601 |
| Intelsat | IS-805 | 304.5° | June 1998 | 36.0 | 6.0 | AS-7000 |
| Intelsat | IS-706 | 307.0° | May 1995 | 42.0 | 28.0 | FS-1300 |
| Intelsat | IS-709 | 310.0° | June 1996 | 42.0 | 20.0 | FS-1300 |
| GE Americom | GE-1i | 313.0° | 2003 | 72.0 | - | n.a. |
| GE Americom | TDRS-6 | 313.0° | January 1993 | 12.0 | - | TRW |
| PanAmSat | PAS-1 | 315.0° | June 1988 | 24.0 | 12.0 | GE 3000 |
| PanAmSat | PAS-1R | 315.0° | November 2000 | 36.0 | 36.0 | HS-601 |
| PanAmSat | PAS-3 | 317.0° | January 1996 | 25.1 | 25.1 | HS-601 |
| PanAmSat | PAS-6 | 317.0° | August 1997 | - | 36.0 | FS-1300 |
| PanAmSat | PAS-6B | 317.0° | December 1998 | - | 32.0 | HS-601 |
| New Skies Satellites | NSS 806 | 319.5° | February 1998 | 36.0 | 6.0 | LM 7000 |
| GE Americom | 515 | 322.3° | January 1989 | 27.0 | - | Ford Aero |
| Intelsat | IS-601 | 325.5° | October 1991 | 64.0 | 24.0 | HS-393 |
| Intelsat | IS-904 | 325.5° | 3Q 2001 | 76.0 | 20.0 | Loral SS |
| Intelsat | IS-801 | 328.5° | February 1997 | 64.0 | 12.0 | AS-7000 |
| Intelsat | IS-907 | 328.5° | TBD | n.a. | n.a. | n.a. |
| Intelsat | IS-511 | 330.5° | June 1985 | 42.0 | 12.0 | F. Aero |
| Intelsat | IS-605 | 332.5° | August 1991 | 64.0 | 24.0 | HS-393 |
| Intelsat | IS-905 | 332.5° | 4Q 2001 | 76.0 | 20.0 | n.a. |
| Intelsat | IS-603 | 335.5° | March 1990 | 64.0 | 24.0 | HS-393 |
| Intelsat | IS-903 | 335.5° | 2Q 2001 | 76.0 | 20.0 | Loral SS |
| GE Americom | GE-2E | 336.0° | 4Q 2002 | - | - | n.a. |
| New Skies Satellites | NSS 7 | 338.5° | 4Q 2001 | 58.0 | 47.0 | Loral SS |
| New Skies Satellites | NSS 803 | 338.5° | September 1997 | 61.0 | 12.0 | LM 7000 |
| New Skies Satellites | NSS K | 338.5° | June 1992 | - | 21.0 | LMA2100 |
| Intelsat | IS-705 | 342.0° | March 1995 | 42.0 | 20.0 | FS-1300 |
| Intelsat | IS-906 | 342.0° | TBD | n.a. | n.a. | n.a. |
| Loral Skynet | Telstar 12 | 345.0° | October 1999 | - | 45.0 | Eurostar |
| Eutelsat | Atlantic Bird 1 | 347.5° | 2Q 2001 | - | 36.0 | n.a. |
| Eutelsat | II-F2 | 347.5° | January 1991 | - | 23.0 | Spacebus |
| Intelsat | IS-707 | 359.0° | March 1996 | 42.0 | 28.0 | FS-1300 |

Note: Included satellites provide international coverage and belong to a constellation with at least 15 transponders dedicated to international voice and data services.

Source: TeleGeography research and company reports

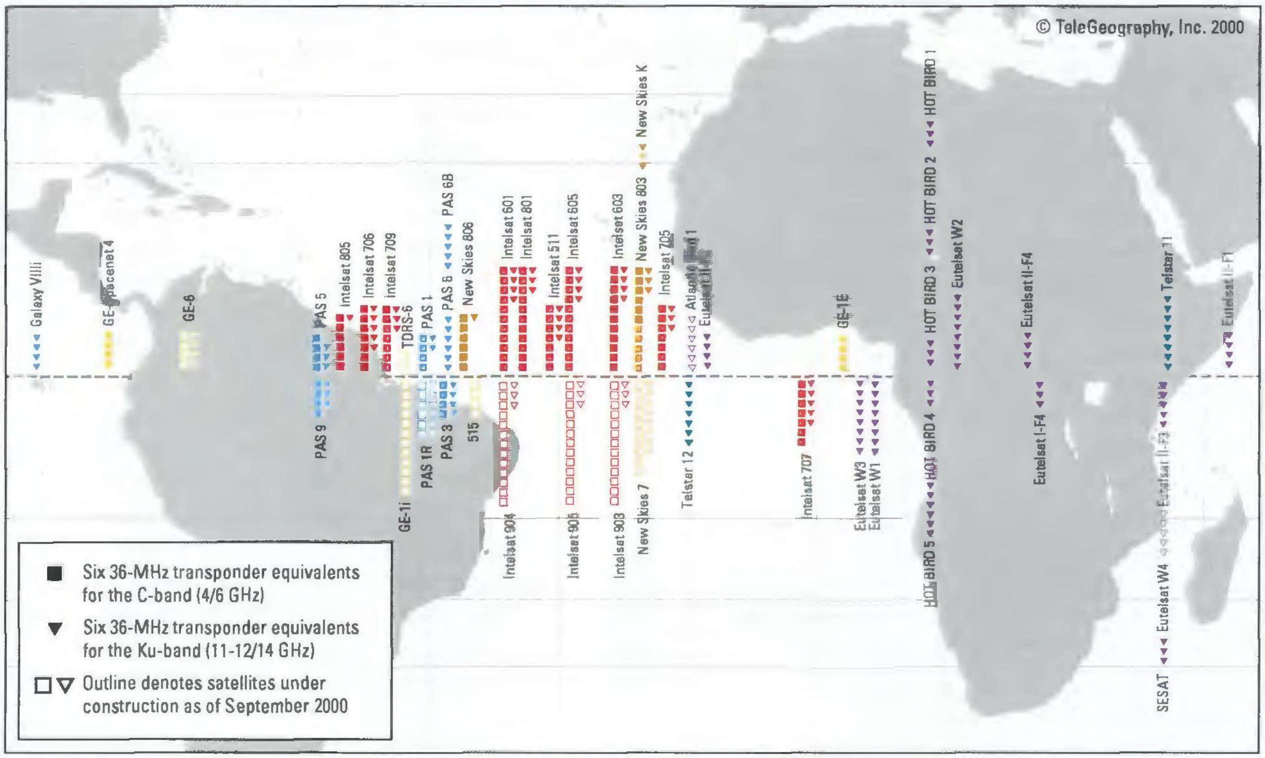
## Figure 4. Major International Telecommunications Satellites in Geostationary Orbit (continued)

| | | Orbital Slot (°E) | Launch Date | Transponders (36 Mhz) C-Band | Ku-Band | Bus |
|---|---|---|---|---|---|---|
| ***Indian Ocean*** | | | | | | |
| Eutelsat | II-F3 | 36.0° | December 1991 | - | 23 | Spacebus |
| Eutelsat | SESAT | 36.0° | April 2000 | - | 18 | n.a. |
| Eutelsat | W4 | 36.0° | May 2000 | - | 29.3 | Spacebus |
| Loral Skynet | Telstar 11 | 37.5° | November 1994 | - | 48 | Eurostar |
| Eutelsat | II-F1 | 48.0° | August 1990 | - | 23 | Spacebus |
| New Skies Satellites | NSS 703 | 57.0° | October 1994 | 40 | 20 | FS-1300 |
| Intelsat | IS-604 | 60.0° | June 1990 | 64 | 24 | HS-393 |
| Intelsat | IS-902 | 60.0° | 2Q 2001 | 76 | 20 | Loral SS |
| Intelsat | IS-602 | 62.0° | October 1989 | 64 | 24 | HS-393 |
| Intelsat | IS-901 | 62.0° | 4Q 2000 | 76 | 20 | Loral SS |
| Intelsat | IS-804 | 64.0° | December 1997 | 64 | 12 | AS-7000 |
| Intelsat | IS-704 | 66.0° | January 1995 | 42 | 20 | FS-1300 |
| PanAmSat | PAS-10 | 68.5° | 1Q 2001 | 12 | 12 | HS 601 |
| PanAmSat | PAS-4 | 68.5° | August 1995 | 25.1 | 24.6 | HS-601 |
| PanAmSat | PAS-7 | 68.5° | September 1998 | 14 | 30 | FS-1300 |
| Loral Skynet | Telstar 10/APSTAR-IIR | 76.5° | October 1997 | 27.8 | 23.5 | FS-1300 |
| Intelsat | APR-1 | 83.0° | June 1999 | 11 | - | n.a. |
| GE Americom | GE-1A | 108.0° | 3Q 2000 | - | 28 | n.a. |
| ***Pacific Ocean*** | | | | | | |
| APSTAR | APSTAR-IA | 134.0° | 1994 | 28 | - | HS-376 |
| APSTAR | APSTAR-I | 138.0° | July 1996 | 28 | - | HS-376 |
| PanAmSat | PAS-8 | 166.0° | November 1998 | 24 | 24 | FS-1300 |
| PanAmSat | PAS-2 | 169.0° | July 1994 | 25.1 | 25.1 | HS-601 |
| GE Americom | GE-2i | 172.0° | 2003 | 60 | - | n.a. |
| Intelsat | IS-802 | 174.0° | June 1997 | 64 | 12 | AS-7000 |
| Intelsat | IS-702 | 177.0° | June 1994 | 42 | 20 | FS-1300 |
| Intelsat | IS-701 | 180.0° | October 1993 | 42 | 20 | FS-1300 |
| New Skies Satellites | NSS 513 | 183.0° | May 1988 | 42 | 16 | Loral SS |
| GE Americom | TDRS-5 | 185.7° | August 1991 | 12 | - | TRW |
| Loral Skynet | Telstar 13 | 239.0° | June 2002 | n.a. | n.a. | Echostar |
| Satmex | Satmex 5 | 243.2° | December 1998 | 24 | 24 | HS 601 |
| Satmex | Solidaridad 2 | 247.0° | October 1994 | 24 | 24 | HS 601 |
| GE Americom | GE-4 | 259.0° | November 1999 | 24 | 32 | A2100 |
| PanAmSat | Galaxy VIIIi | 265.0° | December 1997 | - | 21.3 | HS 601 |
| GE Americom | GE-Spacenet 4 | 279.0° | April 1991 | 24 | - | n.a. |
| GE Americom | GE-6 | 288.0° | 4Q 2000 | 24 | 32 | A2100 |

Note: Satellites included provide international coverage and belong to a constellation with at least 15 transponders dedicated to international voice and data services.

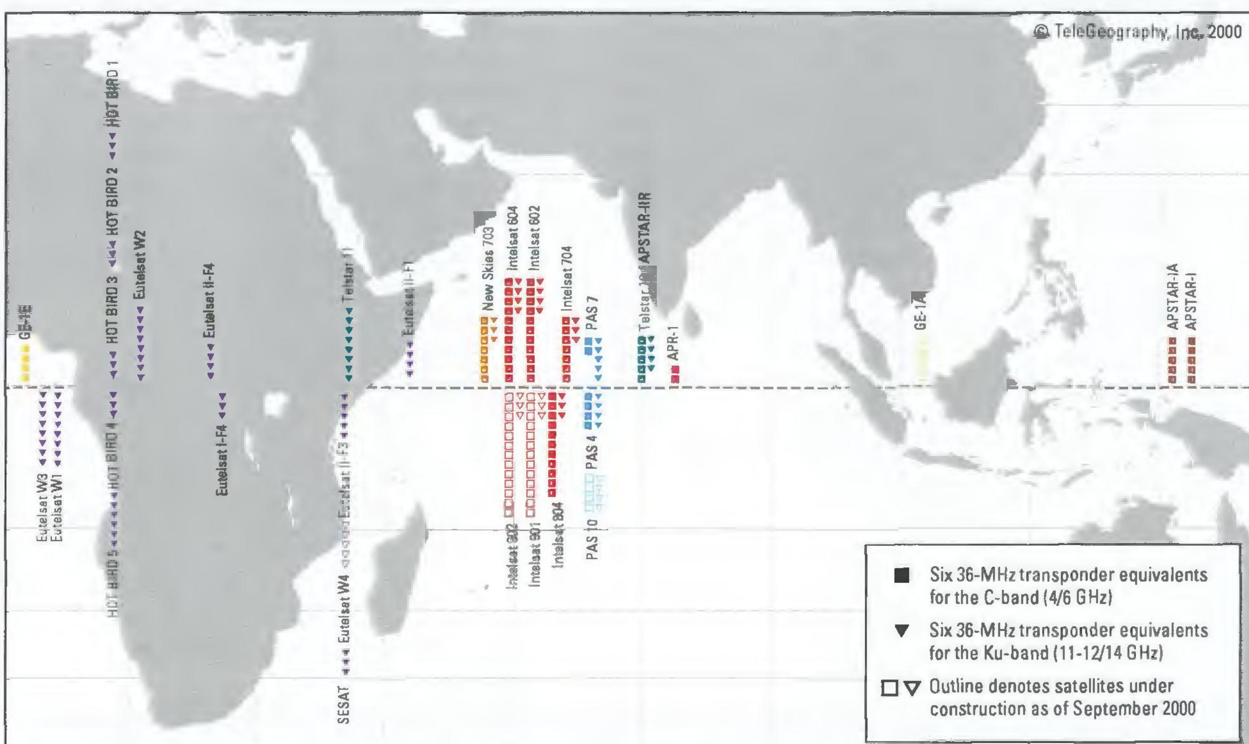
Source: TeleGeography research and company reports

## Figure 5. Map of Major Communications Satellites in the Atlantic Ocean Region



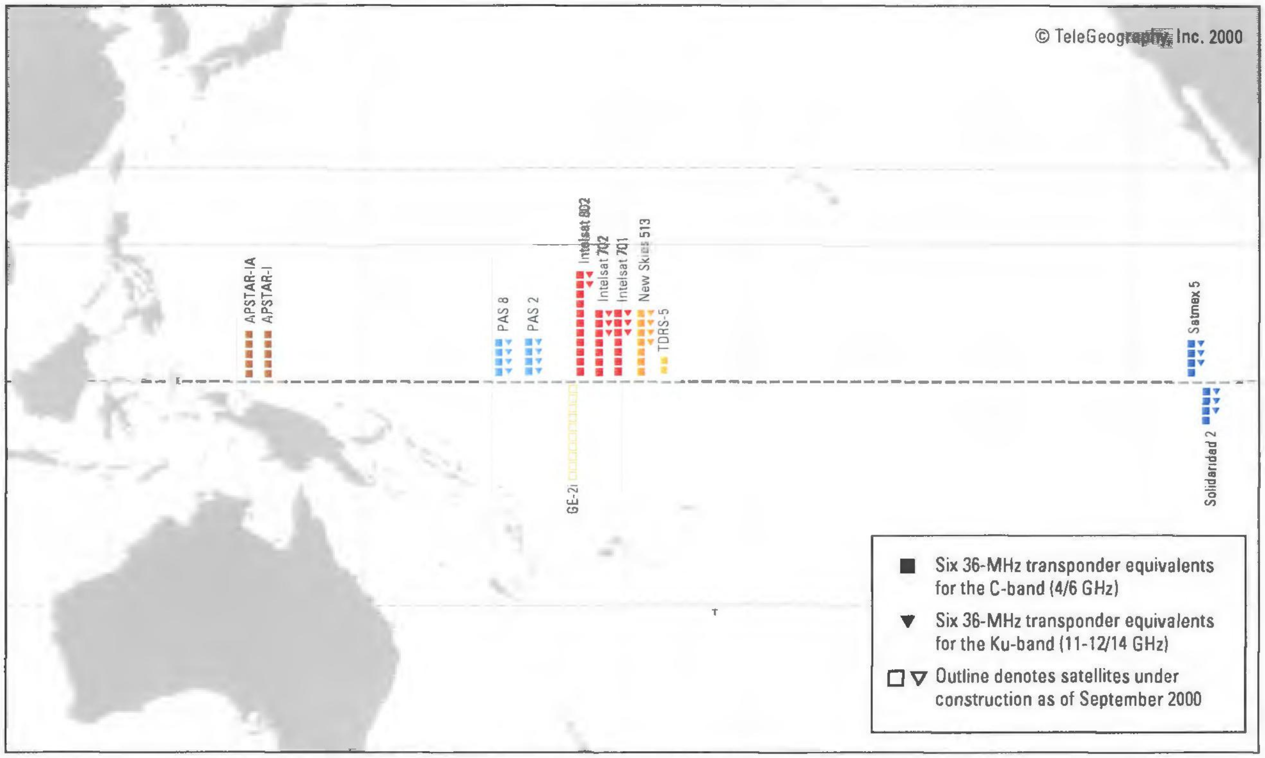

Note: Satellites included provide international coverage and belong to a constellation with at least 15 transponders dedicated to international voice and data services.

## Figure 6. Map of Major Communications Satellites in the Indian Ocean Region




Note: Satellites included provide international coverage and belong to a constellation with at least 15 transponders dedicated to international voice and data services.

**Figure 7. Map of Major Communications Satellites in the Pacific Ocean Region**




Note: Satellites included provide international coverage and belong to a constellation with at least 15 transponders dedicated to international voice and data services.

# Internet Backbones

# International Internet Backbones

**Internet Backbones**

What is an Internet backbone? And when is it international? The questions are not as straightforward as they might seem. International Internet backbones are private data links which cross international political borders, run the Internet Protocol (IP), are reachable from other parts of the Internet, and carry general Internet traffic: e-mail, Web pages, and most of the other popular services which have come to define today's Internet.

That means that international IP links devoted to just one type of traffic—notably, Voice-over-IP (VoIP)—are excluded from our definition of backbones on the public Internet. If VoIP is excluded, though, then why publish international Internet backbone data in a book on international telephony? The answer: because it just might be important.

Despite a history stretching back more than 30 years, today's Internet really began its push toward ubiquity during the 1990s in a rapid transition from academic network to commercial networks. What evolved was a decentralized infrastructure whose end-to-end design made it possible for users to create new network applications without asking too many people's permission.

The resulting infrastructure took media services based on text and simple graphics and turned them into the most widespread media platform since television. That ubiquity only fueled its popularity, however, and soon people were stuffing two-way voice telephony, streaming video, and other bandwidth-intensive applications into the public Internet. They did this not because the Internet's then-infrastructure was particularly well-suited to such services, but because running them over the Internet meant bringing together multiple services on a single platform. On networks, the whole is always more than the sum of its parts.

The so-called "public Internet" is at a crossroads. How will it accommodate very different types of traffic inside the same networks? Some want to solve the problem by bestowing Quality of Service (QoS) provisions upon IP so that networks can distinguish between what needs to be delivered immediately and what needs to be delivered with care. Some, pressed for time, prefer to forego fancy traffic engineering by throwing more bandwidth at the problem, hoping to give every packet enough room to get to its destination in style. And some are abandoning the public Internet altogether: distinct backbones are emerging for self-similar traffic generators, like VoIP or the Usenet's text- and photo-oriented discussion groups. Those highly specialized, single-service backbones are not included here.

That sharpens the scope of what we mean by "Internet" backbones. But it doesn't close off their possibilities. There is increasing excitement over a "new public network" infrastructure which meshes PSTN (public switched telephone network) and IP infrastructure into the backbone of tomorrow's public communications facilities. If the feverish activity taking place around the world can successfully achieve the economies of scale and creative possibilities that interoperable communications services represent, these backbones will have to come together to look like the Internet as many engineers have always drawn it—a cloud.

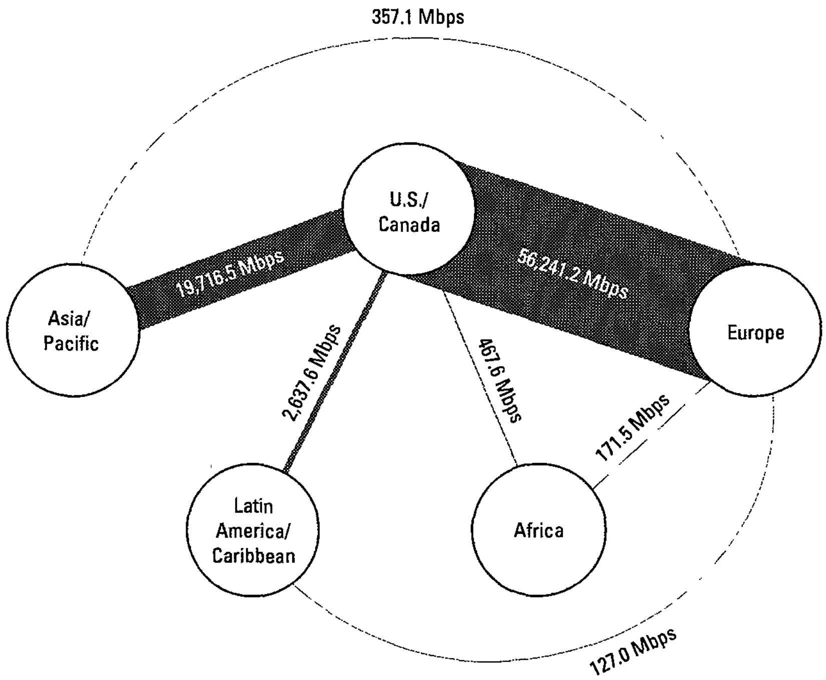
**Bandwidth, Not Traffic**

The maps and statistics on the following pages show international Internet backbone capacity, or bandwidth—not traffic. There are several reasons to keep track of international Internet bandwidth. One is to provide a rough metric for matching supply and demand. But there is another reason: bandwidth take-up may provide a clue to Internet traffic statistics, which are still in very short supply.

International Internet bandwidth is growing faster than international Internet traffic, however. In the past few years, tremendous physical infrastructure builds began to come on-line. Because raw bandwidth does not translate immediately into Internet capacity, however—it must first be lit, sold, deployed, and integrated into data network operations—the numbers showed what, to casual observers, appeared to be a mismatch between physical capacity and Internet capacity. In 2000, however, bandwidth started diffusing up the network layers, moving from physical installation to actually existing network services. As Internet capacity began to take advantage of the fiber explosion, two-and-a-half gigabit per second OC-48 (STM-16) links running Internet Protocol became, if not common, at least widespread.

All this new Internet capacity makes network bandwidth less useful as a proxy for traffic. But it does provide important insights as to how traffic is routed. Historically, steep intraregional bandwidth costs, a comparative lack of local content, and limited regional coordination had caused the U.S. to become the Internet's central switching office, even for data flows within a region. Last year, we found that the

## Figure 1. Interregional Internet Bandwidth, 2000




| Region 1 | Region 2 | International Internet Bandwidth |
|---|---|---|
| Africa | Africa (intraregional) | 9.0 Mbps |
| | Asia/Pacific | 3.8 Mbps |
| | Europe | 171.5 Mbps |
| | Latin America/Caribbean | n.a. |
| | U.S./Canada | 467.6 Mbps |
| | **Region total** | **651.9 Mbps** |
| Asia/Pacific | Africa | 3.8 Mbps |
| | Asia/Pacific (intraregional) | 3,124.0 Mbps |
| | Europe | 357.1 Mbps |
| | Latin America/Caribbean | n.a. |
| | U.S./Canada | 19,716.5 Mbps |
| | **Region total** | **23,201.4 Mbps** |
| Europe | Africa | 171.5 Mbps |
| | Asia/Pacific | 357.1 Mbps |
| | Europe (intraregional) | 176,594.9 Mbps |
| | Latin America/Caribbean | 127.0 Mbps |
| | U.S./Canada | 56,241.2 Mbps |
| | **Region total** | **233,491.7 Mbps** |
| Latin America/Caribbean | Africa | n.a. |
| | Asia/Pacific | n.a. |
| | Europe | 127.0 Mbps |
| | Latin America/Caribbean (intraregional) | 71.0 Mbps |
| | U.S./Canada | 2,637.6 Mbps |
| | **Region total** | **2,835.6 Mbps** |
| U.S./Canada | Africa | 467.6 Mbps |
| | Asia/Pacific | 19,716.5 Mbps |
| | Europe | 56,241.2 Mbps |
| | Latin America/Caribbean | 2,637.6 Mbps |
| | U.S./Canada (intraregional) | 33,973.5 Mbps |
| | **Region total** | **113,036.3 Mbps** |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

Internet was still U.S.-centric but that places like Western Europe and, to a lesser extent, eastern Asia were beginning to develop as secondary hubs (see Figure 1. Interregional Internet Bandwidth, 2000).

In 2000, this trend continued. In Europe, international capacity between European countries again grew at a noticeably faster clip than did outgoing international bandwidth, nudging the continent's in-region connectivity to beyond 75 percent of its total international Internet bandwidth. Asia's intraregional connectivity, too, grew more than twice as fast as to anywhere else, doubling the proportion remaining within the region to one-sixth of total international Internet bandwidth.

Enormous differences still remain from country to country. The U.S.-centric pattern wanes only with substantial and sustained infrastructure builds of the sort that has swept Europe, rolled into Asia, announced itself in Latin America, and stalled in most of Africa. The connectivity divide is reflected in the larger pattern of global net bandwidth (see Figure 2. A Question of Scale). Although fiber builds in Latin America and the Caribbean increased substantially in the last year, the Internet had not yet caught up as of mid-2000, and the continued reliance on slower, more expensive satellite links for international connectivity translated into another year of the World Wide Wait. In continental Africa, similarly, the number of countries connected at above 10 Mbps went from three to six—but Africa-U.S. Internet bandwidth remained the continent's fastest-growing route.

**The Players**

Approximately 300 International Internet Service Providers (IISPs) own, lease, or otherwise get hold of transborder network capacity; place routing computers at either end; and use these segments to cobble together logical networks that, together, form the Internet's international backbone. Three hundred may seem like a lot. Not all backbones are equal, however: in mid-2000 the ten largest IISPs controlled three-quarters of international Internet bandwidth.

Some observers try to make sense of the Internet's snarl of networks by dividing them into three or four tiers. Under that framework, "Tier Ones" are the handful of global backbone operators who have rich interconnection relationships with all other significant providers; "Tier Twos" are the not-quite-Tier-One backbones who end up having to pay for some of their direct backbone connectivity; and "Tier Threes" and "Fours" are the national/regional and local ISPs, depending on the context and topology, in question.

Those definitions are somewhat fuzzy—and for good reason. As a whole, the Internet service provider world is not segmented into hierarchical divisions, so hard-and-fast typologies just aren't possible on a global scale. The same is true, perhaps more so, of the IISP segment. Instead, we have identified four groupings around which IISPs cluster. However imperfect, these markings on the IISP spectrum help understand which way they lean:

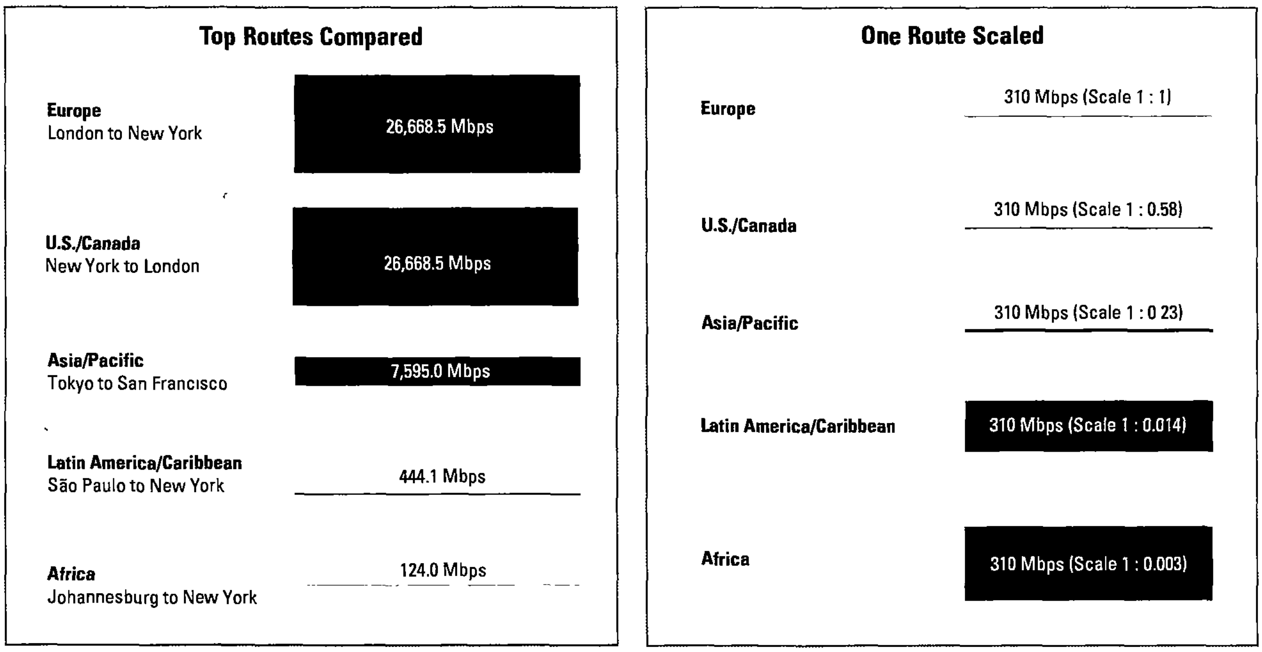
**Global IISP.** Two kinds of IISPs engage in activities which place them in the "global" range. One is a set of very large players who have strong historical roots in the U.S. Internet, either in origin (AT&T/Concert, Genuity, WorldCom, PSINet, Sprint) or by osmosis; Cable & Wireless acquired much of MCI's Internet backbone as a result of the MCI-WorldCom merger. The other group of IISPs are providers who feature managed IP bandwidth over bent-pipe (point-to-point) satellite as important parts of their services portfolios, typically Intelsat signatories like Telecom Italia, whose Seabone offering connects many countries around the world, or service providers like Interpacket. The effort to move from the second set of global IISPs into the first—Teleglobe attempted this during the late 1990s—is a key dynamic within this grouping.

**Regional IISP.** A regional IISP specializes in operating backbone connectivity between different countries in a single region, like GTS E-Bone in Europe, Pacific Century CyberWorks or Telstra in Asia, and Africa Online. Because of the impressive build-out in Europe during the past two years, Western Europe is probably the best example of the impact that regional IISPs can have on reconfiguring a single region's topology map. At the other end of the spectrum, a number of IISPs continue to vault into the regional area by purchasing existing smaller, nationally-based IISP networks; once, these were dominated by former incumbents, but an increasing number of new entrants have borrowed this strategy as well, fuelled by the international spread of venture capital and Initial Public Offerings.

**National IISP.** Typically, this is an Internet provider which has acquired international connectivity as part of a national or local service; which acts increasingly as an upstream provider for other providers who have little or no international connectivity; and which moves to expand into neighboring countries. In 2000, this sector actually shrunk, as existing players federated or were bought up to form regional IISPs.

**Academic IISP.** Research networks, including those operated by academic institutions, often act as international connectivity providers alongside commercial IISPs. In many environments, they operate high-capacity, leading-edge systems, catalyzing Internet development—examples are Europe's DANTE TEN-155 and GÉANT projects—but they are increasingly specializing in exclusively academic and research traffic as part of the interna-

**Figure 2. A Question of Scale**




How much does Internet backbone capacity vary from region to region? A lot. As the figure on the left illustrates, the largest single international Internet route connected to Africa is but a fraction of its European counterpart. That meant that our regional Internet maps couldn't be drawn without varying the scale we used to represent bandwidth from map to map. To get an idea of just how much the scale varied, look to the right-hand figure above. The line that is so thin on top and so thick on the bottom represents 310 Mbps, the equivalent of two OC-3 links, as it is scaled on each of the continental maps.

Of course, some routes were too small to be shown on the maps altogether—even 310 Mbps stretches thin in the bandwidth-rich regions of Europe and U.S. & Canada. Other routes had to be omitted, not because they did not meet the inclusion criteria, but in order to improve map visibility or because the routes were located outside of the base map projection.

For each region, routes are ordered by backbone capacity and then listed alphabetically, where both cities are in the region, or with the local city first, when they aren't. That doesn't imply any hierarchy. But it does mean some routes dropped off because they were too far down in the alphabet, even if they had the same capacity as the fiftieth-largest route listed. Only so much bandwidth can fit on the printed page.

Source: TeleGeography research



tional coordination of Internet2 and advanced research applications.

### Methodology

The data depicted on the following pages—using different scales for different regions—result from a TeleGeography, Inc. study completed in October 2000. The research focused on the network topologies of over 300 IISPs operating international Internet links—routers or switches directly connected across an international border over an internal network. These links and their capacities were then tracked through over 300 cities in more than 180 countries. Each IISP's network routes and capacities were derived from a combination of public documents, confidential interviews, and computer-based network analysis tools.

The study grouped specific switch and router locations according to Consolidated Metropolitan Statistical Area, Census Metropolitan Area, or the equivalent. Only the IP network was mapped, instead of the physical network infrastructure which runs beneath it. In cases where IISPs had provisioned relatively new dedicated IP capacity, the study did not include the capacity unless it was believed to be operational and available for public Internet traffic as of mid-2000 (i.e., bandwidth kept in reserve was excluded). A final note: due to the complex and ever-changing nature of network architectures, omissions may have occurred.

**Figure 3. The Top 50 International Internet Routes, 2000**

| Rank | City, Country | City, Country | Internet Bandwidth |
|---|---|---|---|
| 1 | London, U.K. | New York, U.S. | 26,680.5 Mbps |
| 2 | London, U.K. | Paris, France | 24,340,0 Mbps |
| 3 | Frankfurt, Germany | Paris, France | 14,148.0 Mbps |
| 4 | Amsterdam, Netherlands | London, U.K. | 12,347.0 Mbps |
| 5 | Amsterdam, Netherlands | Frankfurt, Germany | 10,510.0 Mbps |
| 6 | Amsterdam, Netherlands | New York, U.S. | 9,958.0 Mbps |
| 7 | Montreal, Canada | New York, U.S. | 8,749.0 Mbps |
| 8 | Amsterdam, Netherlands | Brussels, Belgium | 8,368.0 Mbps |
| 9 | Amsterdam, Netherlands | Düsseldorf, Germany | 7,999.0 Mbps |
| 10 | Geneva, Switzerland | Paris, France | 7,778.5 Mbps |
| 11 | San Francisco, U.S. | Tokyo, Japan | 7,550.0 Mbps |
| 12 | Chicago, U.S. | Toronto, Canada | 6,575.0 Mbps |
| 13 | Brussels, Belgium | London, U.K. | 6,204.0 Mbps |
| 14 | Frankfurt, Germany | London, U.K. | 4,975.0 Mbps |
| 15 | New York, U.S. | Toronto, Canada | 4,862.0 Mbps |
| 16 | Seattle, U.S. | Vancouver, Canada | 4,707.0 Mbps |
| 17 | Frankfurt, Germany | Milan, Italy | 4,305.0 Mbps |
| 18 | Frankfurt, Germany | Stockholm, Sweden | 3,897.0 Mbps |
| 19 | Copenhagen, Denmark | Stockholm, Sweden | 3,848.0 Mbps |
| 20 | Amsterdam, Netherlands | Paris, France | 3,820.0 Mbps |
| 21 | Frankfurt, Germany | Washington, U.S. | 3,663.0 Mbps |
| 22 | Brussels, Belgium | Paris, France | 3,657.0 Mbps |
| 23 | Amsterdam, Netherlands | Stockholm, Sweden | 3,414.0 Mbps |
| 24 | Madrid, Spain | Paris, France | 3,212.0 Mbps |
| 25 | London, U.K. | Madrid, Spain | 2,880.0 Mbps |
| 26 | Frankfurt, Germany | Geneva, Switzerland | 2,877.0 Mbps |
| 27 | Amsterdam, Netherlands | Geneva, Switzerland | 2,833.5 Mbps |
| 28 | Frankfurt, Germany | New York, U.S. | 2,729.0 Mbps |
| 29 | Barcelona, Spain | Lyon, France | 2,688.0 Mbps |
| 30 | Amsterdam, Netherlands | Madrid, Spain | 2,612.0 Mbps |
| 31 | Geneva, Switzerland | Lyon, France | 2,567.0 Mbps |
| 32 | Amsterdam, Netherlands | Vienna, Austria | 2,533.0 Mbps |
| 33 | Moscow, Russia | Stockholm, Sweden | 2,522.0 Mbps |
| 34 | Amsterdam, Netherlands | Oslo, Norway | 2,488.0 Mbps |
| - | Chicago, U.S. | Montreal, Canada | 2,488.0 Mbps |
| - | Copenhagen, Denmark | Düsseldorf, Germany | 2,488.0 Mbps |
| - | Düsseldorf, Germany | London, U.K. | 2,488.0 Mbps |
| - | Düsseldorf, Germany | Prague, Czech Republic | 2,488.0 Mbps |
| - | Paris, France | Washington, U.S. | 2,488.0 Mbps |
| - | Prague, Czech Republic | Vienna, Austria | 2,488.0 Mbps |
| - | Seattle, U.S. | Toronto, Canada | 2,488.0 Mbps |
| 42 | London, U.K. | Washington, U.S. | 2,378.0 Mbps |
| 43 | Toronto, Canada | Washington, U.S. | 2,176.0 Mbps |
| 44 | Milan, Italy | New York, U.S. | 1,734.0 Mbps |
| 45 | Frankfurt, Germany | Vienna, Austria | 1,676.0 Mbps |
| 46 | New York, U.S. | Stockholm, Sweden | 1,553.0 Mbps |
| 47 | Los Angeles, U.S. | Tokyo, Japan | 1,520.5 Mbps |
| 48 | San Francisco, U.S. | Seoul, Korea, Rep. | 1,336.6 Mbps |
| 49 | Milan, Italy | Paris, France | 1,242.0 Mbps |
| 50 | Hong Kong, China | San Francisco, U.S. | 1,209.5 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

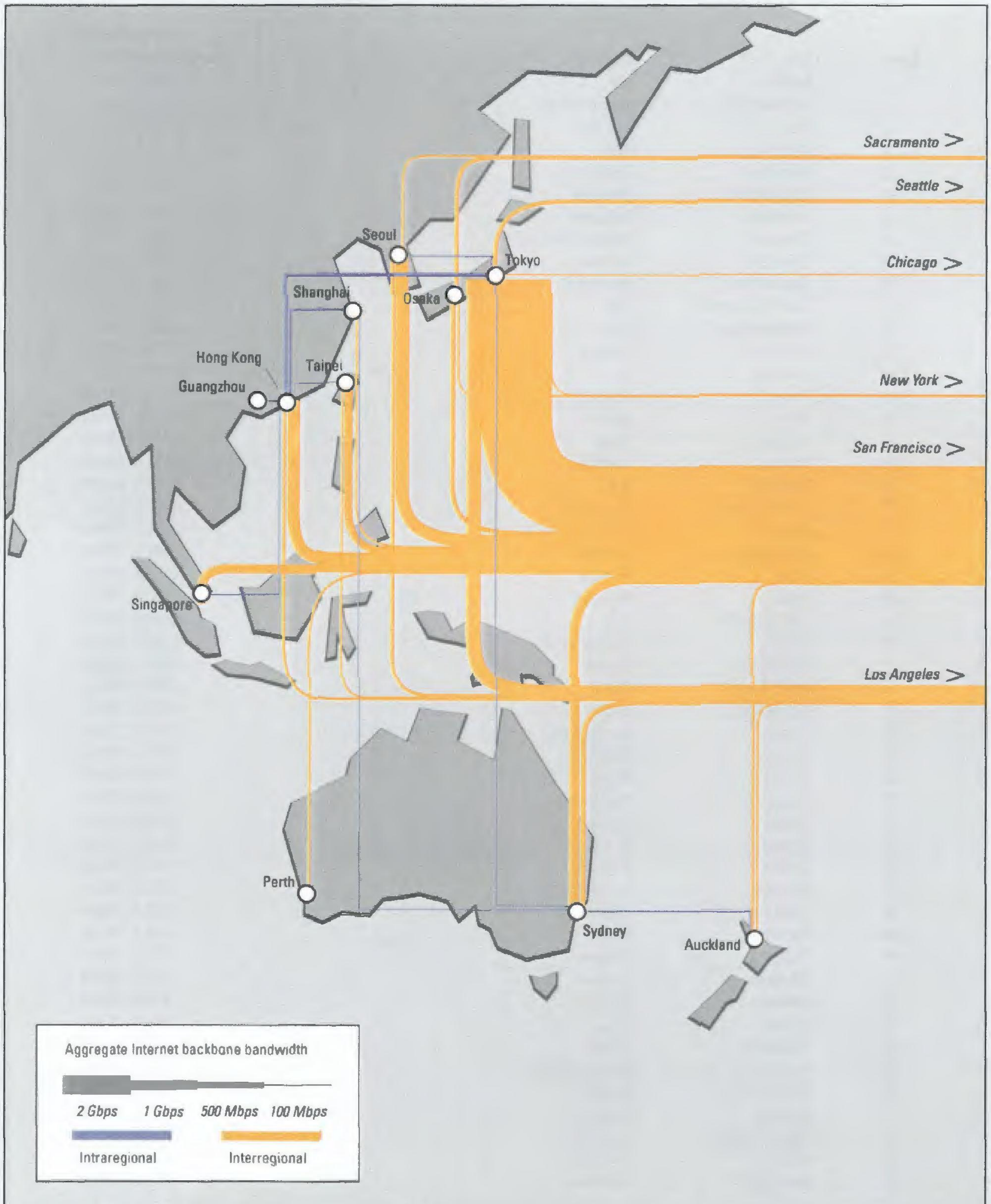
## Figure 4. The Top 50 International Internet Hub Cities, 2000

| Rank | City | Country | International Internet Bandwidth |
|---|---|---|---|
| 1 | London | U.K. | 86,589.7 Mbps |
| 2 | Amsterdam | Netherlands | 68,301.6 Mbps |
| 3 | Paris | France | 62,196.7 Mbps |
| 4 | New York | U.S. | 61,070.6 Mbps |
| 5 | Frankfurt | Germany | 52,332.0 Mbps |
| 6 | Stockholm | Sweden | 18,652.5 Mbps |
| 7 | Brussels | Belgium | 18,630.8 Mbps |
| 8 | Geneva | Switzerland | 17,848.8 Mbps |
| 9 | Toronto | Canada | 16,398.6 Mbps |
| 10 | Düsseldorf | Germany | 15,863.4 Mbps |
| 11 | San Francisco | U.S. | 14,712.5 Mbps |
| 12 | Washington | U.S. | 12,029.7 Mbps |
| 13 | Montreal | Canada | 11,671.8 Mbps |
| 14 | Chicago | U.S. | 10,935.5 Mbps |
| 15 | Tokyo | Japan | 10,835.1 Mbps |
| 16 | Milan | Italy | 9,262.6 Mbps |
| 17 | Madrid | Spain | 9,246.0 Mbps |
| 18 | Vienna | Austria | 8,273.3 Mbps |
| 19 | Seattle | U.S. | 7,658.3 Mbps |
| 20 | Copenhagen | Denmark | 7,520.0 Mbps |
| 21 | Prague | Czech Republic | 6,186.0 Mbps |
| 22 | Vancouver | Canada | 5,547.0 Mbps |
| 23 | Lyon | France | 5,410.0 Mbps |
| 24 | Oslo | Norway | 3,928.0 Mbps |
| 25 | Los Angeles | U.S. | 3,529.6 Mbps |
| 26 | Zürich | Switzerland | 3,198.3 Mbps |
| 27 | Moscow | Russia | 2,956.4 Mbps |
| 28 | Hong Kong | China | 2,949.4 Mbps |
| 29 | Barcelona | Spain | 2,873.0 Mbps |
| 30 | Seoul | Korea, Rep. | 2,317.4 Mbps |
| 31 | Sydney | Australia | 2,162.4 Mbps |
| 32 | Helsinki | Finland | 1,841.0 Mbps |
| 33 | Singapore | Singapore | 1,793.8 Mbps |
| 34 | Taipei | Taiwan | 1,310.9 Mbps |
| 35 | Budapest | Hungary | 1,019.5 Mbps |
| 36 | Dublin | Ireland | 917.0 Mbps |
| 37 | Munich | Germany | 827.0 Mbps |
| 38 | Osaka | Japan | 820.0 Mbps |
| 39 | Palermo | Italy | 818.5 Mbps |
| 40 | Calgary | Canada | 777.0 Mbps |
| 41 | Warsaw | Poland | 767.0 Mbps |
| 42 | Mexico City | Mexico | 749.5 Mbps |
| 43 | Miami | U.S. | 632.7 Mbps |
| 44 | Shanghai | China | 626.0 Mbps |
| 45 | Auckland | New Zealand | 592.0 Mbps |
| 46 | São Paulo | Brazil | 566.6 Mbps |
| 47 | Athens | Greece | 560.1 Mbps |
| 48 | Nova Scotia | Canada | 499.9 Mbps |
| 49 | Lisbon | Portugal | 499.0 Mbps |
| 50 | Stuttgart | Germany | 481.9 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000

Source: TeleGeography research

## Figure 5. Map of Major Asia/Pacific International Backbone Routes, 2000




Note: Map includes international backbone routes with at least 100 Mbps of aggregate capacity. Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

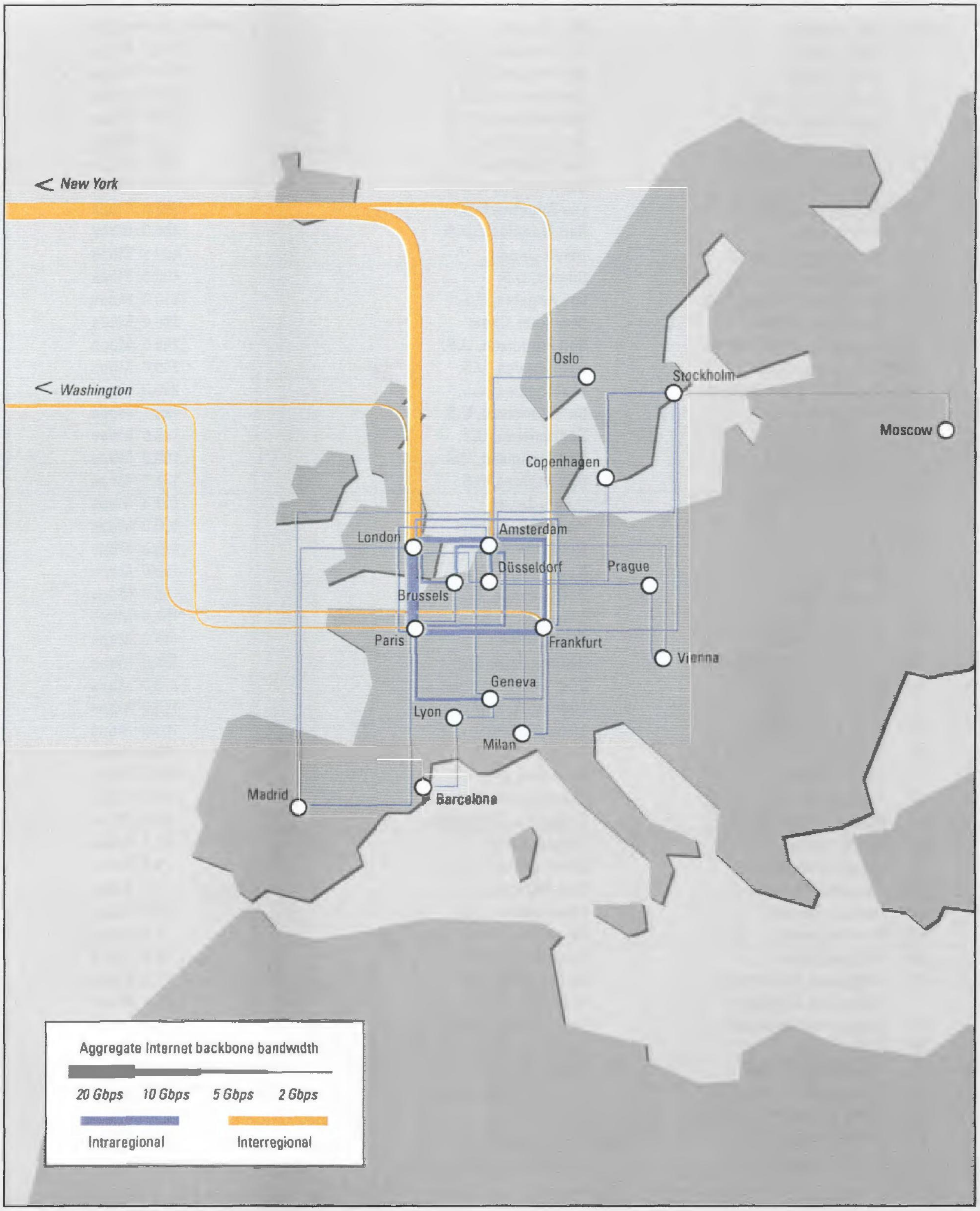
## Figure 6. The Top 50 International Backbone Routes in Asia/Pacific, 2000

| Rank | City, Country | City, Country | Internet Bandwidth |
|---|---|---|---|
| 1 | Tokyo, Japan | San Francisco, U.S. | 7,550.0 Mbps |
| 2 | Tokyo, Japan | Los Angeles, U.S. | 1,520.5 Mbps |
| 3 | Seoul, Korea, Rep. | San Francisco, U.S. | 1,336.6 Mbps |
| 4 | Hong Kong, China | San Francisco, U.S. | 1,209.5 Mbps |
| 5 | Sydney, Australia | San Francisco, U.S. | 1,030.0 Mbps |
| 6 | Singapore, Singapore | San Francisco, U.S. | 932.0 Mbps |
| 7 | Taipei, Taiwan | San Francisco, U.S. | 741.5 Mbps |
| 8 | Sydney, Australia | Los Angeles, U.S. | 496.0 Mbps |
| 9 | Osaka, Japan | San Francisco, U.S. | 465.0 Mbps |
| 10 | Hong Kong, China | Tokyo, Japan | 403.5 Mbps |
| 11 | Tokyo, Japan | Seattle, U.S. | 400.0 Mbps |
| 12 | Seoul, South Korea, Rep. | Los Angeles, U.S. | 310.0 Mbps |
| 13 | Hong Kong, China | Shanghai, China | 296.0 Mbps |
| 14 | Auckland, New Zealand | San Francisco, U.S. | 255.0 Mbps |
| 15 | Hong Kong, China | Los Angeles, U.S. | 245.0 Mbps |
| 16 | Auckland, New Zealand | Los Angeles, U.S. | 200.0 Mbps |
| 17 | Perth, Australia | San Francisco, U.S. | 196.1 Mbps |
| 18 | Seoul, Korea, Rep. | Sacramento, U.S. | 189.0 Mbps |
| 19 | Shanghai, China | San Francisco, U.S. | 165.0 Mbps |
| 20 | Taipei, Taiwan | Los Angeles, U.S. | 161.5 Mbps |
| 21 | Seoul, Korea, Rep. | Tokyo, Japan | 157.3 Mbps |
| 22 | Guangzhou, China | Hong Kong, China | 156.0 Mbps |
| 23 | Abu Dhabi, U.A.E. | New York, U.S. | 155.0 Mbps |
| - | Osaka, Japan | New York, U.S. | 155.0 Mbps |
| - | Osaka, Japan | Sacramento, U.S. | 155.0 Mbps |
| 26 | Tel Aviv, Israel | New York, U.S. | 151.0 Mbps |
| 27 | Sydney, Australia | Tokyo, Japan | 145.0 Mbps |
| 28 | Auckland, New Zealand | Sydney, Australia | 135.0 Mbps |
| 29 | Hong Kong, China | Singapore, Singapore | 118.0 Mbps |
| - | Shanghai, China | Sydney, Australia | 118.0 Mbps |
| 31 | Hong Kong, China | Taipei, Taiwan | 103.0 Mbps |
| 32 | Tokyo, Japan | Chicago, U.S. | 100.0 Mbps |
| - | Tokyo, Japan | New York, U.S. | 100.0 Mbps |
| 34 | Hong Kong, China | Seoul, Korea, Rep. | 96.5 Mbps |
| 35 | Manila, Philippines | Singapore, Singapore | 90.4 Mbps |
| 36 | Taipei, Taiwan | Tokyo, Japan | 87.1 Mbps |
| 37 | Manila, Philippines | San Francisco, U.S. | 79.0 Mbps |
| 38 | Bangkok, Thailand | San Francisco, U.S. | 77.0 Mbps |
| 39 | Perth, Australia | Los Angeles, U.S. | 75.0 Mbps |
| 40 | Mumbai, India | Singapore, Singapore | 70.0 Mbps |
| 41 | Mumbai, India | New York, U.S. | 68.0 Mbps |
| 42 | Singapore, Singapore | Sydney, Australia | 61.0 Mbps |
| - | Singapore, Singapore | Tokyo, Japan | 61.0 Mbps |
| 44 | Singapore, Singapore | Los Angeles, U.S. | 59.0 Mbps |
| 45 | Haifa, Israel | New York, U.S. | 58.5 Mbps |
| 46 | Manila, Philippines | Tokyo, Japan | 57.0 Mbps |
| 47 | Kuala Lumpur, Malaysia | Singapore, Singapore | 56.0 Mbps |
| 48 | Kuala Lumpur, Malaysia | Tokyo, Japan | 55.1 Mbps |
| 49 | Beijing, China | Tokyo, Japan | 53.1 Mbps |
| 50 | Manila, Philippines | Los Angeles, U.S. | 53.0 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

## Figure 7. Map of Major European International Backbone Routes, 2000




Note: Map includes international backbone routes with at least 2 Gbps of aggregate capacity. Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

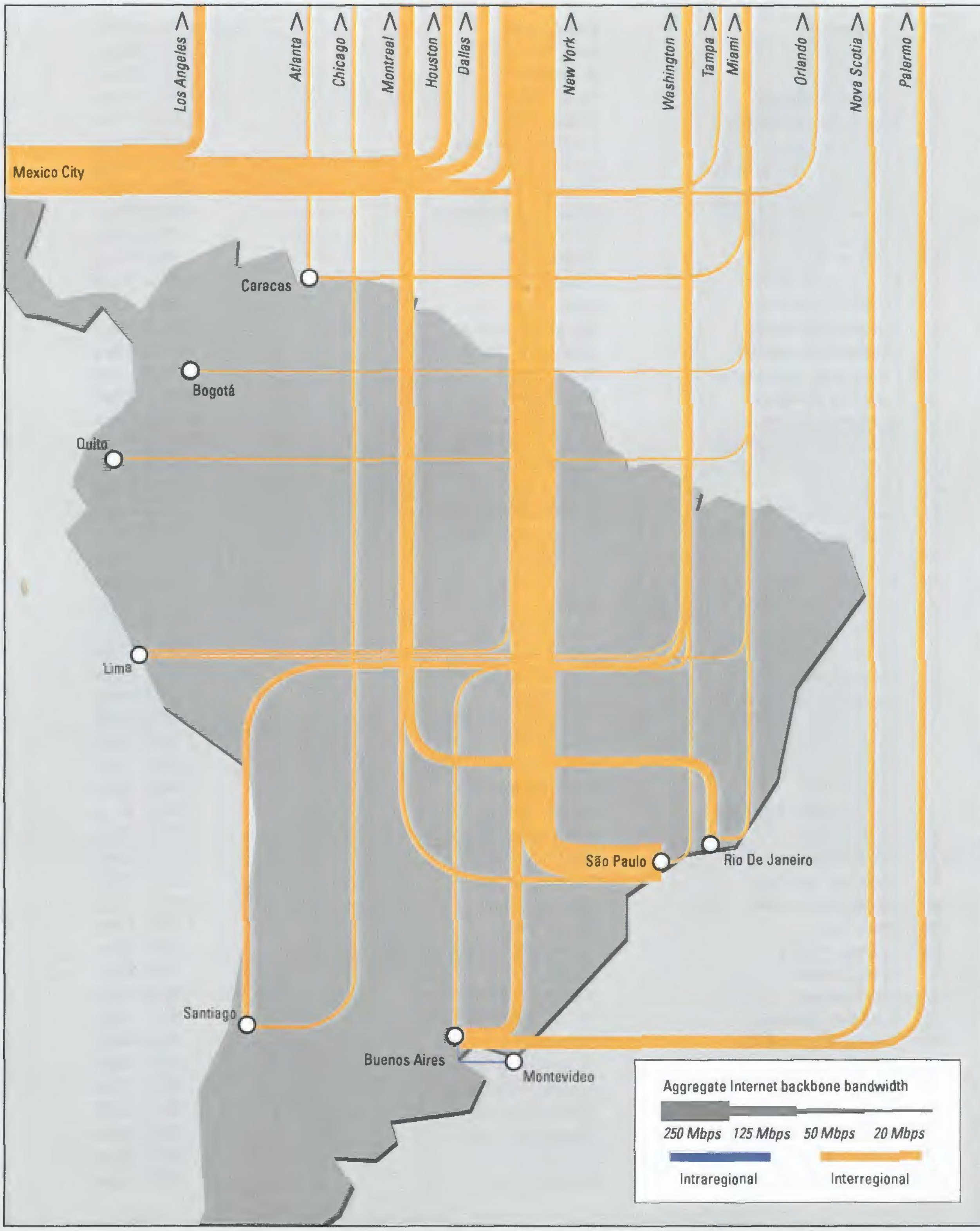
## Figure 8. The Top 50 International Backbone Routes in Europe, 2000

| Rank | City, Country | City, Country | Internet Bandwidth |
|---|---|---|---|
| 1 | London, U.K. | New York, U.S. | 26,680.5 Mbps |
| 2 | London, U.K. | Paris, France | 24,340.0 Mbps |
| 3 | Frankfurt, Germany | Paris, France | 14,148.0 Mbps |
| 4 | Amsterdam, Netherlands | London, U.K. | 12,347.0 Mbps |
| 5 | Amsterdam, Netherlands | Frankfurt, Germany | 10,510.0 Mbps |
| 6 | Amsterdam, Netherlands | New York, U.S. | 9,958.0 Mbps |
| 7 | Amsterdam, Netherlands | Brussels, Belgium | 8,368.0 Mbps |
| 8 | Amsterdam, Netherlands | Düsseldorf, Germany | 7,999.0 Mbps |
| 9 | Geneva, Switzerland | Paris, France | 7,778.5 Mbps |
| 10 | Brussels, Belgium | London, U.K. | 6,204.0 Mbps |
| 11 | Frankfurt, Germany | London, U.K. | 4,975.0 Mbps |
| 12 | Frankfurt, Germany | Milan, Italy | 4,305.0 Mbps |
| 13 | Frankfurt, Germany | Stockholm, Sweden | 3,897.0 Mbps |
| 14 | Copenhagen, Denmark | Stockholm, Sweden | 3,848.0 Mbps |
| 15 | Amsterdam, Netherlands | Paris, France | 3,820.0 Mbps |
| 16 | Frankfurt, Germany | Washington, U.S. | 3,663.0 Mbps |
| 17 | Brussels, Belgium | Paris, France | 3,657.0 Mbps |
| 18 | Amsterdam, Netherlands | Stockholm, Sweden | 3,414.0 Mbps |
| 19 | Madrid, Spain | Paris, France | 3,212.0 Mbps |
| 20 | London, U.K. | Madrid, Spain | 2,880.0 Mbps |
| 21 | Frankfurt, Germany | Geneva, Switzerland | 2,877.0 Mbps |
| 22 | Amsterdam, Netherlands | Geneva, Switzerland | 2,833.5 Mbps |
| 23 | Frankfurt, Germany | New York, U.S. | 2,729.0 Mbps |
| 24 | Barcelona, Spain | Lyon, France | 2,688.0 Mbps |
| 25 | Amsterdam, Netherlands | Madrid, Spain | 2,612.0 Mbps |
| 26 | Geneva, Switzerland | Lyon, France | 2,567.0 Mbps |
| 27 | Amsterdam, Netherlands | Vienna, Austria | 2,533.0 Mbps |
| 28 | Moscow, Russia | Stockholm, Sweden | 2,522.0 Mbps |
| 29 | Amsterdam, Netherlands | Oslo, Norway | 2,488.0 Mbps |
| - | Copenhagen, Denmark | Düsseldorf, Germany | 2,488.0 Mbps |
| - | Düsseldorf, Germany | London, U.K. | 2,488.0 Mbps |
| - | Düsseldorf, Germany | Prague, Czech Republic | 2,488.0 Mbps |
| - | Paris, France | Washington, U.S. | 2,488.0 Mbps |
| - | Prague, Czech Republic | Vienna, Austria | 2,488.0 Mbps |
| 35 | London, U.K. | Washington, U.S. | 2,378.0 Mbps |
| 36 | Milan, Italy | New York, U.S. | 1,734.0 Mbps |
| 37 | Frankfurt, Germany | Vienna, Austria | 1,676.0 Mbps |
| 38 | Stockholm, Sweden | New York, U.S. | 1,553.0 Mbps |
| 39 | Milan, Italy | Paris, France | 1,242.0 Mbps |
| 40 | Helsinki, Finland | Stockholm, Sweden | 999.0 Mbps |
| 41 | Dublin, Ireland | London, U.K. | 872.0 Mbps |
| 42 | Oslo, Norway | Stockholm, Sweden | 862.0 Mbps |
| 43 | Frankfurt, Germany | Zürich, Switzerland | 834.0 Mbps |
| 44 | Geneva, Switzerland | Milan, Italy | 735.0 Mbps |
| 45 | London, U.K. | Stockholm, Sweden | 701.0 Mbps |
| 46 | Frankfurt, Germany | Prague, Czech Republic | 593.0 Mbps |
| 47 | Vienna, Austria | Zürich, Switzerland | 567.0 Mbps |
| 48 | Amsterdam, Netherlands | Washington, U.S. | 555.0 Mbps |
| 49 | Paris, France | New York, U.S. | 469.0 Mbps |
| 50 | Amsterdam, Netherlands | New York, U.S. | 465.0 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

**Figure 9. Map of Major South American International Backbone Routes, 2000**




Note: Map includes international backbone routes with at least 20 Mbps of aggregate capacity. Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

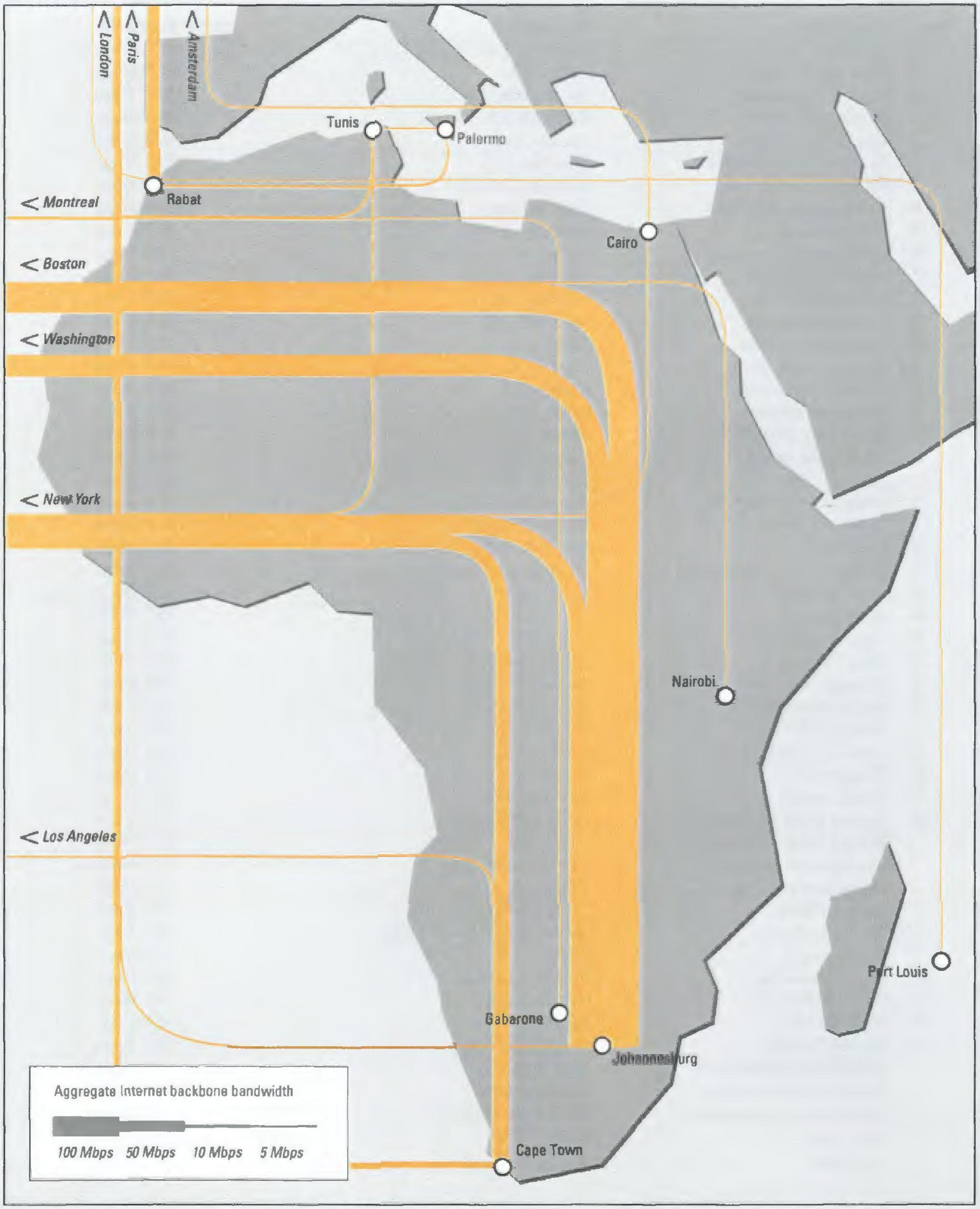
**Figure 10. The Top 50 International Backbone Routes in Latin America and the Caribbean, 2000**

| Rank | City, Country | City, Country | Internet Bandwidth |
|---|---|---|---|
| 1 | São Paulo, Brazil | New York, U.S. | 444.1 Mbps |
| 2 | Mexico City, Mexico | Dallas, U.S. | 165.0 Mbps |
| 3 | Mexico City, Mexico | Los Angeles, U.S. | 159.0 Mbps |
| 4 | Mexico City, Mexico | New York, U.S. | 156.5 Mbps |
| 5 | Mexico City, Mexico | Houston, U.S. | 155.0 Mbps |
| 6 | Buenos Aires, Argentina | New York, U.S. | 148.2 Mbps |
| 7 | Rio de Janeiro, Brazil | Montreal, Canada | 136.0 Mbps |
| 8 | Buenos Aires, Argentina | Palermo, Italy | 102.0 Mbps |
| 9 | Santiago, Chile | Washington, U.S. | 90.3 Mbps |
| 10 | Buenos Aires, Argentina | Nova Scotia, Canada | 79.0 Mbps |
| 11 | São Paulo, Brazil | Montreal, Canada | 68.0 Mbps |
| 12 | Monterrey, Mexico | Houston, U.S. | 52.5 Mbps |
| 13 | Hamilton, Bermuda | New York, U.S. | 49.0 Mbps |
| 14 | Caracas, Venezuela | Miami, U.S. | 47.0 Mbps |
| 15 | Rio de Janeiro, Brazil | Miami, U.S. | 46.0 Mbps |
| 16 | Caracas, Venezuela | Atlanta, U.S. | 45.0 Mbps |
| - | Monterrey, Mexico | Dallas, U.S. | 45.0 Mbps |
| - | Mexico City, Mexico | Orlando, U.S. | 45.0 Mbps |
| - | Mexico City, Mexico | Tampa, U.S. | 45.0 Mbps |
| - | Santiago, Chile | Chicago, U.S. | 45.0 Mbps |
| 21 | Buenos Aires, Argentina | Washington, U.S. | 42.5 Mbps |
| 22 | São Paulo, Brazil | Washington, U.S. | 33.5 Mbps |
| 23 | Lima, Peru | New York, U.S. | 29.0 Mbps |
| 24 | Buenos Aires, Argentina | Montevideo, Uruguay | 28.0 Mbps |
| 25 | Quito, Ecuador | Miami, U.S. | 27.7 Mbps |
| 26 | Lima, Peru | Miami, U.S. | 25.0 Mbps |
| 27 | Bogotá, Colombia | Miami, U.S. | 23.0 Mbps |
| 28 | Lima, Peru | Washington, U.S. | 20.0 Mbps |
| 29 | Caracas, Venezuela | Washington, U.S. | 18.8 Mbps |
| 30 | Rio de Janeiro, Brazil | Washington, U.S. | 17.5 Mbps |
| 31 | Bogotá, Colombia | New York, U.S. | 16.0 Mbps |
| 32 | Caracas, Venezuela | Los Angeles, U.S. | 15.0 Mbps |
| 33 | Santiago, Chile | Miami, U.S. | 14.0 Mbps |
| 34 | Rio de Janeiro, Brazil | New York, U.S. | 13.5 Mbps |
| 35 | Buenos Aires, Argentina | Mexico City, Mexico | 12.0 Mbps |
| - | Buenos Aires, Argentina | Miami, U.S. | 12.0 Mbps |
| - | Buenos Aires, Argentina | San Francisco, U.S. | 12.0 Mbps |
| - | Rio de Janeiro, Brazil | Dallas, U.S. | 12.0 Mbps |
| - | Santiago, Chile | Los Angeles, U.S. | 12.0 Mbps |
| - | São Paulo, Brazil | Los Angeles, U.S. | 12.0 Mbps |
| - | Quito, Ecuador | Orlando, U.S. | 12.0 Mbps |
| 42 | Bogotá, Colombia | Montreal, Canada | 9.5 Mbps |
| 43 | Caracas, Venezuela | New York, U.S. | 8.8 Mbps |
| 44 | Santiago, Chile | New York, U.S. | 8.4 Mbps |
| 45 | Bogotá, Colombia | Toronto, Canada | 8.0 Mbps |
| - | Buenos Aires, Argentina | Lima, Peru | 8.0 Mbps |
| - | Buenos Aires, Argentina | Santiago, Chile | 8.0 Mbps |
| - | Guatemala City, Guatemala | Mexico City, Mexico | 8.0 Mbps |
| - | Lima, Peru | Boston, U.S. | 8.0 Mbps |
| - | Lima, Peru | Seattle, U.S. | 8.0 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

## Figure 11. Map of Major African International Backbone Routes, 2000




Note: Map includes international backbone routes with at least 5 Mbps of aggregate capacity. Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

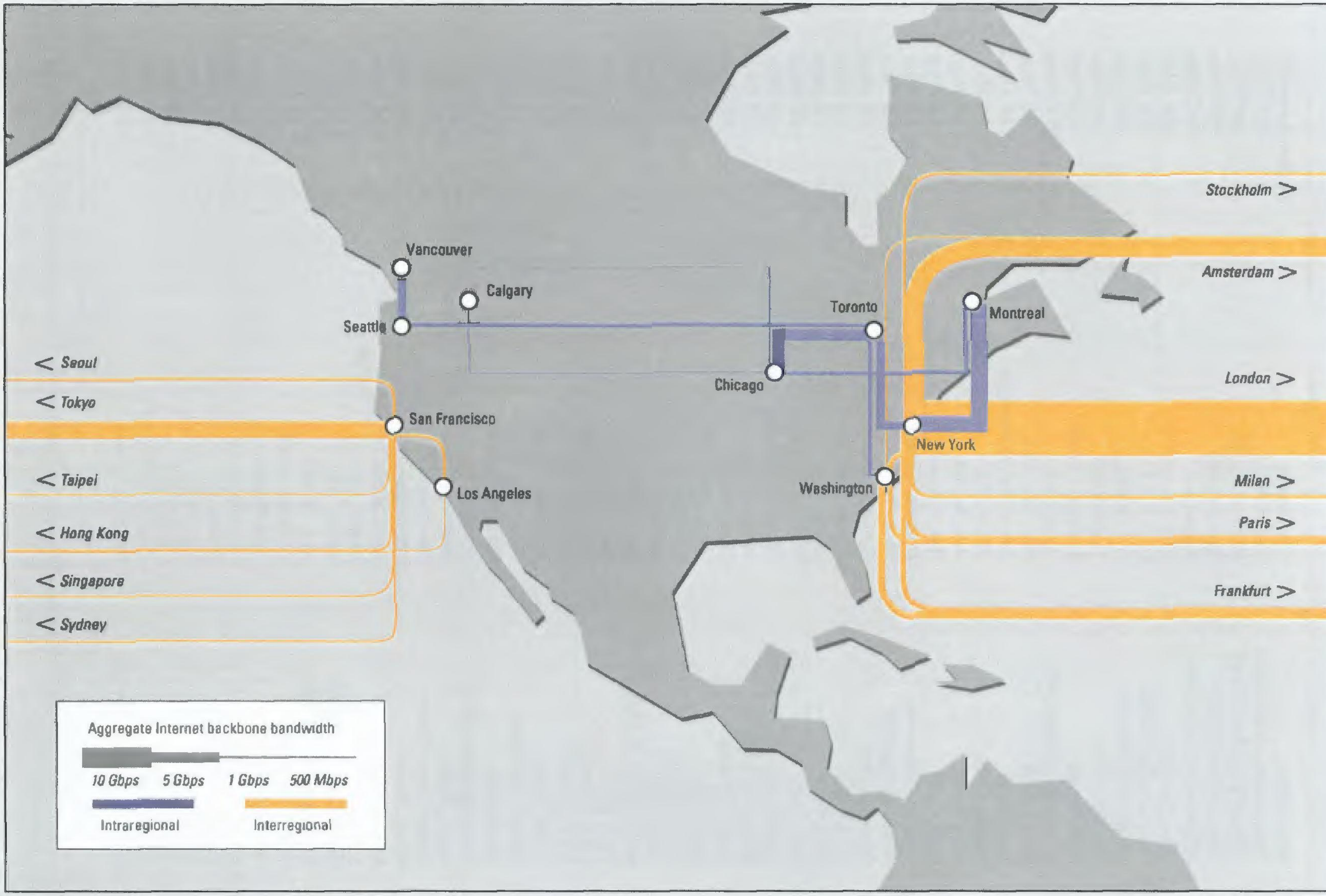
## Figure 12. The Top 50 International Backbone Routes in Africa, 2000

| Rank | City, Country | City, Country | Internet Bandwidth |
|---|---|---|---|
| 1 | Johannesburg, South Africa | New York, U.S. | 117.0 Mbps |
| 2 | Johannesburg, South Africa | Washington, U.S. | 90.0 Mbps |
| 3 | Capetown, South Africa | New York, U.S. | 79.0 Mbps |
| - | Johannesburg, South Africa | Boston, U.S. | 79.0 Mbps |
| 5 | Rabat, Morocco | Paris, France | 68.0 Mbps |
| 6 | Capetown, South Africa | London, U.K. | 34.0 Mbps |
| 7 | Capetown, South Africa | Los Angeles, U.S. | 12.0 Mbps |
| - | Rabat, Morocco | Palermo, Italy | 12.0 Mbps |
| - | Tunis, Tunisia | Montreal, Canada | 12.0 Mbps |
| 10 | Johannesburg, South Africa | London, U.K. | 10.0 Mbps |
| - | Tunis, Tunisia | New York, U.S. | 10.0 Mbps |
| 12 | Cairo, Egypt | Amsterdam, Netherlands | 8.0 Mbps |
| - | Nairobi, Kenya | Boston, U.S. | 8.0 Mbps |
| - | Tunis, Tunisia | Palermo, Italy | 8.0 Mbps |
| 15 | Cairo, Egypt | New York, U.S. | 6.5 Mbps |
| 16 | Gaborone, Botswana | Montreal, Canada | 6.0 Mbps |
| - | Port Louis, Mauritius | Paris, France | 6.0 Mbps |
| 18 | Algiers, Algeria | London, U.K. | 4.0 Mbps |
| - | Cairo, Egypt | Atlanta, U.S. | 4.0 Mbps |
| - | Cairo, Egypt | London, U.K. | 4.0 Mbps |
| - | Cairo, Egypt | Montreal, Canada | 4.0 Mbps |
| - | Johannesburg, South Africa | Windhoek, Namibia | 4.0 Mbps |
| - | Port Louis, Mauritius | New York, U.S. | 4.0 Mbps |
| - | Rabat, Morocco | New York, U.S. | 4.0 Mbps |
| 25 | Cairo, Egypt | Los Angeles, U.S. | 2.0 Mbps |
| - | Algiers, Algeria | Luxembourg | 2.0 Mbps |
| - | Algiers, Algeria | Washington, U.S. | 2.0 Mbps |
| - | Antananarivo, Madagascar | Paris, France | 2.0 Mbps |
| - | Cairo, Egypt | Toronto, Canada | 2.0 Mbps |
| - | Dakar, Senegal | Montreal, Canada | 2.0 Mbps |
| - | Nairobi, Kenya | Montreal, Canada | 2.0 Mbps |
| - | Tripoli, Libya | Montreal, Canada | 2.0 Mbps |
| - | Victoria, Seychelles | Hong Kong, China | 2.0 Mbps |
| 35 | Accra, Ghana | Montreal, Canada | <2.0 Mbps |
| - | Kinshasa, Congo, D.R. of | Brussels, Belgium | <2.0 Mbps |
| 37 | Lagos, Nigeria | Montreal, Canada | <2.0 Mbps |
| 38 | Abidjan, Cote-d'Ivoire | New York, U.S. | <2.0 Mbps |
| - | Accra, Ghana | Washington, U.S. | <2.0 Mbps |
| - | Annaba, Algeria | Paris, France | <2.0 Mbps |
| - | Bamako, Mali | Boston, U.S. | <2.0 Mbps |
| - | Dar es Salaam, Tanzania | Boston, U.S. | <2.0 Mbps |
| - | Dar es Salaam, Tanzania | Oslo, Norway | <2.0 Mbps |
| - | Harare, Zimbabwe | Montreal, Canada | <2.0 Mbps |
| - | Harare, Zimbabwe | Oslo, Norway | <2.0 Mbps |
| - | Harare, Zimbabwe | Washington, U.S. | <2.0 Mbps |
| - | Kampala, Uganda | Boston, U.S. | <2.0 Mbps |
| - | Nairobi, Kenya | New York, U.S. | <2.0 Mbps |
| - | Nairobi, Kenya | Paris, France | <2.0 Mbps |
| - | Nairobi, Kenya | Singapore, Singapore | <2.0 Mbps |
| - | Ouagadougou, Burkina-Faso | Montreal, Canada | <2.0 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data current to October 2000

Source: TeleGeography research

## Figure 13. Map of Major International Backbone Routes in the U.S. and Canada, 2000




Note: Map includes overseas backbone routes with at least 500 Mbps of aggregate capacity. Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

## Figure 14. The Top 50 International Backbone Routes in the U.S. and Canada, 2000

| Rank | City, Country | City, Country | Internet Bandwidth |
|---|---|---|---|
| 1 | New York, U.S. | London, U.K. | 26,680.5 Mbps |
| 2 | New York, U.S. | Amsterdam, Netherlands | 9,958.0 Mbps |
| 3 | Montreal, Canada | New York, U.S. | 8,749.0 Mbps |
| 4 | San Francisco, U.S. | Tokyo, Japan | 7,550.0 Mbps |
| 5 | Chicago, U.S. | Toronto, Canada | 6,575.0 Mbps |
| 6 | New York, U.S. | Toronto, Canada | 4,862.0 Mbps |
| 7 | Seattle, U.S. | Vancouver, Canada | 4,707.0 Mbps |
| 8 | Washington, U.S. | Frankfurt, Germany | 3,663.0 Mbps |
| 9 | New York, U.S. | Frankfurt, Germany | 2,729.0 Mbps |
| 10 | Chicago, U.S. | Montreal, Canada | 2,488.0 Mbps |
| - | Seattle, U.S. | Toronto, Canada | 2,488.0 Mbps |
| - | Washington, U.S. | Paris, France | 2,488.0 Mbps |
| 13 | Washington, U.S. | London, U.K. | 2,378.0 Mbps |
| 14 | Toronto, Canada | Washington, U.S. | 2,176.0 Mbps |
| 15 | New York, U.S. | Milan, Italy | 1,734.0 Mbps |
| 16 | New York, U.S. | Stockholm, Sweden | 1,553.0 Mbps |
| 17 | Los Angeles, U.S. | Tokyo, Japan | 1,520.5 Mbps |
| 18 | San Francisco, U.S. | Seoul, Korea, Rep. | 1,336.6 Mbps |
| 19 | San Francisco, U.S. | Hong Kong, China | 1,209.5 Mbps |
| 20 | San Francisco, U.S. | Sydney, Australia | 1,030.0 Mbps |
| 21 | San Francisco, U.S. | Singapore, Singapore | 932.0 Mbps |
| 22 | Calgary, Canada | Chicago, U.S. | 777.0 Mbps |
| 23 | San Francisco, U.S. | Taipei, Taiwan | 741.5 Mbps |
| 24 | Chicago, U.S. | Vancouver, Canada | 622.0 Mbps |
| 25 | Washington, U.S. | Amsterdam, Netherlands | 555.0 Mbps |
| 26 | Los Angeles, U.S. | Sydney, Australia | 496.0 Mbps |
| 27 | New York, U.S. | Paris, France | 469.0 Mbps |
| 28 | New York, U.S. | Amsterdam, Netherlands | 465.0 Mbps |
| - | New York, U.S. | Palermo, Italy | 465.0 Mbps |
| - | San Francisco, U.S. | Osaka, Japan | 465.0 Mbps |
| 31 | New York, U.S. | São Paulo, Brazil | 444.1 Mbps |
| 32 | Seattle, U.S. | Tokyo, Japan | 400.0 Mbps |
| 33 | San Francisco, U.S. | London, U.K. | 355.0 Mbps |
| 34 | New York, U.S. | Zürich, Switzerland | 324.0 Mbps |
| 35 | Los Angeles, U.S. | Seoul, Korea, Rep. | 310.0 Mbps |
| 36 | San Francisco, U.S. | Auckland, New Zealand | 255.0 Mbps |
| 37 | New York, U.S. | Copenhagen, Denmark | 245.0 Mbps |
| - | Los Angeles, U.S. | Hong Kong, China | 245.0 Mbps |
| 39 | New York, U.S. | Moscow, Russia | 242.0 Mbps |
| 40 | Los Angeles, U.S. | Auckland, New Zealand | 200.0 Mbps |
| - | San Francisco, U.S. | Frankfurt, Germany | 200.0 Mbps |
| 42 | San Francisco, U.S. | Perth, Australia | 196.1 Mbps |
| 43 | Sacramento, U.S. | Seoul, Korea, Rep. | 189.0 Mbps |
| 44 | Dallas, U.S. | Mexico City, Mexico | 165.0 Mbps |
| - | San Francisco, U.S. | Shanghai, China | 165.0 Mbps |
| 46 | Los Angeles, U.S. | Taipei, Taiwan | 161.5 Mbps |
| 47 | Los Angeles, U.S. | Mexico City, Mexico | 159.0 Mbps |
| 48 | New York, U.S. | Mexico City, Mexico | 156.5 Mbps |
| 49 | Chicago, U.S. | Calgary, Canada | 155.0 Mbps |
| - | Houston, U.S. | Mexico City, Mexico | 155.0 Mbps |

Note: Figures represent estimated Internet bandwidth between Consolidated Metropolitan Statistical Areas or equivalents. Domestic backbone routes are omitted. Data as of mid-2000.

Source: TeleGeography research

# Traffic Analysis

# Overview of International Traffic Trends

The effects of telecom market liberalization began to take hold in 1999, having been initiated in many countries only a year earlier. Falling retail prices, combined with the sustained rapid growth of mobile phone usage, caused traffic growth to surge from approximately 13 percent in 1998 to over 15 percent in 1999. Worldwide international telephone traffic volume reached 107.8 billion minutes in 1999. The strong growth of international public switched minutes appears all the more remarkable in light of slumping fax traffic volumes and the increasing number of minutes moving off the Public Switched Telephone Network (PSTN) thanks to bypass mechanisms such as Voice-over-Internet Protocol (VoIP). Such trends during 1999 suggest that the international telecom industry had one foot on the accelerator, but the other on the brake.

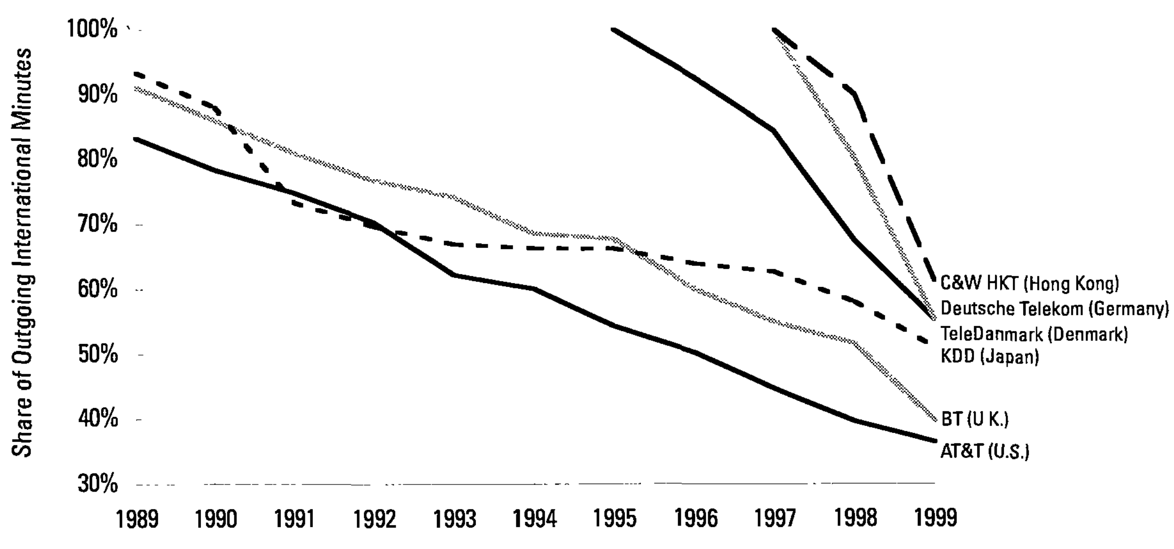
**Pedal to the Metal**

*Mobile Telephony.* Tens of millions of new mobile subscribers boosted international call volumes in 1999. In Europe alone, cellular operators added 75 million customers. The surge in cross-border roaming calls, which regularly are counted as international traffic, also contributed to heavier call volumes. Together, mobile roaming and subscribership are key factors in explaining why total international traffic from countries such as Germany and the Netherlands, which had been growing at rates of five percent or less in 1996 and 1997, showed double digit growth in 1999.

*Intensifying competition.* Competition has intensified far more quickly in countries which liberalized their international long distance (ILD) markets in the late 1990s, compared to the more gradual increases observed in those markets that liberalized ten to 15 years ago. In the U.S., competition in ILD services began in 1982-1983; 12 years later, in 1995, AT&T's market share was still more than 50 percent. In contrast, competition was introduced in Germany in 1998, and Deutsche Telekom's market share had fallen to 55 percent by 1999. While Deutsche Telekom's decline in dominance has been particularly swift, its experience is certainly not unique (see Figure 1. Incumbent Market Shares Go in One Direction).

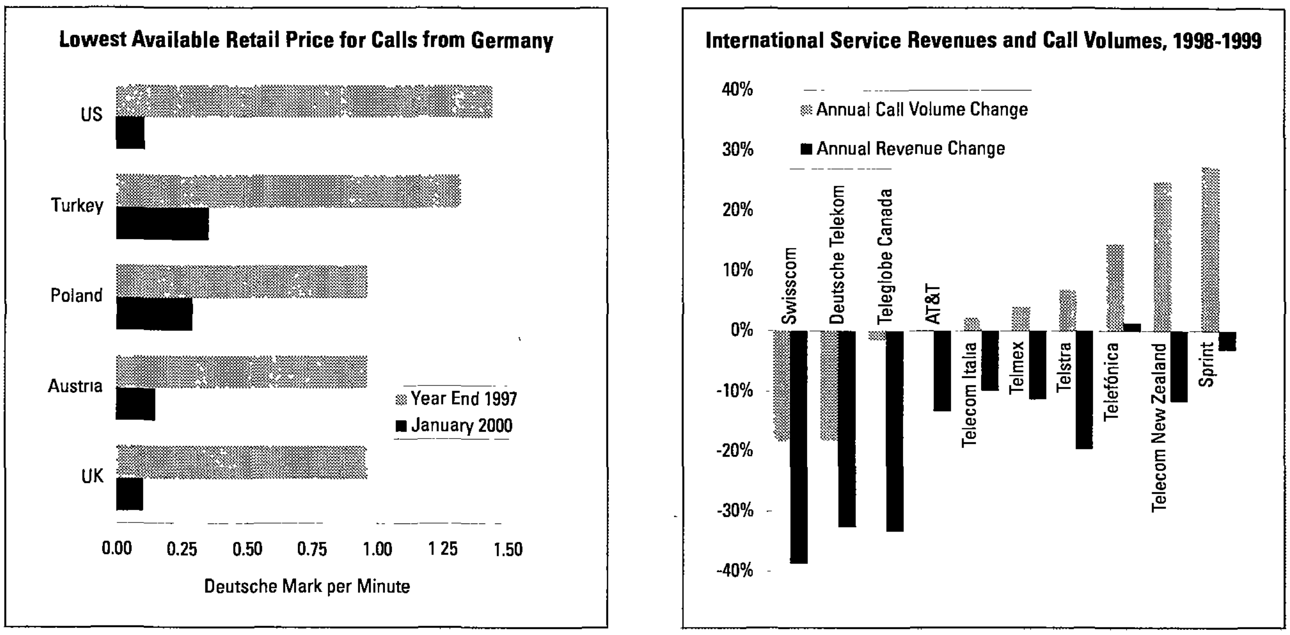
*New Carriers.* The rise of the multinational carrier (MNC) model is one reason why incumbent market shares are shrinking more quickly in the newly liberalized markets than in countries that introduced competition in the 1980s and early 1990s. Prior to the 1998 "Big Bang" telecom liberalization in Europe and elsewhere, only a handful of countries permitted competition. Usually, only a few significant competitors

**Figure 1. Incumbent Market Shares Go in One Direction**




Source: TeleGeography research

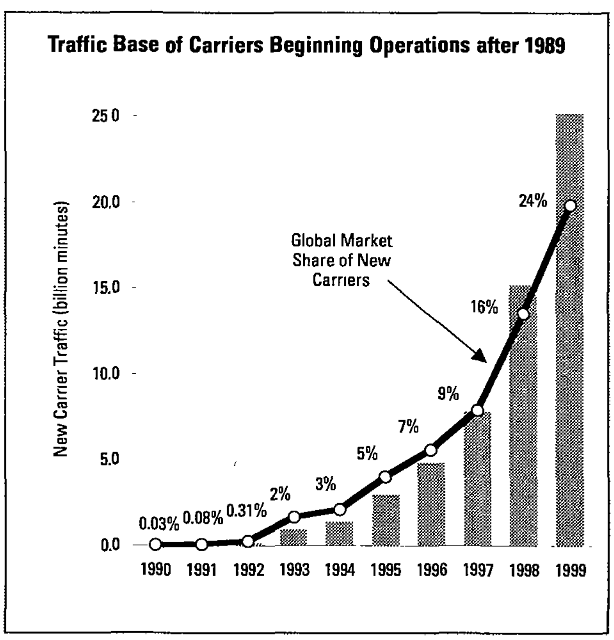
## Figure 2. Falling Prices, Falling Revenues




Note: In January 2000, one U.S. dollar equaled 1.94 Deutsche Marks.
Source: Regierungsbehörde für Telekommunikation und Post (RegTP), company reports, and TeleGeography research © TeleGeography, Inc. 2000

emerged to challenge the incumbent. These carriers often focused exclusively on one market. The proliferation of competition since 1998 has created a critical mass of deregulated markets to support a multinational strategy, in which a carrier provides facilities-based international service from many different countries (see "The Growth of International Services Competition" in the Carriers section of this report). MNCs hold a number of advantages over challengers pursuing a single market strategy. First, they enjoy economies of scale. They can apply the technical expertise, marketing skills, and company funding developed through their initial efforts in one country to new markets. Second, MNC affiliates have access to parent company international networks, which permit end-to-end routing in many cases, thus facilitating the evasion of costly settlement charges. Finally, because many of their clients are themselves multinationals, MNCs have a ready pool of customers when they move into new markets. For all these reasons, multinational carriers can steal away incumbent market shares with astonishing alacrity. In 1999, the number of minutes carried by new competitors grew over 70 percent, and accounted for 24 percent of world PSTN traffic (see Figure 3. Charge of the Challengers).

## Figure 3. Charge of the Challengers




Note: New carrier traffic includes only carriers that began facilities-based operation after 1989.
Source: TeleGeography research © TeleGeography, Inc. 2000

Taken together, the subsidiaries of many multinational carriers now carry more traffic than the incumbent operators of most countries. Some of these operators have emerged very quickly. In just the last year, U.S.-based World Access has purchased, among others, multinationals FaciliCom and WorldxChange as well as German operator TelDaFax. If it completes its proposed merger with STAR Telecommunications, World Access will be the fourth largest international carrier in the U.S.

Multinational carriers need not be new operators. Teleglobe, for example, has transformed itself from the overseas telecom service monopoly of Canada into a major global player. If the five billion minutes of international traffic from all of its country affiliates were to be aggregated, Teleglobe would be the third largest carrier in the world, ahead of all but AT&T and WorldCom.

*Price cuts.* Fierce price competition has spurred call volume growth in many countries. However, TeleGeography's research indicates that competitive pressure has been so intense in some countries that prices have fallen much faster than demand can possibly increase. For example, in Germany, prices on some routes have tumbled by as much as 90 percent in only two years, while call volumes grew by only 45 percent (see Figure 2. Falling Prices, Falling Revenues).

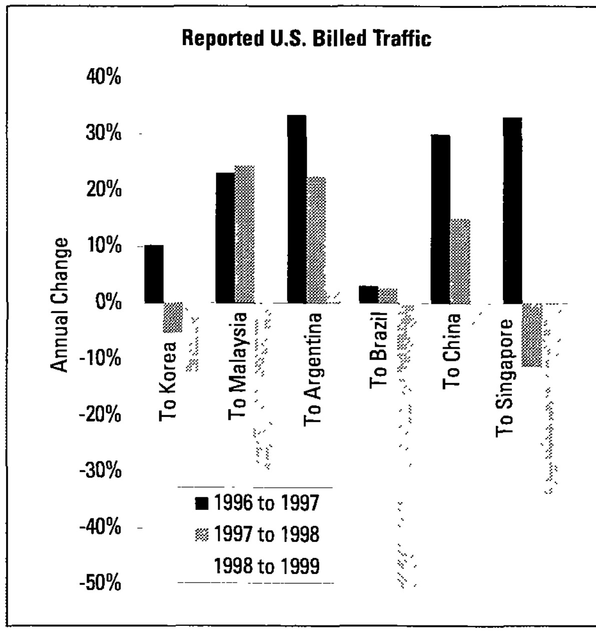
The aggressive price-cutting strategies of new carriers have placed incumbent carriers in a quandary—a tradition of monopoly and heavy regulation have rendered many of them uniquely ill-equipped to engage in price competition. If they cut prices to compete with their rivals, they will undermine the steep ILD profit margins on which they have based their business. However, if they do not cut their prices, they will lose customers to their new competitors. In Germany, prices fell so rapidly that Deutsche Telekom had no choice but to follow suit. However, their challengers cut prices far more aggressively, and Deutsche Telekom lost not just market share, but also subscribers. In the past two years, Deutsche Telekom's international voice traffic has fallen by 19 percent, and revenues have plunged by 44 percent. In this, too, Deutsche Telekom's experience has not been unique (again, see Figure 2).

### Foot on the Brake

*Fax Traffic.* The public switched traffic tracked by TeleGeography includes both voice and fax minutes. Since the 1980s, fax has been a critical component in the traffic mix. Fax traffic is particularly important on routes dominated by business calling and between countries that do not share a common language—that is, in cases when written language is more reliable than oral communication. Fax traffic has also been significant between countries separated by multiple time zones, where fax and email are more reliable than real-time applications (e.g., voice). With fax, a person can send a message even if the other party has left the office for the day.

Estimates for the mid-1990s put fax minutes at 30 percent of total international traffic. Yet by 1999, fax appeared to account for only half that share. Evidence points to email as the culprit. In many situations, email has proven quicker, cheaper, and easier to use than facsimiles; however, fax traffic does remain significant on certain routes. Both email and fax volumes are likely high from the United States, where 55 percent of outgoing international traffic travels to countries more than four time zones away. Fax as a share of total traffic is highest from Asia, where multiple character sets render email a less reliable technology than the trusty fax machine.

**Figure 4. Bypass at Work?**




Source: TeleGeography research © TeleGeography, Inc. 2000

*Bypass Traffic.* In the case of bypass, the description of international traffic as "flows" is apt because these calls, like water, seem to route around obstacles—such as high settlement rates. The traffic tables in *TeleGeography 2001* reflect the global total of 107.8 billion minutes of public switched calls. We estimate that, in 1999, an additional five to eight billion minutes skirted the settlement rate mechanism, unaccounted (see Figure 4. Bypass at Work?).

Growth of Voice-over-IP (VoIP), a form of bypass, is particularly rapid. While VoIP accounted for only about 1.6 percent of total international voice traffic in 1999, it represents a much larger proportion of traffic on certain key routes. For example, TeleGeography estimates that VoIP equaled at least 20 percent of traffic between the U.S. and China in 1999. In 2000, we expect global VoIP volumes to more than double.

### The Road Ahead

The following pages explore in detail the directions in which international telecommunications are heading. First, an analysis of bypass and refile traffic provides a look at the drivers of alternative traffic arrangements. Results from a three-month survey complement this analysis with an in-depth study of international VoIP. Information on mobile traffic volumes adds another perspective, showing how the wireless industry shapes international telecommunications. Finally, statistics on international call quality suggest how metrics besides call prices and volumes are important for understanding international telecom trends.

# Bypass and Refile Traffic

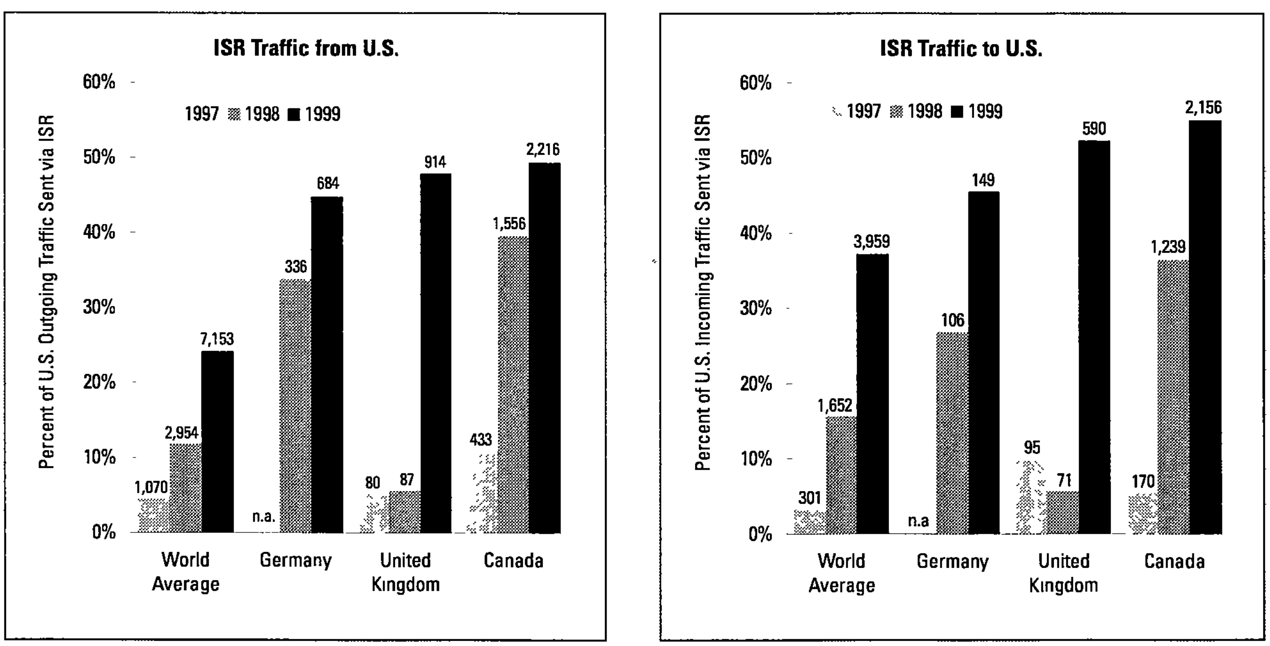
Until just a few years ago, international telecommunication companies shared the cost and revenue for nearly every cross-border public switched call in accordance with the decades-old accounting rate regime. To send a call abroad, a carrier would route the signal onto its own international "half circuit," then transfer the call onto the matching network of its foreign counterpart for final termination. For this service, the originating carrier would pay the foreign telco a hefty settlement fee, usually equal to one-half the accounting rate negotiated by the two carriers. However, as competition shrinks profit margins, carriers are finding new ways to protect their bottom lines; one approach is to retain more of their existing revenue streams by sending traffic around this settlement system.

**Legal Bypass**

Legal bypass, which eschews traditional international settlement in favor of direct interconnection with foreign local exchange carriers (LECs), accounts for the largest portion of alternatively routed traffic. Regulators often refer to the practice as International Simple Resale (ISR), reflecting the practice of leasing and re-using private lines from foreign carriers—for many years, the only way to acquire a line to international destinations. This practice is gradually giving way to new options, such as the outright ownership of bandwidth between and within multiple countries.

In 1999, legal bypass traffic accounted for approximately 15 percent of international call volumes worldwide. This percentage is surprisingly large considering the relatively small number of countries (at present, only a few dozen) that permit these alternative termination arrangements. However, legal bypass represents a growing portion of international traffic because, although few in number, these countries tend to have very high traffic volumes. Of the 20 largest countries ranked by international minutes, 16 offer some form of direct interconnection. Although the U.S. regulator permitted ISR with only 23 countries in 1999, these routes accounted for one-quarter of all U.S. outgoing traffic (see Figure 1. Top ISR Routes with the U.S., 1997-1999). Yet those sums are just the beginning. Not all U.S. carriers used ISR to connect their calls to these 23 countries. If

**Figure 1. Top ISR Routes with the U.S., 1997-1999**

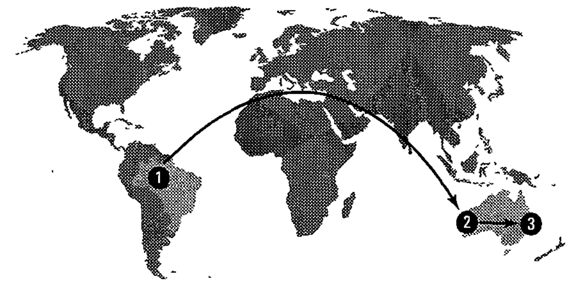



Note: Numbers above columns indicate millions of minutes sent via International Simple Resale (ISR). ISR with Germany was not legal in 1997.

Source: FCC carrier filings

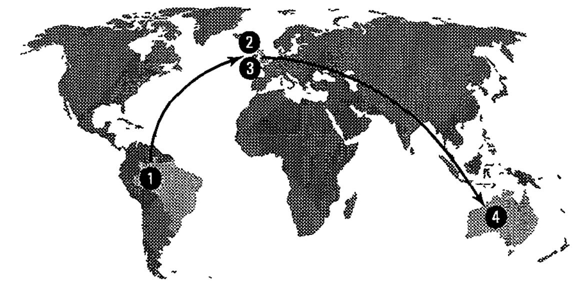
**Figure 2. Call Delivery Methods**

**Standard Public Switched Call**



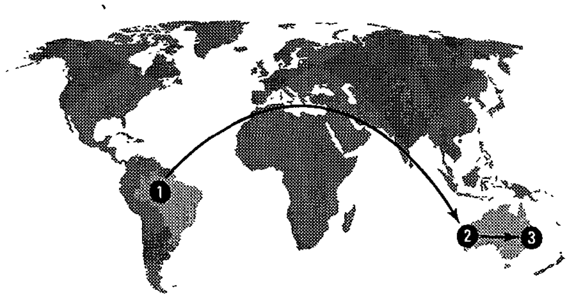
1. Customer dials international number.
2. Call is sent over the Public Switched Telephone Network (PSTN) by originating carrier, which pays settlement charge to terminating carrier in destination country.
3. Call is delivered to its final destination by terminating carrier.

**Refile**



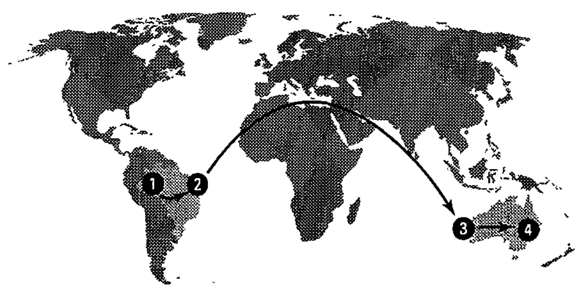
1. Customer dials international number.
2. Originating carrier sends call to hub country via PSTN or over international private line, known as International Simple Resale (ISR).
3. Refile carrier re-originates call over PSTN.
4. Call is delivered to final destination via refile carrier, which pays settlement charge to terminating carrier.

**Switched Bypass**



1. Customer dials international number.
2. Call is routed over international private line to switch in destination country but outside network incumbent telco (e.g., to closed user group or mobile operator).
3. Call is re-rerouted to incumbent telco's network and completed as a local call on PSTN. No international settlements are paid by the originating carrier.

**VoIP Bypass**



1. Customer dials international number. Call is routed over PSTN to gateway computer.
2. Call is converted from analog voice to Internet Protocol (IP) format and sent over the Internet to a gateway in terminating country.
3. Call is converted back to analog format.
4. Call is completed as a local call on PSTN. No international settlements are paid by the originating carrier.

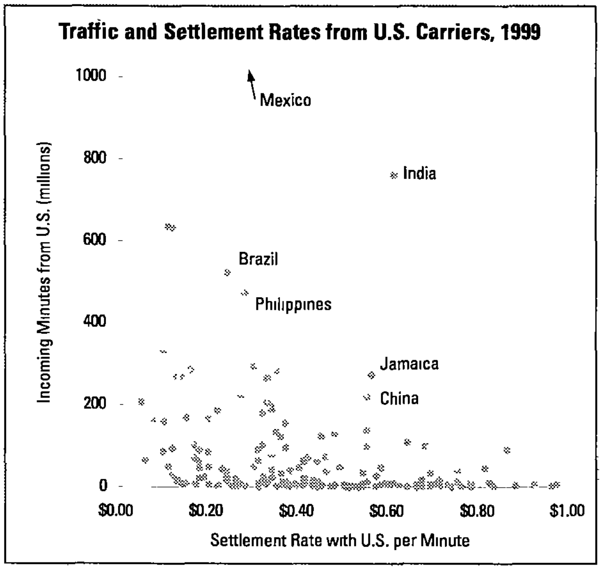


every carrier did, nearly 50 percent of U.S. traffic would take advantage of legal bypass.

### Illicit Bypass

Although calls to countries where ISR is legal constitute almost 50 percent of U.S. outgoing traffic, they account for a mere 17 percent of total U.S. settlement outpayments. The remaining 80 percent of settlement revenues flow to countries where accounting rate bypass is illegal and per minute termination rates are, on average, four times higher. These countries present the greatest cost savings opportunities for bypass of the settlement rate and are, therefore, the most attractive targets for carriers seeking to evade settlement payments (see Figure 3. Bypass Targets). Some countries, (appearing in Figure 3 as gray circles hugging the "x" axis) have very high settlement rates but low volumes of incoming traffic. Other countries, (stacked along the "y" axis in Figure 3) receive substantial amounts of incoming calls but have low settlement rates. It is the combination of relatively high settlement rates and heavy traffic volumes that has historically created large volumes of illicit bypass traffic (e.g., to China, Jamaica, Philippines, Brazil, India, and Mexico).

## Figure 3. Bypass Targets




Note: Data are for the three largest U.S. carriers (AT&T, WorldCom, and Sprint). Traffic to Mexico is off this scale at 3.6 billion minutes with a settlement payment of $0.26 per minute.

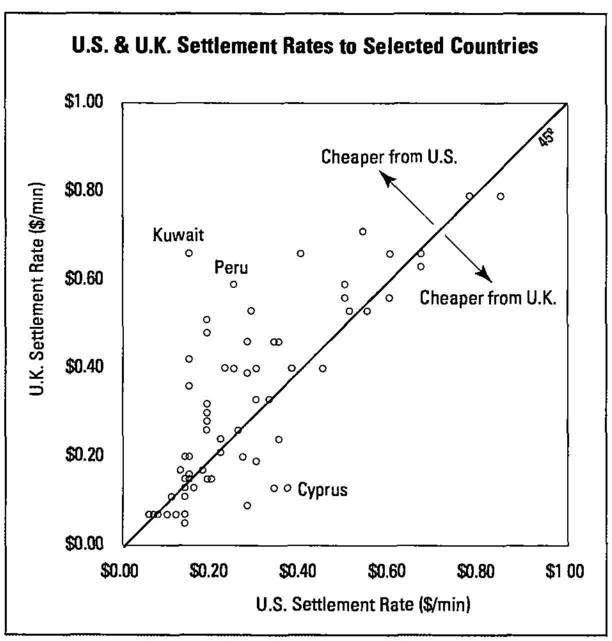
Source: TeleGeography research © TeleGeography, Inc. 2000

Carriers looking to smuggle phone calls into foreign countries have a range of options. Internet Protocol (IP) telephony is one, relatively new, avenue for bypass. The transmission of voice over packet-switched data networks may occur primarily over the public Internet, or through private managed lines and terminating on traditional handsets.

Companies can also accomplish bypass through older, switch-based technologies. Although few countries permit direct interconnection with the domestic PSTN necessary for ISR, many are more lenient in licensing intra-company services for multinational corporations, provided that calls are contained within a "closed" user group. A common ploy for illegal bypass is to lease international circuits from an incumbent apparently for such closed use, then "leaking" non-group international minutes onto the local network.

So how much international traffic illegally bypasses the accounting rate system? By virtue of their illicit character, traffic volumes in this "gray market" are extraordinarily difficult to track. A smuggling arrangement is often transient: carriers lease a private line, aggressively ramp-up international call volumes, and then terminate the operation just as quickly, before local authorities even raise an eyebrow. TeleGeography estimates that illicit bypass volume was somewhere in the range of four to seven percent of global international traffic in 1999. Of these calls, roughly one-third traveled as VoIP, the remainder as switched bypass over leased lines. Moreover, VoIP volumes are set to climb dramatically in the next few years. (See "VoIP Routes & Traffic" below.) Although illicit bypass accounts for only a small percentage of total world traffic, the practice wreaks havoc in some countries, siphoning up to 35 percent of incoming international traffic. In 1999, an estimated $200-250 million dollars in settlement payments were lost due to illicit bypass from the U.S. alone.

## Figure 4. The Refile Shell Game




**Hypothetical Refile Transactions**

| | | Settlement w/o Refile | Refile Fee | Settlement w/ Refile | Gain (Loss) |
|---|---|---|---|---|---|
| Origin. | U.K. | ($0.66) | ($0.25) | | $0.41 |
| Hub | U.S. | | $0.25 | ($0.15) | $0.10 |
| Destin. | Kuwait | $0.66 | | $0.15 | ($0.51) |
| Origin. | U.K. | ($0.59) | ($0.35) | | $0.24 |
| Hub | U.S. | | $0.35 | ($0.25) | $0.10 |
| Destin. | Peru | $0.59 | | $0.25 | ($0.34) |
| Origin. | U.S. | ($0.34) | ($0.23) | | $0.11 |
| Hub | U.K. | | $0.23 | ($0.13) | $0.10 |
| Destin. | Cyprus | $0.34 | | $0.13 | ($0.21) |

Source: FCC, Office of Telecommunications (OFTEL), and TeleGeography research © TeleGeography, Inc.

### Refile

Refile represents a third form of alternatively routed traffic. Instead of avoiding accounting rates altogether, those carriers employing refile bend the rules of the international settlement regime to their advantage. Refiling occurs when a carrier secretly re-routes an outgoing international call through a third country, taking advantage of the intermediate country's lower settlement rate with the final destination country. Although the legal status of refile is more debatable than that of many other forms of bypass, the practice is certainly illicit. With the intent of disguising the true origin of traffic, the refile carrier in the intermediate country strips the numbering code, which identifies the originating country, replacing it with its own country code. This ruse makes economic sense in cases where settlement rate disparity exists between originating countries. For example, in mid-year 2000, the official settlement rate for traffic to Kuwait was $0.15 per minute from the U.S. and $0.66 per minute from the U.K. (see Figure 4. The Refile Shell Game). By charging British carriers a fee somewhere between the U.S. and U.K. rates—say, $0.25 for a one-minute call—a U.S.-based refiler could turn a $0.10 profit. Another winner would be the British carrier, saving $0.41 (minus the negligible transmission costs of re-routing the call through the U.S.). In contrast, the Kuwaiti telco would lose $0.51 in potential settlement income from the transaction.

Refile traffic accounted for approximately 9.5 percent of world international call volumes in 1999. This percentage is much higher on routes to some developing countries, which tend to have higher settlement rates with most of their correspondents. For example, up to one-third of all calls to India, Pakistan, and Malaysia may have been refiled in 1999, resulting in a significant loss of settlement income in those countries.

### Conclusion

Countries wishing to stamp out refile and illegal bypass face two realistic options. The first option is to invest in the sophisticated technology necessary to detect the many sources of illicit flows, with an eye to quashing bypass operations in the long term. The other option is to lower the official settlement rate, which would reduce the incentive for bypass and refile, forcing the would-be illicit operators above ground by drying up their margins.

# VoIP Routes & Traffic

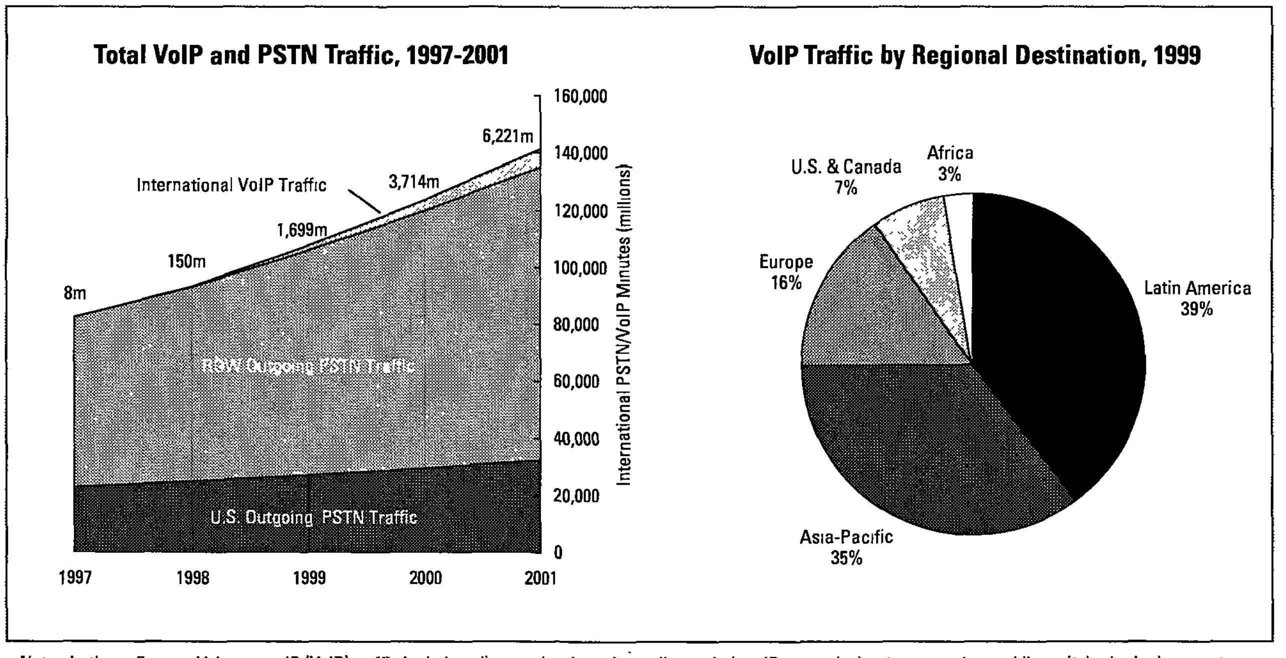
## Entering Adolescence

Since TeleGeography began tracking international phone calls more than a decade ago, market forces and technological innovation have driven down prices and increased traffic flows across the globe. The Internet has no doubt played a significant role in accelerating this process in the last few years, but quantifying the effect on actual traffic flows has been largely a speculative practice. Just two years ago, the combined traffic of all the companies routing international calls over Internet Protocol (IP) networks accounted for less than one-half of one percent of the world's international minutes. Although Voice-over-IP (VoIP) has only recently left its infancy as an alternative to traditional circuit-switched calling, the core infrastructure and support systems necessary for making VoIP a serious choice have now come online.

In 1999, cross-border VoIP call volumes reached approximately 1.7 billion minutes—about 1.6 percent of total international voice traffic. Based on TeleGeography's survey results for the first half of 2000, the total international VoIP market should reach 3.7 billion minutes for calendar year 2000 and, if the growth continues, 6.2 billion minutes in 2001 (see Figure 1. International VoIP and PSTN Traffic Summary).

But the VoIP industry is still young and unpredictable. While new and incumbent carriers alike are laying plans for IP networks that will carry all of their voice traffic in coming years, they have a way to go yet. The industry is still driven by specialist VoIP providers acting as carriers' carriers to established phone companies, taking advantage of the arbitrage opportunities between official PSTN settlement fees and the de facto termination rates they can achieve (see Figure 3. Major VoIP Carriers & Traffic). VoIP clearinghouses that link together the raft of new entrants which need a means to exchange traffic and settle accounts are also important (see Figure 4. Major VoIP Clearinghouses). The myriad new retail VoIP businesses that offer free PC-to-phone calling by way of advertising on Web-based commu-

**Figure 1. International VoIP and PSTN Traffic Summary**




Note: In these figures, Voice-over-IP (VoIP) traffic includes all cross-border voice calls carried on IP networks but terminated on public switched telephone networks; PC-to-PC communications and private network traffic are excluded. PSTN traffic includes circuit-switched voice and fax traffic carried on traditional international facilities as well as international simple resale (ISR) facilities.

Source: TeleGeography survey results

## Figure 2. The Top 20 U.S.-Originated VoIP Routes, 1999-2000

### Largest U.S.-Originated VoIP Routes, 1999

| | | |
|---|---|---|
| 1. | U.S. to Mexico | 28% |
| 2. | U.S. to Israel | 6% |
| 3. | U.S. to China | 5% |
| 4. | U.S. to Korea, Rep. | 4% |
| 5. | U.S. to India | 4% |
| 6. | U.S. to U.K. | 3% |
| 7. | U.S. to Singapore | 3% |
| 8. | U.S. to Brazil | 3% |
| 9. | U.S. to Canada | 2% |
| 10. | U.S. to Ecuador | 2% |
| 11. | U.S. to Greece | 2% |
| 12. | U.S. to France | 2% |
| 13. | U.S. to Peru | 2% |
| 14. | U.S. to Philippines | 2% |
| 15. | U.S. to Germany | 1% |
| 16. | U.S. to Malaysia | 1% |
| 17. | U.S. to Russia | 1% |
| 18. | U.S. to Australia | 1% |
| 19. | U.S. to Taiwan | 1% |
| 20. | U.S. to Hong Kong | 1% |
| | Other routes | 26% |

Routes expressed as a percentage of reported international VoIP traffic

### Largest U.S.-Originated VoIP Routes, 2000

| | | |
|---|---|---|
| 1. | U.S. to Mexico | 35% |
| 2. | U.S. to China | 7% |
| 3. | U.S. to U.K. | 4% |
| 4. | U.S. to Brazil | 3% |
| 5. | U.S. to Israel | 3% |
| 6. | U.S. to Russia | 2% |
| 7. | U.S. to Canada | 2% |
| 8. | U.S. to India | 2% |
| 9. | U.S. to Bulgaria | 2% |
| 10. | U.S. to Poland | 2% |
| 11. | U.S. to S. Africa | 2% |
| 12. | U.S. to Romania | 2% |
| 13. | U.S. to Greece | 2% |
| 14. | U.S. to Lebanon | 2% |
| 15. | U.S. to Philippines | 1% |
| 16. | U.S. to Peru | 1% |
| 17. | U.S. to Colombia | 1% |
| 18. | U.S. to Taiwan | 1% |
| 19. | U.S. to Bangladesh | 1% |
| 20. | U.S. to Korea, Rep. | 1% |
| | Other routes | 25% |

Routes expressed as a percentage of reported international VoIP traffic

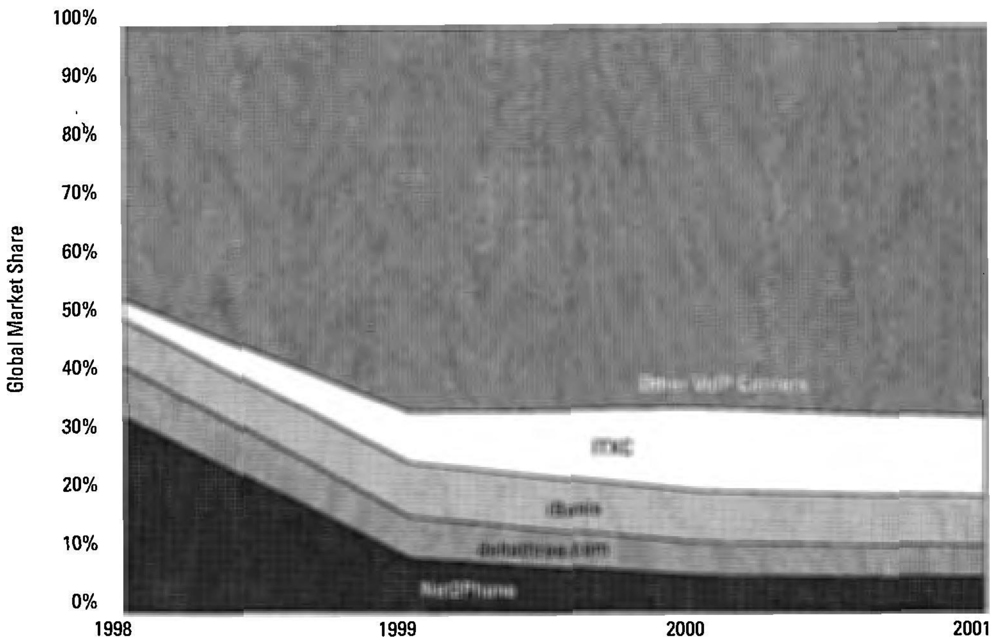
Note: Route rankings are based on actual traffic reports by major wholesale and retail VoIP carriers as well as VoIP clearinghouses. Figures do not include all VoIP carriers and routes, however, so some omissions may have occurred. Year 2000 rankings are based on statistics supplied for the first six months of 2000.

Source: TeleGeography survey results

## Figure 3. Major VoIP Carriers & Traffic

| Company | 1999 (Jan.-Dec.) Traffic (min.) | 1999 (Jan.-Dec.) Revenues | 2000 (Jan.-June) Traffic (min.) | 2000 (Jan.-June) Revenues | Market Cap. (Oct. 2, 2000) | Major Shareholders |
|---|---|---|---|---|---|---|
| deltathree.com (NASD: DDDC) | 120 m | $12.4 m | 130 m | $15.3 m | $104.5 m | RSL Com (95.5%) |
| Genuity (NASD: GENU) | n.a. | $3.0 m | 30 m | $20.0 m | $1,255.0 m | Verizon (10%) |
| iBasis (NASD: IBAS) | 157 m | $19.4 m | 205 m | $23.3 m | $541.1 m | n.a. |
| ITXC (NASD: ITXC) | 150 m | $28.0 m | 366 m | $33.7 m | $563.6 m | n.a. |
| Net2Phone (NASD: NTOP) | 259 m | $41.0 m | 230 m | $50.0 m | $1,238.8 m | AT&T (32%) IDT (17%) |
| Wherever.net (NASD: WNET) | 38 m | n.a. | 46 m | $2.6 m | $61.0 m | Hontung Venture Capital (12%) |

**Market Share of International VoIP Minutes, 1998-2001**




Note: Traffic statistics include only international VoIP minutes; revenue figures include services, software, and equipment in addition to per minute charges for IP voice and fax services.

Source: TeleGeography survey research and company reports



nications portals constitute a third driver of traffic, although most of these flows do not cross international borders as of yet.

### Our Survey

Given the still nascent stage of the VoIP industry, the installed base of circuit-switched transmission equipment, and the difficulty of tracking calls terminated in places where you may not want to advertise your success, making predictions is hazardous business. Instead, in this essay we focus on what we do know. The statistics and analysis presented on these pages are based on TeleGeography's first annual VoIP routes survey, concluded in September 2000.

The goal of our survey was twofold: first, to measure how much VoIP traffic transits international networks; and second, to establish where it is going. The data presented here include international phone calls that transit public or private IP networks at some point but are ultimately terminated on traditional fixed or mobile networks. PC-to-PC com-

**Figure 4. Major VoIP Clearinghouses**

| Clearinghouse/URL | 1999 (Jan.-Dec.) Members | 1999 Traffic | 1999 Revenue | 2000 (Jan.-June) Members | 2000 Traffic | 2000 Revenue |
|---|---|---|---|---|---|---|
| Concert Global Clearinghouse (www.concert.com) | 84 | 90 m | n.a. | 100 | 120 m | n.a. |
| GRIC Comm., Inc. ( www.gric.com) | 250 | 98 m | $8.0 m | 350 | 118 m | $11.7 m |
| ipx, inc. (www.ipx-inc.com) | 3 | 15 m | $2.3 m | 31 | 19 m | $2.6 m |
| Telia Clearinghouse Services (clearinghouse.telia.com) | 31 | 7 m | $0.7 m | 34 | 17 m | $1.8 m |

Note. Concert, ipx, and Telia traffic and revenue figures are for international VoIP minutes only; GRIC traffic and revenue figures include per-minute tracking of dial-up Internet service roaming. Clearinghouse membership figures for 1999 are current to December and 2000 figures are current to June.

Source: TeleGeography survey research and company reports



munications and private corporate network traffic are excluded because neither are directly comparable to PSTN traffic flows. And, because our survey is based on the reports of most—but not all—companies carrying VoIP traffic, some routes may be under-reported. As a result, the route tables in Figure 2 present traffic flows in relative proportions rather than absolute minutes as we do in our PSTN tables.

**The Results**

Overall, our findings prove what we already suspected—that VoIP is a new means to an old end. Because U.S.-based companies have had a head start in setting up their businesses, most of the world's VoIP traffic currently originates in the U.S.—each of the world's top 20 VoIP routes for 1999 and 2000 originate there. Furthermore, because the Internet remains U.S.-centric, U.S.-based VoIP carriers have access to the most international IP bandwidth at the lowest prices. And, just as the U.S. continues to act as the primary hub for Internet traffic, the U.S. may retain its position as a refile hub for VoIP traffic even as the ranks of VoIP carriers proliferate into Western Europe and Asia.

Although VoIP calling patterns run roughly parallel to established PSTN demand, the largest share of VoIP traffic has terminated in the countries where existing PSTN settlement rates are highest relative to the actual cost of getting the call there. Also, because quality expectations may be lower on many popular arbitrage routes, VoIP calls compare favorably to the equally mediocre quality of many circuit-switched calls.

The obvious example of the initial trend is traffic on the U.S.-Mexico route, which accounted for about one-third of global VoIP traffic in 1999 and 2000. In the near future, we also expect that traffic into China, Brazil, and India will increase dramatically as VoIP termination arrangements expand and IP infrastructure matures, providing a viable alternative to prohibitively high PSTN settlement rates (see Figure 2. The Top 20 U.S.-Originated VoIP Routes, 1999-2000).

But VoIP is not all about arbitrage. Although established carriers have yet to migrate much of their traffic onto VoIP networks, many have begun trials or made announcements of their transition to more efficient all-IP infrastructure in coming years. Moreover, as new IP communications services and devices become available, they may stimulate new demand and increase VoIP traffic flows beyond the growth rates characteristic of the traditional voice telephony market. We will be watching—and reporting—these developments as they occur.

# International Traffic from Mobile Phones

"By 2001, one in ten international calls will originate on mobile terminals."

*-TeleGeography 2000*

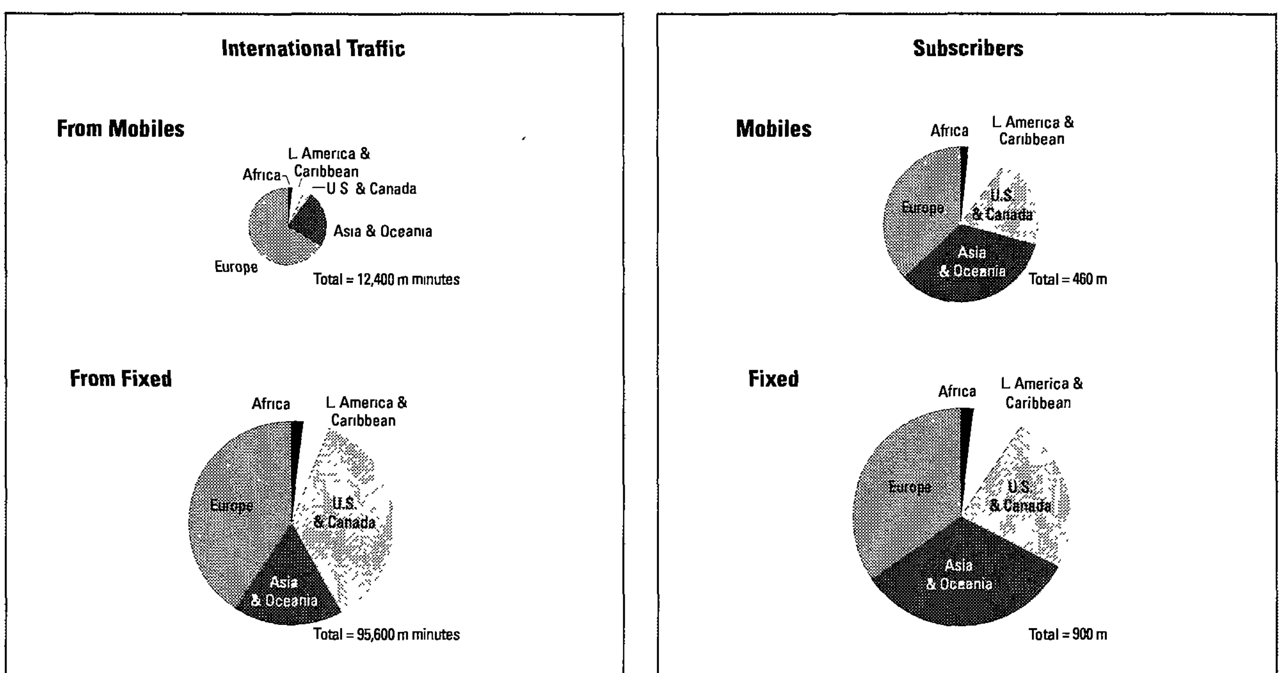
That bold statement, penned just one year ago in the first-ever study of mobile-based international call volumes, had the right idea but the wrong date. Mobile-originated international calling already has exceeded the envisioned one in ten ratio, increasing from eight percent of international calls in 1998 to 11.5 percent in 1999 (see Figure 1. Mobile vs. Fixed International Traffic and Subscribers by World Region, 1999). At current growth rates, mobile calls in 2001 will account for one out of every *four* international minutes. Two factors in particular help explain the growing importance of mobile networks in international calling: wireless subscribership growth and roaming.

**Subscribership**

Sometimes, the simplest explanations are the best: mobile-originated international minutes are increasing because more people are using cellular phones. While fixed line subscribership growth remains in the single digits in most regions of the world, mobile subscribership growth has not slowed from its torrid pace in the 1990s. In Africa, the number of new mobile phone lines doubled during 1999. In Europe, cellular subscribership grew by 60 percent—a fact all the more remarkable when one considers that there were already 100 million mobile phone users in 1998. Mobile users now account for one-third of all phone subscribers worldwide, and appear set to exceed fixed lines around the middle of this decade.

The growth of mobile-originated international traffic stemming from subscribership changes may be as much a case of traffic substitution as it is of traffic creation. Many of the international calls placed from wireless phones would otherwise have been dialed from fixed line sets. Furthermore, although most people still use cellular phones as a supplement to their fixed line phones, growing numbers of subscribers are switching off their fixed lines altogether. Between 1998 and 1999, the total number of active fixed lines actually *declined* in fourteen countries, including Austria, Japan, and Israel. The growing disparity in wireless versus fixed subscribership patterns helps explain why inter-

**Figure 1. Mobile vs. Fixed International Traffic and Subscribers by World Region, 1999**




Source: TeleGeography research and ITU

national call minutes from mobile phones increased by a robust 66 percent in 1999 compared to a relatively paltry 11 percent growth from fixed line phones.

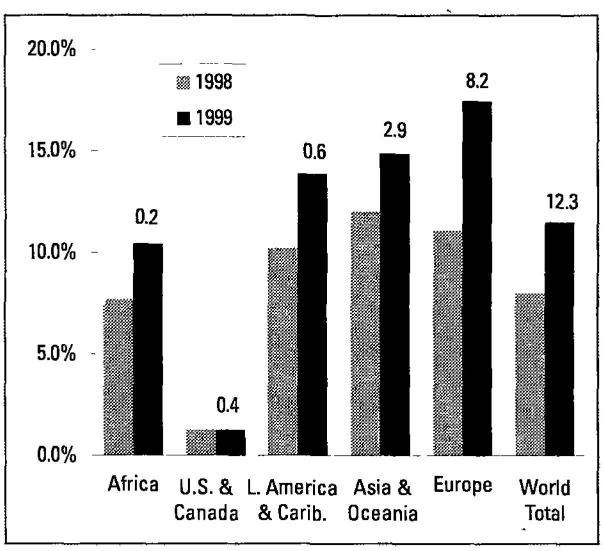
### Roaming

Calls from cell phone users when traveling abroad represent a second major impetus for traffic growth. The reason has to do with the roundabout circuit that many roaming calls take. If a German businessman traveling in Zürich were to call someone in Switzerland, for example, the call likely would first be switched through his operator's facilities in Germany before traveling back across the Swiss border. Each roaming call—even calls to local destinations in Zürich—would count as international traffic from Germany to Switzerland.

In contrast to the subscribership effect, which shifts some international traffic from fixed lines onto mobile phones, roaming largely creates new international traffic that otherwise would not exist. In 1999, for example, the number of international call minutes from Germany to Switzerland increased from 400 to 650 million minutes, a fact that is hard to explain except for roaming.

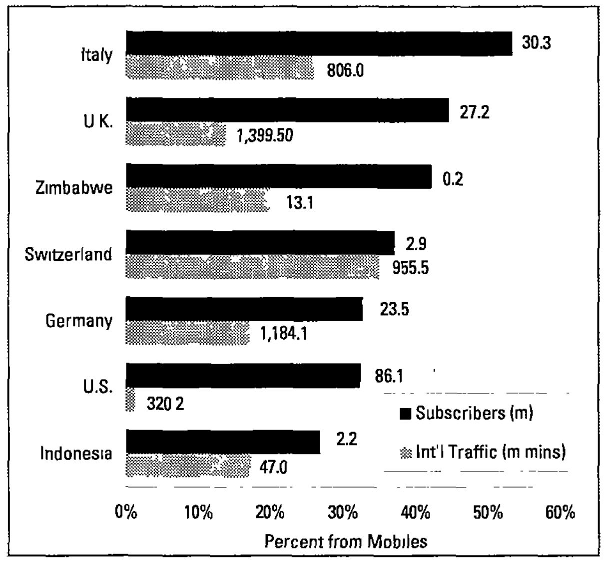
Roaming is particularly significant in Europe, Africa, and Asia, where the common standard Global System for Mobile Communications (GSM) permits interconnectivity. The widespread use of roaming over GSM networks helps explain why international mobile calls appear so high in these regions (see Figure 2. Percent of International Traffic from Mobiles, 1998-1999). Roaming is even beginning to have a noticeably upward impact on total international traffic volumes. Mobile-originated international traffic is one reason why total international traffic from Europe in 1999 grew at its fastest pace in over a decade. The roaming phenomenon is also a factor in the low level of international calls placed from cellular phones in the U.S., where GSM networks are less common (see Figure 3. Mobile Subscribers and International Traffic for Selected Countries, 1999).

**Figure 2. Percent of International Traffic from Mobiles, 1998-1999**




Note: Numbers show total mobile-originated international minutes in billions.
Source: TeleGeography research and ITU © TeleGeography, Inc. 2000

**Figure 3. Mobile Subscribers and International Traffic for Selected Countries, 1999**




Note: Numbers show absolute levels of subscribership and call minutes from mobiles. Lengths of bars show relative levels from mobiles.
Source: TeleGeography research and ITU © TeleGeography, Inc. 2000

### Limits to Growth

Despite the spectacular increases in mobile-originated international calling, limits to its growth do remain. Worldwide, individuals place 105 minutes of international calls per year on their fixed line sets but only 25 minutes per year on their mobile phones. In Italy, over half of all telephones are mobiles, and yet 74 percent of international calls come from wireline phones. The reason is that, despite their drive toward ubiquity, mobile terminals are not perfect substitutes for wireline telephones. In many countries, call prices from mobile phones remain more expensive than from wireline sets. Also, many people prefer to place international calls from their offices or homes, where they have more reliable call quality and less background noise. As we concluded in our *TeleGeography 2000* analysis, it seems safe to say that "the fixed line telephone will remain the dominant medium for originating and terminating international calls" for the foreseeable future. But then again, the astonishing growth of cellular telephony has a history of leaving even the best predictions in its wake.

# International Call Quality Metrics

Minutes, revenues, bandwidth—all are vital statistics for tracking changes in the telecom industry. In fact, much of what we know about international telecommunications traffic reflects such volumetric data. Yet statistics that describe call quantity paint only a partial picture—call *quality* is also a critical component. However, while collecting volumetric data is relatively straightforward; quality, on the other hand, is subjective. So how can quality be quantified?

**Measuring the Subjective**

Monnet UK Ltd., an independent Quality of Service (QoS) arbiter, is implementing one approach. In addition to monitoring call quality on its clients' networks, Monnet also constructs industry benchmarks, pooled from data provided by participating carriers. Figure 2 shows survey results for 45 destination countries, based on a sample of 30 million international calls from German and U.K. carriers between June 1 and August 31, 2000.

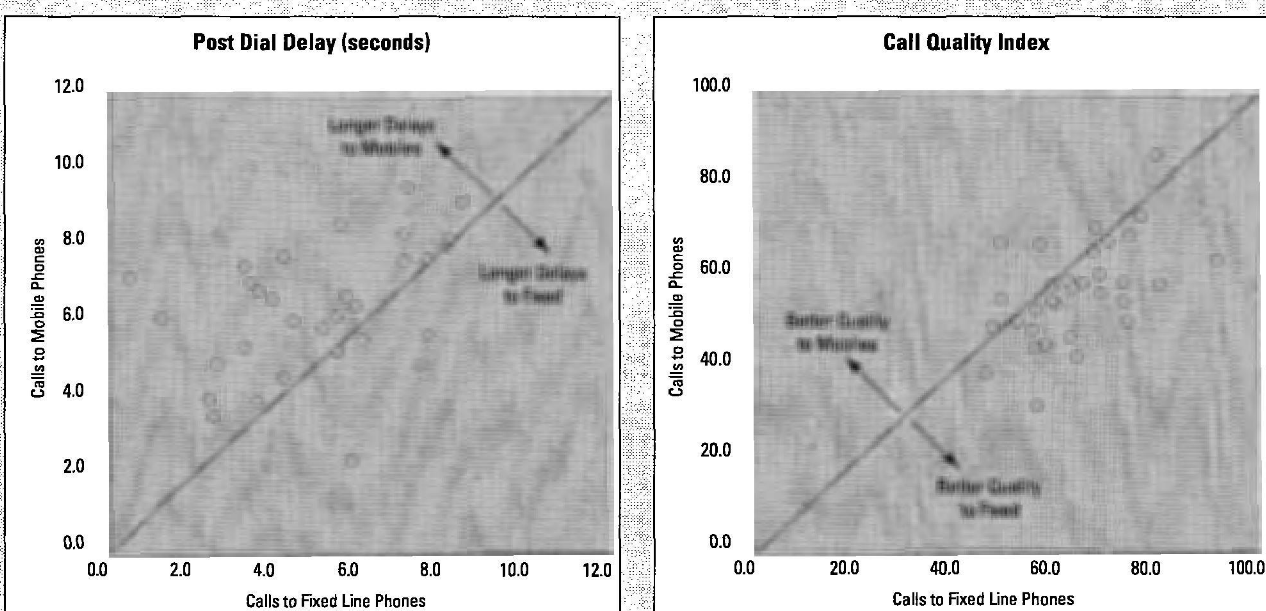
Monnet employs three indicators to measure call quality:

- Answer Seizure Ratio. ASR measures the percentage of successful call attempts between a switch and a given destination. A 50 percent ASR means that only one-half of all call attempts were answered by a person or device; an unanswered call or busy signal counts as an unsuccessful call. That means ASR is affected not only by performance factors—availability of dial tone and the network's ability to establish a transmission path or switch a call—but also by phenomena ranging from a changed dialing code to a holiday season, leading to more unanswered calls due to wrong numbers or busy signals. ASR standards vary significantly by region. For example, the range of acceptable ASR for calls to developed countries generally is 60 to 75 percent.

- Post Dial Delay. PDD measures the time it takes a network to establish a connection once the caller has finished dialing. Hence, a PDD of 8.2 means that an average of 8.2 seconds elapse between the dial and the ring at the other end.

- Call Quality Index. CQI, expressed on a scale of 0 to 100, consists of a basket of five qualitative factors: signal level, noise, echo path loss, echo path delay, and speech activity. All five factors are based on a technical model provided in ITU-T Recommendation G.107 (www.itu.int/itudoc/itu-t/rec/g/g100-699/s_g107.htm). To earn a "best" ranking, a call must post a CQI score between 80-100; on the other end of the scale, a CQI of less than 60 is characterized as "poor."

**Figure 1. Call Quality from Germany to Mobile and Fixed Line Telephones**




Source: Monnet UK Ltd. Design © TeleGeography, Inc. 2000

## Figure 2. Quality Metrics on Calls from Germany and the U.K., June-August 2000

| Destination | Answer Seizure Ratio from Germany | Answer Seizure Ratio from U.K. | Post Dial Delay (seconds) from Germany | Post Dial Delay (seconds) from U.K. | Call Quality Index from Germany | Call Quality Index from U.K. |
|---|---|---|---|---|---|---|
| Australia | 42% | 37% | 8.2 | 9.0 | 61.4 | 53.8 |
| Austria | 67% | 29% | 5.4 | 4.5 | 78.1 | 68.5 |
| Belgium | 54% | 30% | 2.7 | 6.1 | 67.7 | 60.6 |
| Brazil | 34% | 37% | 5.5 | 4.5 | 62.5 | 64.9 |
| Canada | 63% | 72% | 4.9 | 1.7 | 83.8 | 83.6 |
| Chile | 35% | 13% | 3.6 | 5.1 | 60.6 | 67.2 |
| China | 33% | 28% | 7.1 | 10.3 | 49.1 | 52.5 |
| Colombia | 34% | 22% | 5.6 | 4.9 | 55.5 | 58.2 |
| Denmark | 53% | 56% | 6.0 | 3.6 | 44.6 | 64.6 |
| Ecuador | 16% | 24% | 7.1 | 4.1 | 52.5 | 53.6 |
| Finland | 47% | 60% | 5.3 | 2.9 | 66.4 | 65.2 |
| France | 34% | 57% | 4.5 | 3.4 | 58.5 | 54.0 |
| Germany | 44% | 61% | 7.6 | 2.3 | 68.0 | 77.2 |
| Ghana | 14% | 19% | 6.1 | 6.4 | 42.9 | 38.8 |
| Greece | 46% | 45% | 4.9 | 2.3 | 58.8 | 64.1 |
| Hong Kong | 60% | 56% | 6.0 | 4.0 | 75.8 | 47.7 |
| India | 19% | 24% | 7.3 | 7.4 | 47.4 | 55.9 |
| Ireland | 52% | 43% | 2.9 | 4.7 | 81.7 | 62.3 |
| Israel | 20% | 36% | 8.7 | 6.9 | 61.1 | 63.5 |
| Italy | 31% | 24% | 4.6 | 9.4 | 53.7 | 58.1 |
| Japan | 42% | 20% | 7.0 | 6.3 | 79.8 | 76.4 |
| Korea, Rep. | 27% | 32% | 8.1 | 6.0 | 69.3 | 59.4 |
| Kuwait | 46% | 36% | 4.2 | 4.9 | 56.1 | 58.3 |
| Macedonia | 27% | 36% | 6.7 | 4.9 | 48.2 | 55.1 |
| Malaysia | 44% | 46% | 6.9 | 5.9 | 77.4 | 63.4 |
| Mexico | 41% | 39% | 5.7 | 5.6 | 68.0 | 70.4 |
| Netherlands | 47% | 44% | 2.9 | 5.9 | 67.9 | 58.8 |
| Norway | 14% | 52% | 4.0 | 4.2 | 51.7 | 67.6 |
| Pakistan | 14% | 19% | 6.6 | 5.7 | 46.0 | 44.1 |
| Peru | 31% | 42% | 3.9 | 5.1 | 51.9 | 61.5 |
| Philippines | 34% | 34% | 7.2 | 5.3 | 52.8 | 56.6 |
| Poland | 47% | 46% | 4.2 | 4.3 | 66.9 | 65.2 |
| Romania | 47% | 25% | 2.0 | 7.1 | 60.0 | 63.8 |
| Russia | 34% | 31% | 6.0 | 5.2 | 64.9 | 58.1 |
| Saudi Arabia | 36% | 40% | 4.3 | 4.2 | 54.0 | 59.2 |
| Singapore | 60% | 61% | 7.3 | 3.2 | 60.2 | 55.2 |
| South Africa | 59% | 45% | 7.5 | 5.3 | 55.0 | 59.0 |
| Spain | 30% | 20% | 6.1 | 6.2 | 58.7 | 59.6 |
| Sweden | 49% | 61% | 2.4 | 6.2 | 74.0 | 60.7 |
| Switzerland | 34% | 49% | 4.8 | 3.7 | 65.6 | 69.4 |
| Taiwan | 37% | 51% | 7.7 | 5.8 | 58.0 | 57.6 |
| Turkey | 26% | 28% | 4.2 | 7.6 | 53.7 | 56.6 |
| UAE | 34% | 38% | 9.2 | 6.4 | 64.7 | 63.0 |
| United Kingdom | 48% | 73% | 2.8 | 2.4 | 71.2 | 68.4 |
| United States | 66% | 73% | 3.2 | 2.8 | 81.5 | 68.8 |
| **Average (Summer 2000)** | **40.0%** | **41.0%** | **5.0** | **5.4** | **65.2** | **61.4** |
| ***Average (Summer 1999)*** | ***58.0%*** | ***42.9%*** | ***3.4*** | ***4.7*** | ***75.6*** | ***60.0*** |

Source: Monnet UK Ltd., 2 Honey Lane, Cheapside, London EC2V 8BT, U.K.
Tel +44 20 7367 5350 • Fax +44 20 7367 5360 • Email: info@monnet.uk.com • http://www.monnet.uk.com

Many factors affect CQI scores, including basic infrastructure problems, packet loss in IP networks, the excessive use of compression, and switching calls between many service providers.

**Window on Industry Change**

For carriers that subscribe to quality testing services such as Monnet's, industry-wide benchmarks provide an essential tool for pinpointing those network links that are not up to par with the competition. Beyond the immediate commercial benefit to subscribers, benchmarks also identify wider industry trends, such as the predictable gap between call quality to developing and developed countries due largely to weaker telecom infrastructure.

Quality data vary not only by destination, but by the country of origination and time period studied, as well. For example, calls measured by Monnet during the June-August 1999 period from Germany scored markedly higher than those calls from the U.K. In the summer of 2000, however, averages of call quality statistics from the two countries were nearly identical. Possible explanations for this convergence point to wider implications for the industry:

- Mobile Traffic. When a call transits a mobile network, a number of characteristics appear that tend to drive down Call Quality Index scores—noise, echo, and delay (see Figure 1. Call Quality from Germany to Mobile and Fixed Line Telephones). The economics of sending calls to mobiles further complicate the metric; high interconnect fees to mobile networks induce terminating carriers in some countries to answer those incoming calls destined for mobile phones with a busy signal. This practice may partially explain the sliding German call quality discussed earlier, considering the high growth rate of traffic to mobile terminals from Germany.

- Rapidly expanding call volumes. Especially in newly opened markets such as Germany, emerging carriers sometimes attract more traffic than originally anticipated by network planners. Some network links simply cannot handle these unexpectedly heavy traffic loads, and the network upgrades necessary to accommodate such traffic volumes require investment over a long time period. In order to continue offering service while networks are overloaded, some carriers have resorted to "call gapping." Using this practice, a carrier accepts only a limited portion of total placed calls at any one time; individuals whose calls are blocked generally hear a recorded message stating that "all circuits are busy."

- Price/Quality Tradeoff. In Germany, call prices on some international routes have plummeted 90 percent in just two years, squeezing profit margins. In response, more service providers are willing to purchase minutes from wholesale carriers at mediocre quality—as long as they deliver at rock bottom prices. Many of these wholesale carriers operate in the gray market of international telecommunications, using alternative routing technologies such as Voice-over-Internet Protocol (VoIP) to evade costly PSTN settlement charges. While these mechanisms enable cost-cutting by carriers, they can also frustrate call quality guarantees.

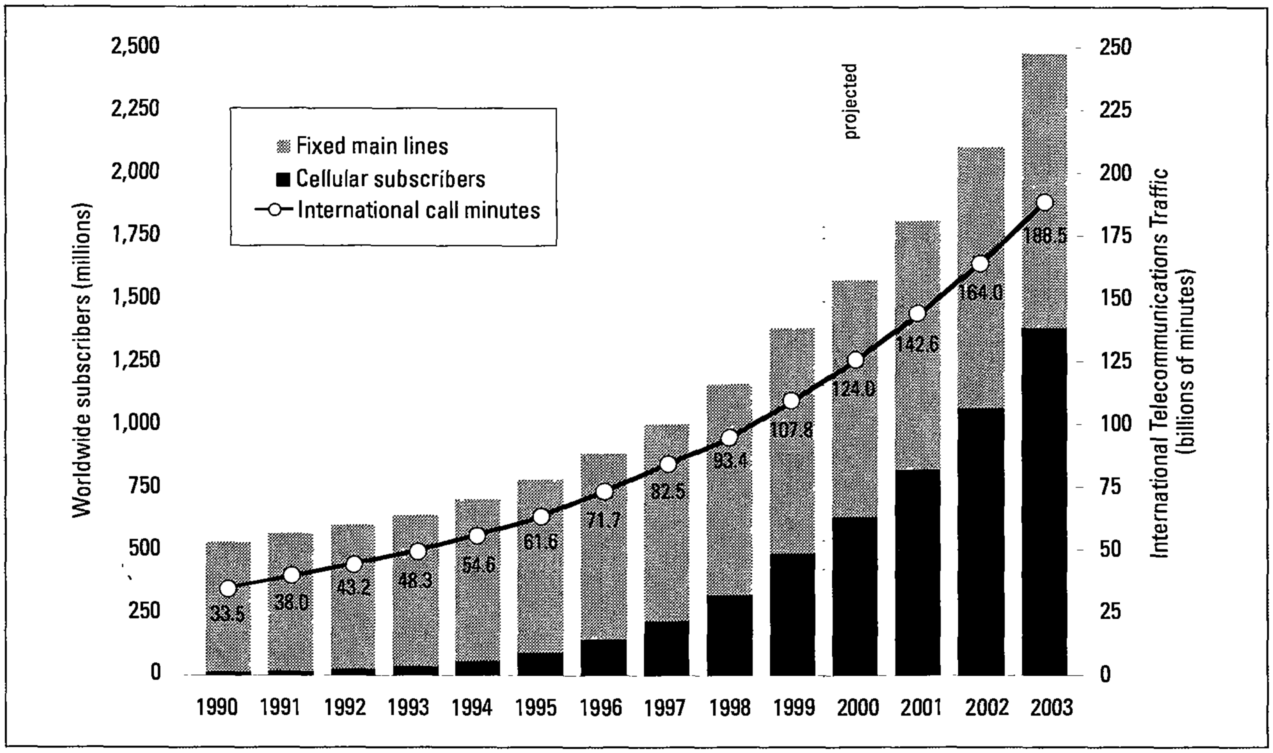
- Least Cost Routing. Overall, the correlations between Germany- and U.K.-originated call quality metrics were markedly higher in 2000 than in 1999. For example, CQI ratings from Germany and the U.K. tended to be more highly correlated in 2000 than in 1999 to various destinations (e.g., India and Kuwait). This convergence of U.K. and German call quality data suggests a greater reliance on least cost routing. Fueling this trend are the many fast-growing multinational carriers in Germany with a substantial presence in other major markets, such as the U.K. Often, these carriers switch calls through affiliate networks before sending them on to their final destinations. If, as seems likely, calls from Germany and the U.K. are carried increasingly over the same international links, it stands to reason that call quality levels for these two countries will converge.

Call quality metrics are a critical part of the movement toward a more robust standard of international service. First and foremost, specific call quality metrics enable carriers to monitor flow and to diagnose their networks for maintenance and upgrades. However, industry benchmarks also illuminate technological and regional trends that impact wider business development decisions.

# Traffic Summary

# Global Traffic Review

## Figure 1. International Traffic and Main Line Growth




Note: Data include outbound international traffic on public networks only. *Projections assume 15% traffic growth, 5% main line growth, and 30% mobile subscriber growth annually.* Source: ITU and TeleGeography research © TeleGeography, Inc. 2000

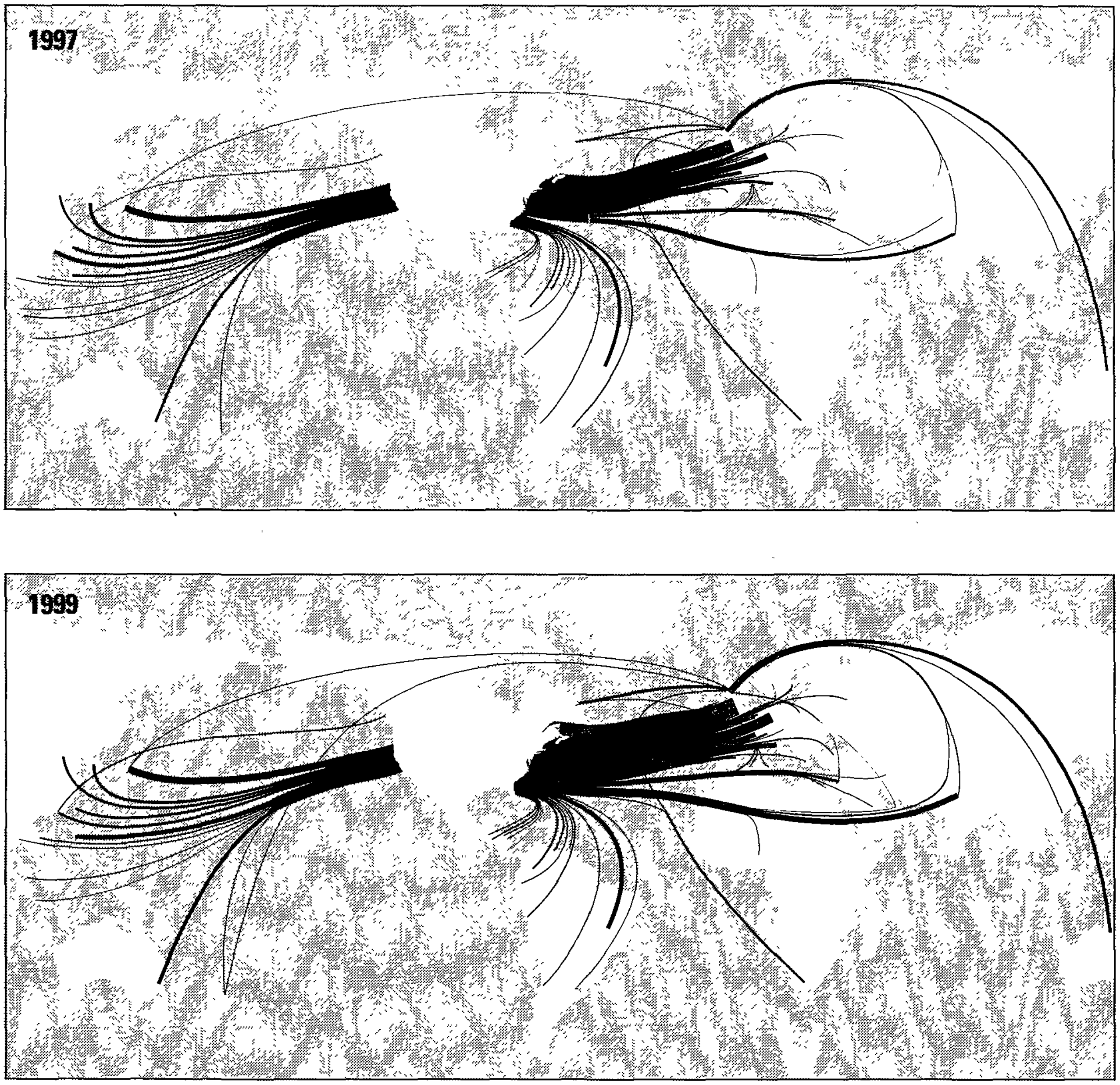
## Figure 2. International Traffic, Revenue, and Subscriber Growth

| | *Historical Trend* | | | *Slow Growth* | | *Same Growth* | | *Fast Growth* | |
|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **1995** | **1999** | **CAGR 1995-99** | **2003** | **CAGR 1999-2003** | **2003** | **CAGR 1999-2003** | **2003** | **CAGR 1999-2003** |
| Calls (bn) | 17.1 | 34.7 | 19.3% | 60.4 | 14.9% | 67.1 | 18.0% | 71.9 | 20.0% |
| Minutes (bn) | 61.6 | 107.5 | 14.9% | 169.2 | 12.0% | 188.0 | 15.0% | 201.4 | 17.0% |
| per main line subscriber | 89.0 | 119.4 | 7.6% | 151.7 | 6.2% | 163.9 | 8.2% | 170.8 | 9.3% |
| per main line plus mobile | 78.9 | 77.6 | -0.4% | 73.6 | -1.3% | 74.3 | -1.1% | 72.2 | -1.8% |
| Revenue (US$ bn) | 55.0 | 66.7 | 4.9% | 71.9 | 1.9% | 69.9 | 1.2% | 65.4 | -0.6% |
| **Assumptions** | | | | | | | | | |
| Call length (mins) | 3.6 | 3.1 | -3.7% | 2.8 | -2.5% | 2.8 | -2.5% | 2.8 | -2.5% |
| Price per minute (US$) | 0.90 | 0.62 | -8.9% | 0.43 | -9.0% | 0.37 | -12.0% | 0.32 | -15.0% |
| Main lines (m) | 691 | 900 | 6.8% | 1,115 | 5.5% | 1,147 | 6.3% | 1,180 | 7.0% |
| Mobile subscribers (m) | 89 | 485 | 52.8% | 1,184 | 25.0% | 1,385 | 30.0% | 1,611 | 35.0% |
| Total subscribers (m) | 781 | 1,385 | 15.4% | 2,299 | 13.5% | 2,532 | 16.3% | 2,791 | 19.1% |

Note: 1995-99 based on reported data. 2000-2003 based on ITU and TeleGeography forecasts. Scenarios are as follows:
1. Slow Growth: Traffic growth slows as minutes move off the public switched network (PSTN) and large markets mature.
2. Same Growth: Traffic growth continues at similar rate of last five years, assuming that faster rates of price-cutting keep traffic on the PSTN.
3. Fast Growth: Traffic growth increases, assuming a faster growth rate of network subscribers and faster rates of price-cutting, plus a significant component of new demand created by international traffic generated from mobiles

Source: ITU *World Telecommunication Indicators Database*, ITU estimates, and TeleGeography research © TeleGeography, Inc. 2000

**Figure 3. Intercontinental Traffic Flows, 1997 & 1999**




**Key** Traffic Flows

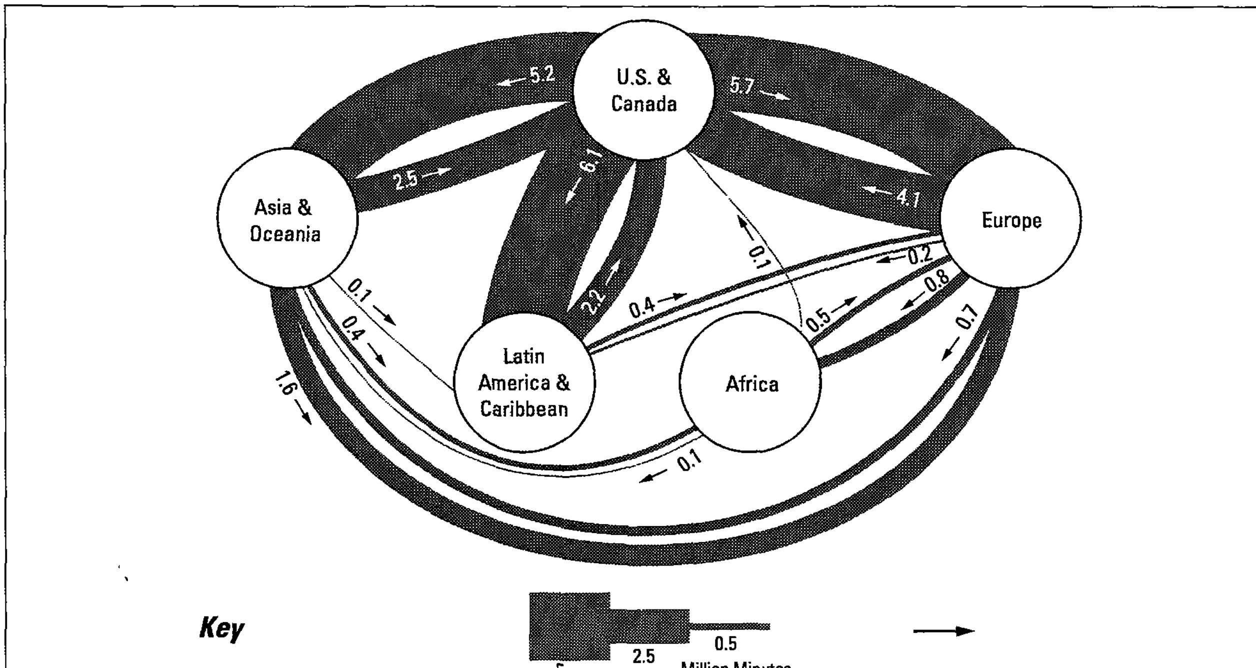
2,500 1,000 500 100
Million Minutes

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

These maps show all intercontinental routes with an annual volume of more than 100 million minutes. The total volume of these routes in 1999 was 26.6 billion minutes, approximately 25 percent of global international traffic.

# International Traffic by Region

## Figure 1. Interregional Traffic Flows, 1999



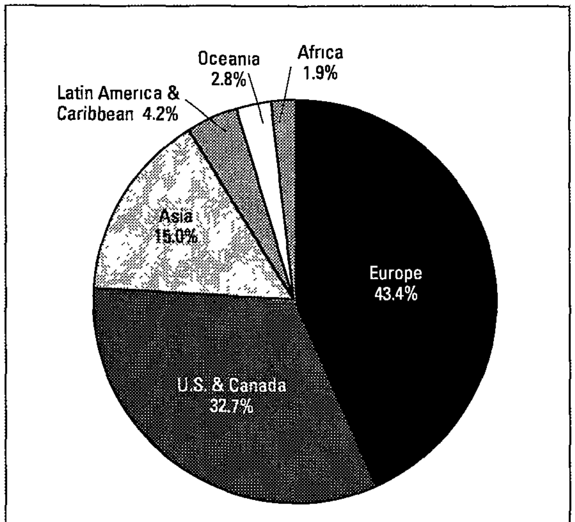

All figures are given in billions of minutes of telecommunications traffic for the public telephone network.

Each band is proportional to the total annual traffic from one region to another.

Arrows indicate direction of traffic between regions

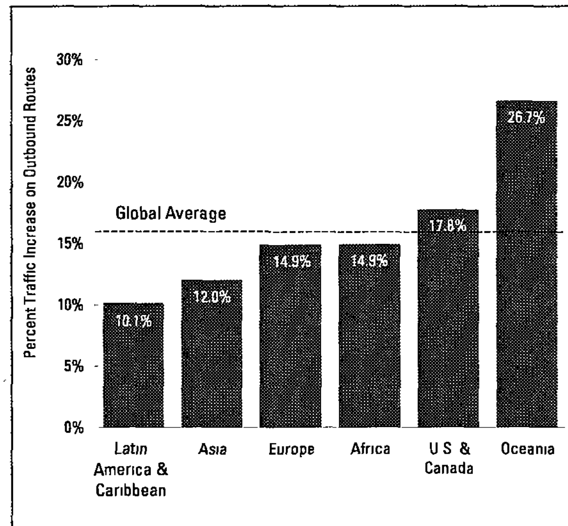
Note: These interregional traffic flows total 30.6 billion minutes. That sum does not equal global total of 107.8 billion minutes because (1) data set based on top 20 outgoing routes for 130 largest countries only; (2) traffic within regions account for a further 52.2 billion minutes based on data set; (3) interregional routes below 100 million minutes not shown. © TeleGeography, Inc. 2000

## Figure 2. International Traffic by Origin, 1999



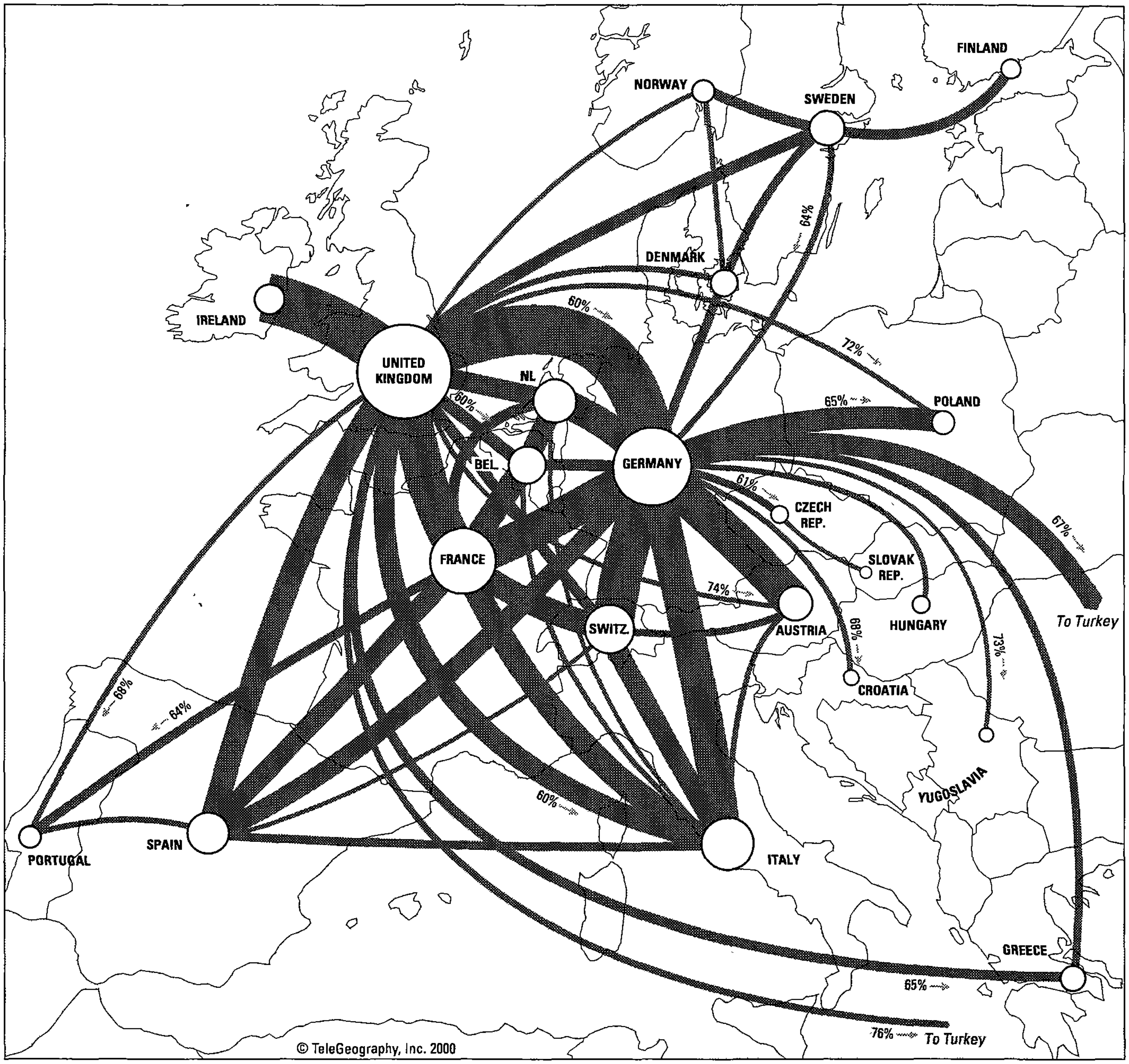

Note: Global traffic was 107.8 bn minutes in 1999. © TeleGeography, Inc. 2000

## Figure 3. Traffic Growth by Region, 1998-1999




Note: Global traffic was 107.8 bn minutes in 1999. © TeleGeography, Inc. 2000

## Figure 4. European Telecommunications Traffic Flows, 1999




### *Key*

All figures are given in millions of minutes of telecommunications traffic for the public telephone network.

The map shows all intra-European routes with a combined 1999 volume of more than 135 million minutes

**Traffic Flows**

600 400 200

Million Minutes

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

**Total Outgoing Traffic**

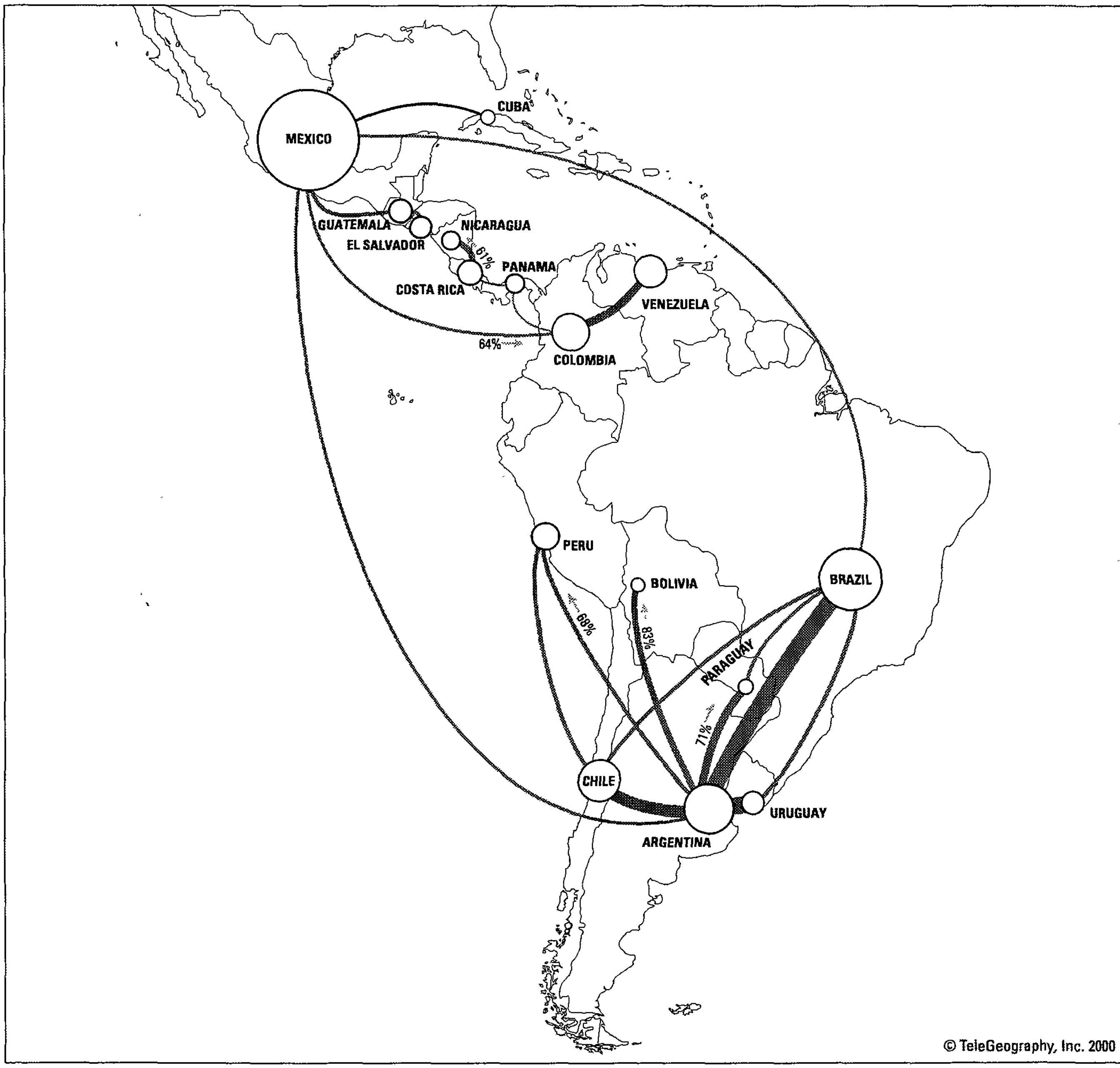
250
1,000
5,000
Million Minutes

The area of each circle is proportional to the volume of the total annual outgoing traffic from each country.

**Balance of Traffic**

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

## Figure 5. Latin American Telecommunications Traffic Flows, 1999




### *Key*

All figures are given in millions of minutes of telecommunications traffic for the public telephone network.

The map shows all routes within Latin America with a combined 1999 volume of more than 10 million minutes.

**Traffic Flows**

100 50 10

Million Minutes

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

**Total Outgoing Traffic**

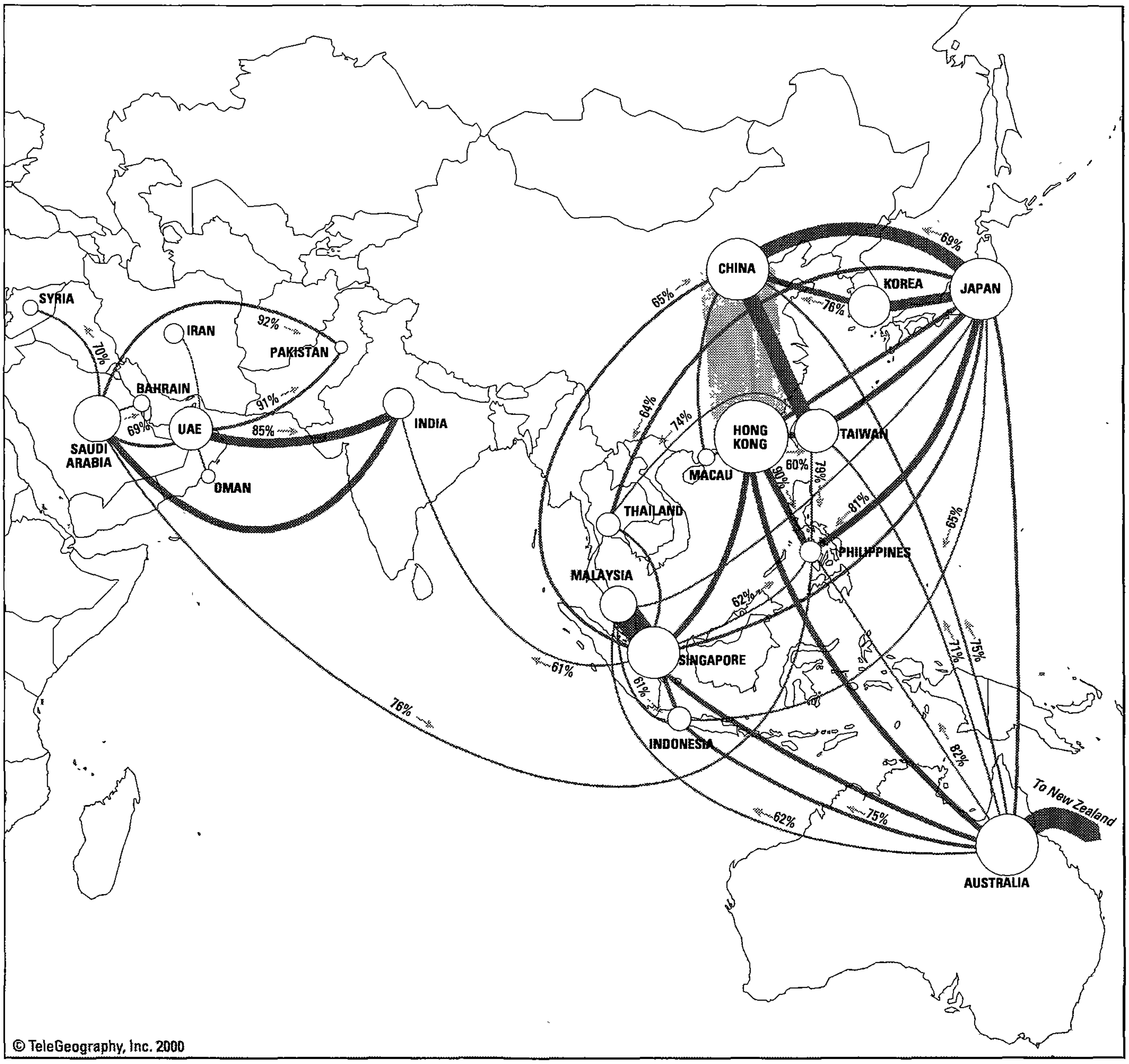
100
500
1,000
Million Minutes

The area of each circle is proportional to the volume of the total annual outgoing traffic from each country.

**Balance of Traffic**

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

## Figure 6. Asian Telecommunications Traffic Flows, 1999




### Key

All figures are given in millions of minutes of telecommunications traffic for the public telephone network.

The map shows all intra-Asian routes with a combined 1999 volume of more than 50 million minutes.

**Traffic Flows**

500 200 50
Million Minutes

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

**Total Outgoing Traffic**

100
500
1,500
Million Minutes

The area of each circle is proportional to the volume of the total annual outgoing traffic from each country.

**Balance of Traffic**

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

# International Traffic by Country

**Figure 1. Outgoing International Telephone Traffic Growth for Selected Countries, 1998-1999**

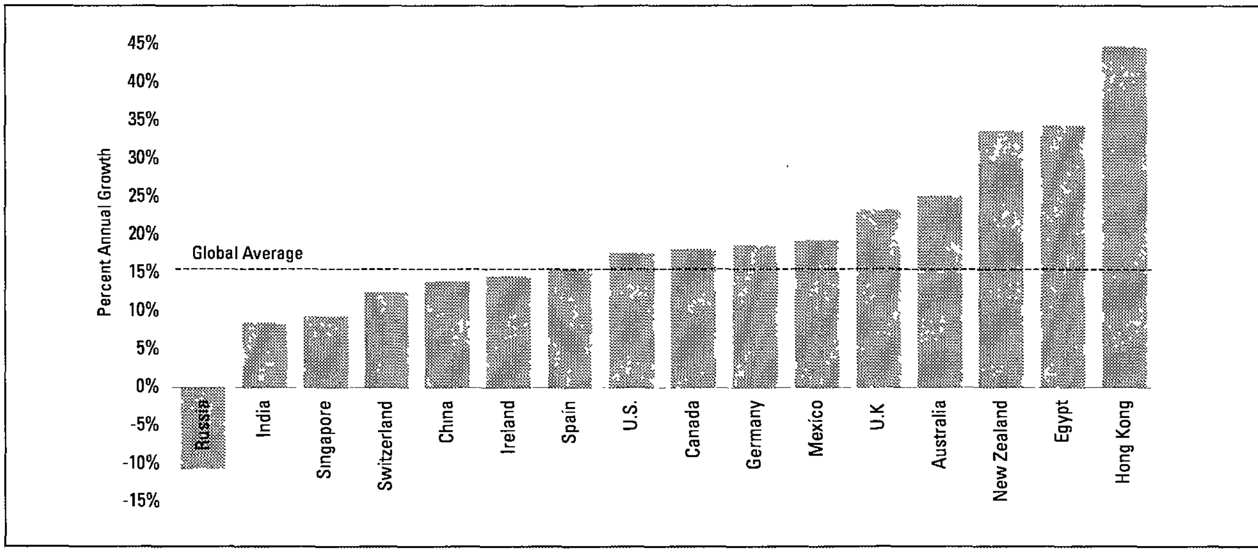
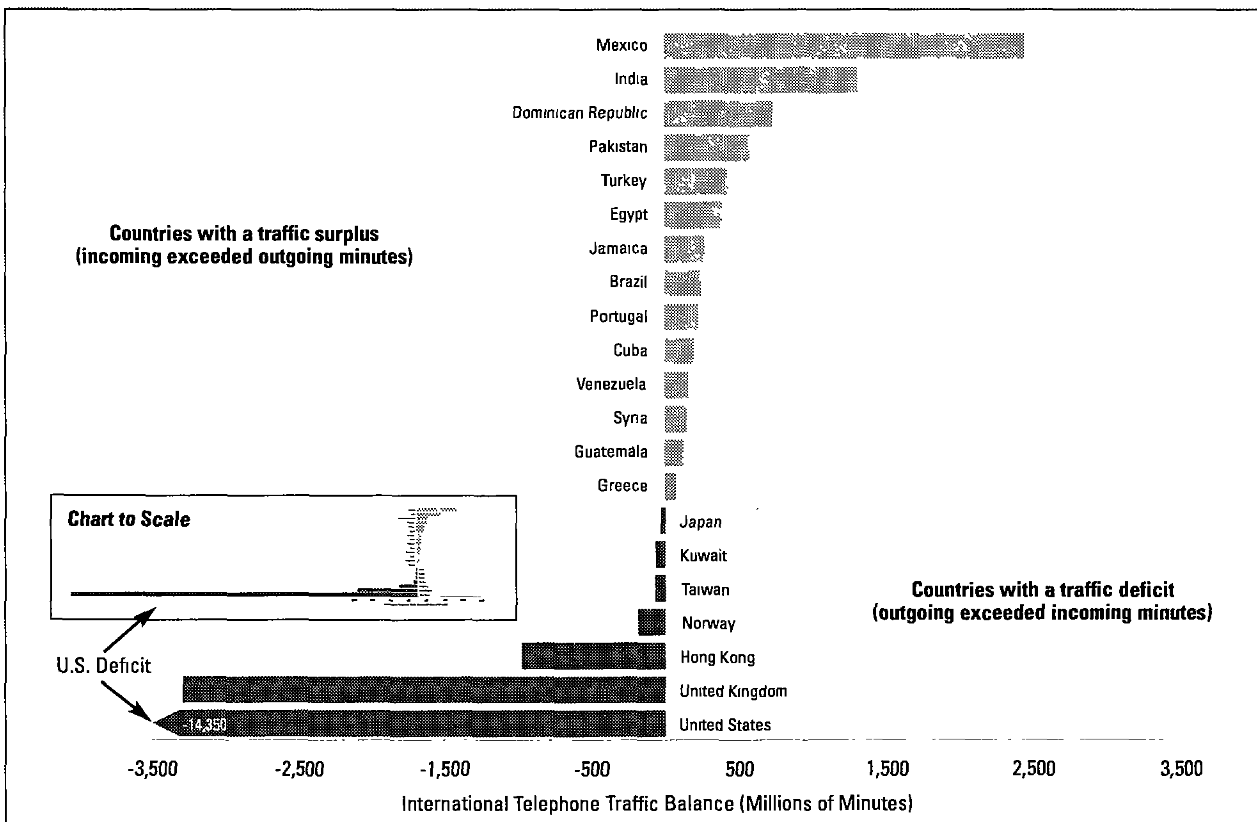





**Figure 2. Telephone Traffic Balances for Selected Countries, 1999**



## Figure 3. International Traffic Indicators, 1999

| | International Traffic | | | | | | |
|---|---|---|---|---|---|---|---|
| | Outgoing (m minutes) | Incoming (m minutes) | Balance (m minutes) | Population (m) | Minutes (Out) per Capita | Main Lines (thous.) | Minutes (Out) per Main Line |
| Albania (a) | 74.6 | 121.7 | 47.1 | 3.9 | 19.4 | 140 | 531.4 |
| Algeria (d) | 121.3 | n.a. | n.a. | 30.1 | 4.0 | 1,477 | 82.1 |
| Andorra | 53.2 | n.a. | n.a. | 0.1 | 708.3 | n.a. | 1,516.9 |
| Angola | 35.0 | 33.1 | -1.9 | 12.5 | 2.8 | 96 | 362.9 |
| Argentina | 377.6 | n.a. | n.a. | 36.6 | 10.3 | 7,357 | 51.3 |
| Armenia | 33.7 | 89.8 | 56.0 | 3.5 | 9.6 | 547 | 61.6 |
| Australia (b) | 2,115.0 | n.a. | n.a. | 18.9 | 111.8 | 9,857 | 214.6 |
| Austria (c) | 1,350.0 | n.a. | n.a. | 8.2 | 165.1 | 3,939 | 342.7 |
| Azerbaijan (a) | 32.2 | 68.6 | 36.4 | 7.7 | 4.2 | 730 | 44.1 |
| Bahamas (d) | 63.5 | 90.0 | 26.5 | 0.3 | 214.6 | 106 | 600.1 |
| Bahrain (a) | 134.1 | 106.5 | -27.5 | 0.7 | 201.6 | 165 | 810.8 |
| Bangladesh (d) | 41.8 | 196.2 | 154.4 | 124.8 | 0.3 | 378 | 110.5 |
| Belarus (a, c) | 161.2 | 195.6 | 34.4 | 10.3 | 15.7 | 2,683 | 60.1 |
| Belgium (a) | 1,590.0 | n.a. | n.a. | 10.2 | 156.6 | 5,100 | 311.8 |
| Bolivia | 29.7 | 82.2 | 52.5 | 8.1 | 3.6 | 502 | 59.1 |
| Bosnia-Herzegovina (c) | 97.2 | 200.5 | 103.3 | 3.8 | 25.3 | 368 | 264.2 |
| Brazil (a) | 574.8 | 838.5 | 263.7 | 168.0 | 3.4 | 24,985 | 23.0 |
| Brunei (c) | 18.8 | 21.7 | 2.9 | 0.3 | 58.3 | n.a. | 227.7 |
| Bulgaria | 98.9 | n.a. | n.a. | 8.3 | 11.9 | 2,833 | 34.9 |
| Canada (a) | 5,680.0 | n.a. | n.a. | 30.5 | 186.3 | 19,957 | 284.6 |
| Chile | 270.0 | n.a. | n.a. | 15.0 | 18.0 | 3,109 | 86.9 |
| China | 1,950.0 | n.a. | n.a. | 1,266.8 | 1.5 | 108,716 | 17.9 |
| Costa Rica (a) | 94.1 | 109.0 | 14.9 | 3.9 | 23.9 | 803 | 117.3 |
| Côte d'Ivoire (d) | 57.3 | 46.6 | -10.7 | 14.3 | 4.0 | 170 | 337.1 |
| Cuba | 32.6 | 225.3 | 192.7 | 11.2 | 2.9 | 434 | 75.1 |
| Cyprus (a, c) | 168.2 | 134.1 | -34.0 | 0.8 | 216.0 | 424 | 396.6 |
| Czech Republic (a) | 364.0 | 452.2 | 88.2 | 10.3 | 35.5 | 3,806 | 95.6 |
| Denmark (a) | 800.0 | n.a. | n.a. | 5.3 | 150.6 | 3,638 | 219.9 |
| Dominican Republic | 185.7 | 920.0 | 734.3 | 8.4 | 22.2 | n.a. | 229.3 |
| Egypt | 171.0 | 554.6 | 383.6 | 67.2 | 2.5 | 4,686 | 36.5 |
| El Salvador (c) | 47.0 | n.a. | n.a. | 6.2 | 7.6 | 468 | 100.4 |
| Estonia (a) | 74.6 | 84.8 | 10.2 | 1.4 | 51.6 | 510 | 146.3 |
| Finland (c) | 423.9 | n.a. | n.a. | 5.2 | 82.1 | 2,850 | 148.7 |
| France | 4,950.0 | n.a. | n.a. | 58.9 | 84.1 | 34,100 | 145.2 |
| Georgia (c) | 46.7 | 65.7 | 19.0 | 5.5 | 8.6 | 672 | 69.5 |
| Germany (a) | 6,965.0 | n.a. | n.a. | 82.2 | 84.8 | 48,300 | 144.2 |
| Ghana | 30.1 | 118.4 | 88.2 | 19.7 | 1.5 | 159 | 189.9 |
| Greece (c) | 725.7 | 794.2 | 68.5 | 10.6 | 68.3 | 5,611 | 129.3 |
| Guatemala | 83.3 | 208.6 | 125.3 | 11.1 | 7.5 | 605 | 137.7 |
| Guyana | 16.1 | 101.0 | 84.9 | 0.9 | 18.8 | 64 | 250.8 |
| Hong Kong (a, b) | 2,720.3 | 1,747.2 | -973.1 | 6.9 | 395.2 | 3,869 | 703.1 |
| Hungary (a) | 343.9 | n.a. | n.a. | 10.2 | 33.7 | 4,109 | 83.7 |
| India (a, b, c) | 473.3 | 1,772.5 | 1,299.2 | 998.1 | 0.5 | 26,511 | 17.9 |
| Indonesia (a, c) | 269.6 | n.a. | n.a. | 209.3 | 1.3 | 6,080 | 44.3 |
| Iran | 200.4 | 216.3 | 15.9 | 66.8 | 3.0 | 8,371 | 23.9 |
| Ireland (b) | 1,015.0 | n.a. | n.a. | 3.7 | 273.9 | 1,770 | 573.4 |
| Israel (a) | 804.0 | n.a. | n.a. | 6.1 | 131.8 | 2,800 | 287.1 |
| Italy | 3,100.0 | n.a. | n.a. | 57.3 | 54.1 | 26,502 | 117.0 |
| Jamaica (a) | 66.4 | 335.9 | 269.5 | 2.6 | 25.9 | 510 | 130.3 |
| Japan (b) | 1,956.6 | 1,929.6 | -27.0 | 126.5 | 15.5 | 62,490 | 31.3 |
| Jordan (a) | 132.5 | n.a. | n.a. | 6.5 | 20.4 | n.a. | 244.7 |
| Kazakhstan (c) | 104.5 | 149.8 | 45.3 | 16.3 | 6.4 | 1,760 | 59.4 |
| Korea, Rep. (c) | 898.0 | n.a. | n.a. | 46.5 | 19.3 | 20,518 | 43.8 |
| Kuwait | 170.0 | 120.0 | -50.0 | 1.9 | 89.6 | 456 | 373.2 |
| Kyrgyzstan (c) | 23.5 | n.a. | n.a. | 4.7 | 5.0 | 356 | 66.0 |

Notes: Data are in millions of minutes of public switched traffic

a. International minutes based on billing point of traffic.
b. International traffic for year ending 31 March, 2000. Australia, Mauritius, Pakistan ends 30 June.
c. Traffic data exclude some carriers or routes. (See country table for details.)
d. Data are for 1998.

## Figure 3. International Traffic Indicators, 1999 (continued)

| | International Traffic Outgoing (m minutes) | Incoming (m minutes) | Balance (m minutes) | Population (m) | Minutes (Out) per Capita | Main Lines (thous.) | Minutes (Out) per Main Line |
|---|---|---|---|---|---|---|---|
| Latvia (a) | 55.6 | 90.0 | 34.4 | 2.4 | 22.8 | 732 | 76.0 |
| Luxembourg | 319.1 | 277.5 | -41.5 | 0.4 | 743.4 | 311 | 1,026.3 |
| Macau (a) | 132.8 | 97.7 | -35.1 | 0.4 | 303.3 | 178 | 744.3 |
| Macedonia (c) | 82.3 | 152.5 | 70.3 | 2.0 | 40.9 | 471 | 174.7 |
| Malaysia (a, b) | 690.0 | n.a. | n.a. | 21.8 | 31.6 | 4,431 | 155.7 |
| Malta | 39.0 | 50.2 | 11.2 | 0.4 | 101.1 | 198 | 197.5 |
| Mauritius (b) | 31.4 | 43.3 | 11.9 | 1.1 | 27.3 | 257 | 122.2 |
| Mexico (a) | 1,563.0 | 4,007.5 | 2,444.5 | 97.4 | 16.1 | 10,927 | 143.0 |
| Moldova (a) | 49.0 | 101.1 | 52.1 | 4.4 | 11.2 | 555 | 88.2 |
| Morocco | 219.5 | n.a. | n.a. | 27.9 | 7.9 | 1,467 | 149.7 |
| Mozambique | 20.3 | 38.8 | 18.5 | 19.3 | 1.1 | 78 | 260.4 |
| Myanmar | 17.4 | 29.8 | 12.4 | 45.1 | 0.4 | 249 | 69.9 |
| Namibia | 61.2 | 51.2 | -10.0 | 1.7 | 36.1 | 108 | 565.7 |
| Netherlands | 2,150.0 | n.a. | n.a. | 15.8 | 135.7 | 9,610 | 223.7 |
| New Zealand (b) | 815.0 | n.a. | n.a. | 3.8 | 212.9 | 1,877 | 434.2 |
| Nicaragua (a) | 52.0 | 72.7 | 20.7 | 4.9 | 10.5 | 147 | 354.3 |
| Norway (a) | 567.0 | 386.9 | -180.1 | 4.4 | 127.5 | 3,165 | 179.1 |
| Oman (a, c) | 101.3 | 83.4 | -17.9 | 2.5 | 41.2 | 220 | 459.5 |
| Pakistan (b, c) | 75.1 | 644.9 | 569.8 | 134.5 | 0.6 | 2,986 | 25.2 |
| Palestinian Authority (c) | 34.9 | n.a. | n.a. | 3.1 | 11.3 | n.a. | n.a. |
| Panama (a) | 53.6 | 95.8 | 42.2 | 2.8 | 19.1 | 462 | 115.9 |
| Paraguay | 34.7 | 54.8 | 20.1 | 5.4 | 6.5 | 297 | 116.8 |
| Peru (a) | 88.9 | 302.6 | 213.7 | 25.2 | 3.5 | 1,689 | 52.7 |
| Philippines (a, b) | 218.0 | n.a. | n.a. | 74.5 | 2.9 | 2,940 | 74.1 |
| Poland (a) | 624.0 | n.a. | n.a. | 38.7 | 16.1 | 10,068 | 62.0 |
| Portugal (c) | 532.8 | 753.3 | 220.5 | 10.0 | 53.4 | 4,230 | 126.0 |
| Qatar | 128.5 | 84.0 | -44.5 | 0.6 | 218.1 | 155 | 829.5 |
| Russia (c) | 928.2 | 929.3 | 1.1 | 147.2 | 6.3 | 30,388 | 30.5 |
| Saudi Arabia | 1,060.0 | n.a. | n.a. | 20.9 | 50.7 | n.a. | 347.4 |
| Senegal | 36.5 | 111.1 | 74.7 | 9.2 | 3.9 | 166 | 219.9 |
| Singapore (a, b) | 1,350.0 | n.a. | n.a. | 3.2 | 418.6 | 1,861 | 725.6 |
| Slovak Republic (a) | 162.8 | 208.7 | 45.9 | 5.4 | 30.3 | 1,655 | 98.4 |
| Slovenia (d) | 129.6 | 137.0 | 7.4 | 2.0 | 65.0 | 757 | 171.2 |
| South Africa | 461.1 | n.a. | n.a. | 39.9 | 11.6 | 5,493 | 83.9 |
| Spain (a) | 1,935.0 | n.a. | n.a. | 39.4 | 49.1 | 16,480 | 117.4 |
| Sri Lanka | 45.5 | n.a. | n.a. | 18.6 | 2.4 | 679 | 66.9 |
| Sudan (c) | 21.9 | 105.3 | 83.3 | 28.9 | 0.8 | 251 | 87.3 |
| Swaziland (b) | 29.3 | n.a. | n.a. | 1.0 | 29.9 | 31 | 959.8 |
| Sweden (a) | 1,365.0 | n.a. | n.a. | 8.9 | 154.0 | 5,889 | 231.8 |
| Switzerland | 2,730.0 | n.a. | n.a. | 7.1 | 382.1 | 4,992 | 546.9 |
| Syria (a) | 125.6 | 256.7 | 131.1 | 15.7 | 8.0 | 1,600 | 78.5 |
| Taiwan (a) | 949.3 | 882.0 | -67.3 | 22.1 | 42.9 | 12,044 | 78.8 |
| Thailand (a, c) | 298.7 | 327.8 | 29.1 | 60.9 | 4.9 | 5,216 | 57.3 |
| Trinidad & Tobago (a, b) | 67.2 | 158.8 | 91.6 | 1.3 | 52.2 | 276 | 243.9 |
| Turkey (c) | 698.4 | 1,122.7 | 424.3 | 68.2 | 10.2 | 18,054 | 38.7 |
| Turkmenistan (c) | 16.5 | n.a. | n.a. | 4.4 | 3.8 | 359 | 46.0 |
| Ukraine | 359.2 | n.a. | n.a. | 50.7 | 7.1 | 10,074 | 35.7 |
| United Arab Emirates | 963.0 | n.a. | n.a. | 2.4 | 401.6 | 975 | 987.5 |
| United Kingdom (a, b) | 10,141.0 | 6,853.4 | -3,287.6 | 58.7 | 172.6 | 33,750 | 300.5 |
| United States (a) | 29,608.8 | 10,640.8 | -18,968.0 | 276.2 | 107.2 | 188,331 | 157.2 |
| Uruguay | 80.1 | 98.3 | 18.2 | 3.3 | 24.2 | 897 | 89.3 |
| Uzbekistan (a) | 68.5 | 75.0 | 6.6 | 23.9 | 2.9 | 1,599 | 42.8 |
| Venezuela (a) | 160.2 | 315.3 | 155.2 | 23.7 | 6.8 | 2,586 | 61.9 |
| Yugoslavia (a) | 227.0 | 498.8 | 271.7 | 10.6 | 21.3 | 2,281 | 99.5 |
| Zimbabwe (b) | 65.6 | 59.0 | -6.6 | 11.5 | 5.7 | 239 | 274.5 |

Notes: Data are in millions of minutes of public switched traffic.
a International minutes based on billing point of traffic.
b. International traffic for year ending 31 March, 2000. Australia, Mauritius, and Pakistan ends 30 June
c. Traffic data exclude some carriers or routes. (See country table for details.)
d. Data are for 1998.

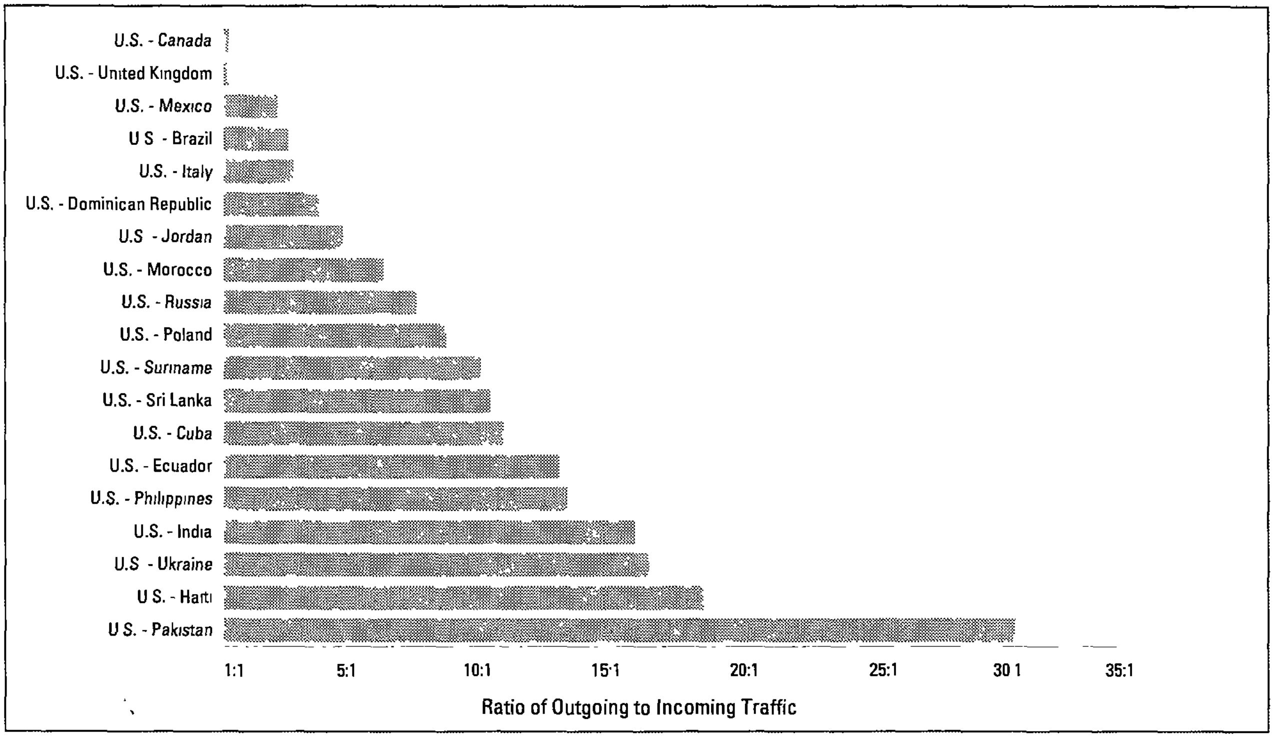
# International Traffic by Route

## Figure 1. The Top 50 International Routes, 1999

| | Countries | Minutes Each Way | Total Minutes |
|---|---|---|---|
| 1. | U.S. - Canada | 4,491.3 — 3,925.0 | 8,416.3 |
| 2. | U.S. - Mexico | 4,084.3 — 1,364.6 | 5,449.0 |
| 3. | U.S. - U.K. | 1,909.6 — 1,610.9 | 3,520.5 |
| 4. | Hong Kong - China | 1,263.7 — 1,020.0 | 2,283.7 |
| 5. | U.S. - Germany | 1,525.3 — 455.0 | 1,980.3 |
| 6. | U.K. - Germany | 913.3 — 605.0 | 1,518.3 |
| 7. | U.K. - Ireland | 809.3 — 700.0 | 1,509.3 |
| 8. | U.S. - Japan | 874.2 — 406.4 | 1,280.6 |
| 9. | Germany - Switzerland | 650.0 — 620.0 | 1,270.0 |
| 10. | U.K. - France | 655.8 — 555.0 | 1,210.8 |
| 11. | Austria - Germany | 625.0 — 555.0 | 1,180.0 |
| 12. | France - Germany | 565.0 — 540.0 | 1,105.0 |
| 13. | U.S. - India | 996.4 — 59.9 | 1,056.4 |
| 14. | Germany - Italy | 590.0 — 465.0 | 1,055.0 |
| 15. | U.S. - Italy | 772.0 — 210.0 | 982.0 |
| 16. | U.S. - France | 626.3 — 350.0 | 976.3 |
| 17. | Netherlands - Germany | 450.0 — 440.0 | 890.0 |
| 18. | U.S. - Philippines | 773.4 — 55.0 | 828.4 |
| 19. | Singapore - Malaysia | 465.0 — 350.0 | 815.0 |
| 20. | U.S. - Brazil | 623.5 — 183.6 | 807.1 |
| 21. | France - Italy | 400.0 — 370.0 | 770.0 |
| 22. | U.S. - Dominican Republic | 626.8 — 137.1 | 763.9 |
| 23. | Switzerland - France | 420.0 — 330.0 | 750.0 |
| 24. | France - Belgium | 405.0 — 345.0 | 750.0 |
| 25. | U.K. - Spain | 435.2 — 300.0 | 735.2 |
| 26. | U.S. - Australia | 420.5 — 300.0 | 720.5 |
| 27. | Germany - Poland | 445.0 — 240.0 | 685.0 |
| 28. | Netherlands - Belgium | 340.0 — 325.0 | 665.0 |
| 29. | U.K. - Italy | 396.6 — 260.0 | 656.6 |
| 30. | U.K. - Australia | 325.6 — 325.0 | 650.6 |
| 31. | New Zealand - Australia | 365.0 — 280.0 | 645.0 |
| 32. | Switzerland - Italy | 370.0 — 270.0 | 640.0 |
| 33. | Germany - Turkey | 420.0 — 204.9 | 624.9 |
| 34. | France - Spain | 315.0 — 300.0 | 615.0 |
| 35. | Spain - Germany | 320.0 — 280.0 | 600.0 |
| 36. | U.K. - Netherlands | 348.1 — 250.0 | 598.1 |
| 37. | U.S. - Israel | 362.6 — 200.0 | 562.6 |
| 38. | U.S. - Korea, Rep. | 351.4 — 210.0 | 561.4 |
| 39. | Canada - U.K. | 295.0 — 247.9 | 542.9 |
| 40. | U.S. - Taiwan | 333.4 — 162.0 | 495.5 |
| 41. | Taiwan - China | 286.9 — 205.0 | 491.9 |
| 42. | U.S. - Hong Kong | 242.1 — 240.3 | 482.4 |
| 43. | Russia - Ukraine | 264.1 — 215.4 | 479.5 |
| 44. | U.S. - China | 416.0 — 50.0 | 466.0 |
| 45. | U.S. - Netherlands | 284.3 — 135.0 | 419.3 |
| 46. | U.S. - Spain | 325.2 — 90.0 | 415.2 |
| 47. | Japan - China | 285.1 — 130.0 | 415.1 |
| 48. | U.S. - Jamaica | 364.3 — 44.5 | 408.8 |
| 49. | U.K. - Belgium | 234.6 — 155.0 | 389.6 |
| 50. | Sweden - U.K. | 200.0 — 186.3 | 386.3 |

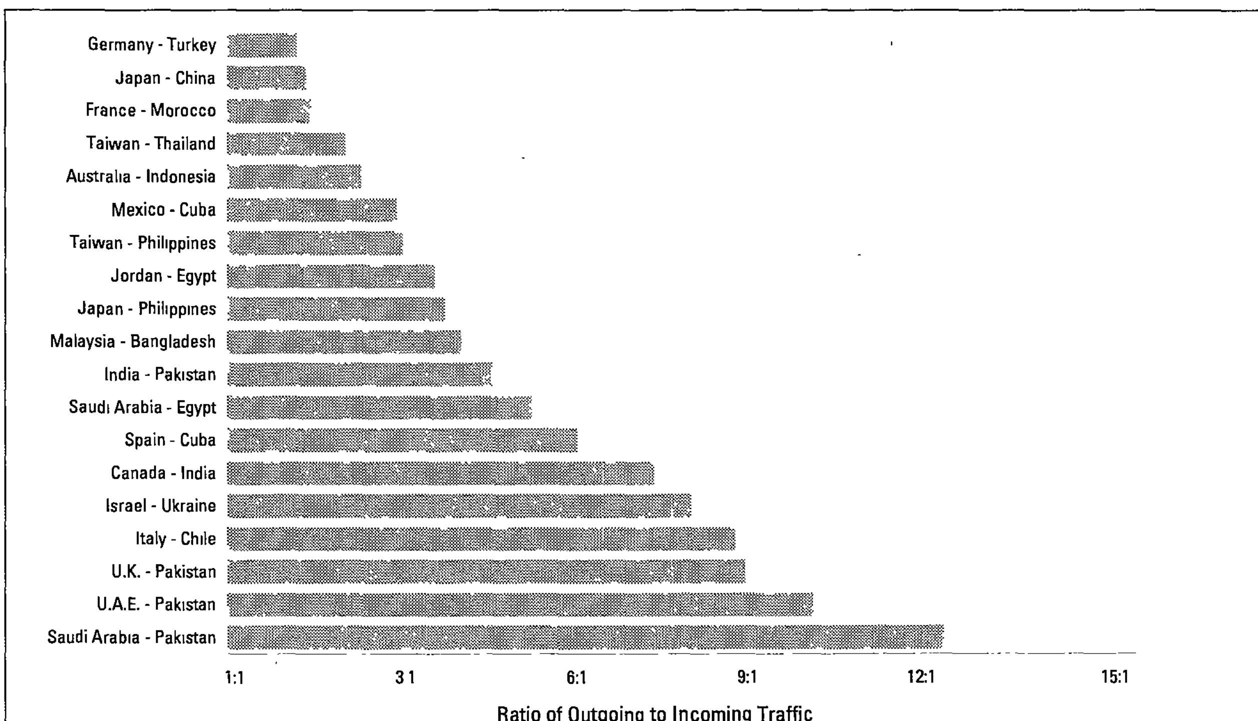
Note: All data in millions of minutes of telecommunications traffic The country which generates more traffic on each route is listed first. The routes listed above total 55.5 billion minutes, equal to 51 percent of all international traffic. Data for Australia, Hong Kong, Ireland, Japan, Malaysia, New Zealand, Singapore, and the U.K. are for fiscal year 1999/2000

**Figure 2. Traffic Imbalances on Selected U.S. Routes, 1999**



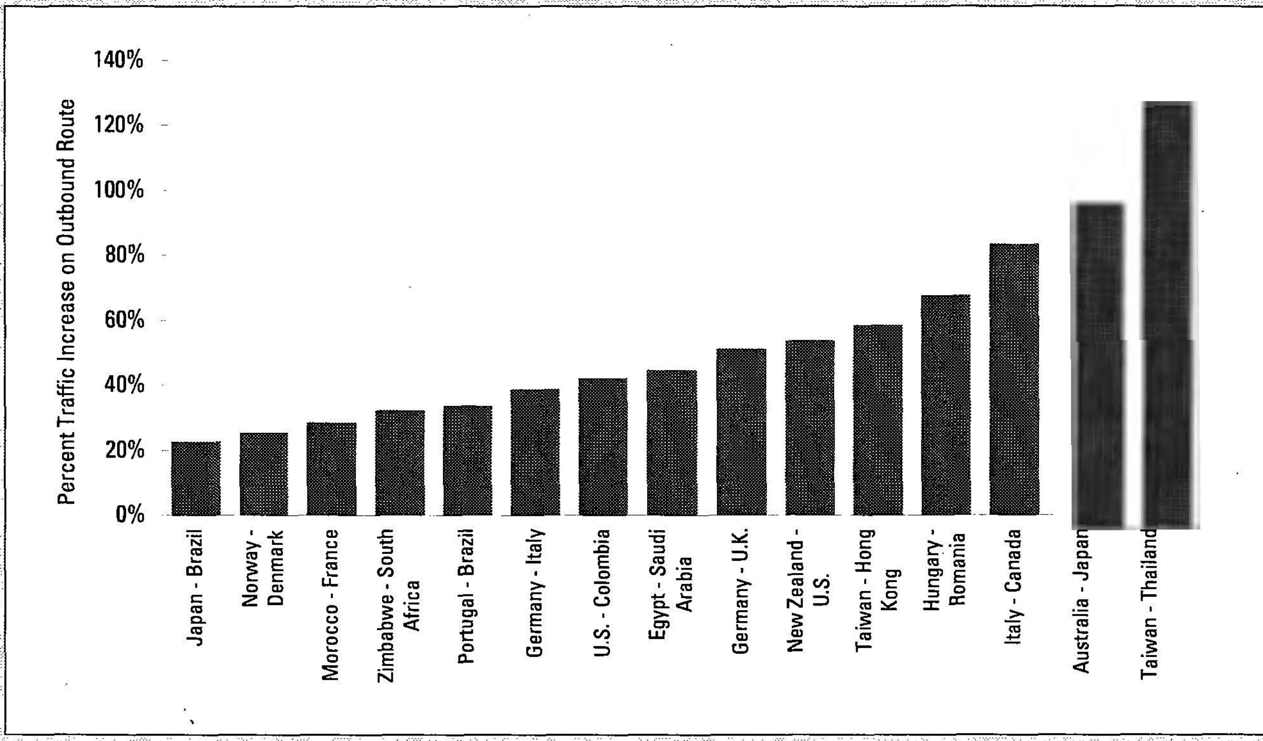

Note: Country with traffic deficit on route listed first. A ratio of 1:1 would indicate a perfect balance on a route. U.S. data based on billing point of call, and may not reflect actual call ratios due to refile and call-back. © TeleGeography, Inc. 2000

**Figure 3. Traffic Imbalances on Selected Non-U.S. Routes, 1999**




Note: Country with traffic deficit on route listed first. A ratio of 1:1 would indicate a perfect balance on a route. Data for some countries based on billing point of call, and may not reflect actual call ratios due to refile and call-back. © TeleGeography, Inc. 2000

**Figure 4. International Outbound Routes with Rapidly Growing Traffic, 1998-1999**




Note: Country originating traffic listed first; country terminating traffic listed second. Some data based on billing point of call, and may not reflect actual route growth rates due to refile and call-back.

# International Traffic Statistics

# Albania

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Italy | 26.8 | 35.9% |
| 2. Greece | 24.9 | 33.3% |
| 3. Germany | 4.4 | 5.9% |
| 4. United Kingdom | 2.5 | 3.4% |
| 5. United States | 2.4 | 3.2% |
| 6. Switzerland | 1.8 | 2.5% |
| 7. Yugoslavia | 1.6 | 2.2% |
| 8. Turkey | 1.2 | 1.6% |
| 9. France | 1.2 | 1.6% |
| 10. Macedonia | 1.1 | 1.5% |
| 11. Belgium | 1.1 | 1.5% |
| 12. Austria | 0.6 | 0.8% |
| 13. Netherlands | 0.5 | 0.7% |
| 14. Canada | 0.4 | 0.5% |
| 15. Spain | 0.3 | 0.4% |
| 16. Croatia | 0.3 | 0.4% |
| 17. Bulgaria | 0.3 | 0.4% |
| 18. Romania | 0.2 | 0.3% |
| 19. Hungary | 0.2 | 0.3% |
| 20. Denmark | 0.2 | 0.3% |
| Other | 1.3 | 1.7% |
| **Total** | **74.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 93.6 | 121.7 |
| Outgoing | 40.8 | 49.2 | 74.6 |
| Surplus (Deficit) | n.a. | 44.4 | 47.1 |
| Total Volume | n.a. | 142.8 | 196.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Algeria

## Largest Telecommunications Routes, 1998

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 62.0 | 51.1% |
| 2. | United Kingdom | 7.9 | 6.5% |
| 3. | Italy | 5.5 | 4.5% |
| 4. | Morocco | 5.1 | 4.2% |
| 5. | Spain | 4.7 | 3.9% |
| 6. | Germany | 4.0 | 3.3% |
| 7. | Canada | 3.9 | 3.2% |
| 8. | United States | 3.4 | 2.8% |
| 9. | Belgium | 3.3 | 2.7% |
| 10. | Switzerland | 2.5 | 2.1% |
| 11. | United Arab Emirates | 1.9 | 1.6% |
| 12. | Saudi Arabia | 1.7 | 1.4% |
| 13. | Syria | 1.3 | 1.1% |
| 14. | Egypt | 1.2 | 1.0% |
| 15. | Lebanon | 1.1 | 0.9% |
| 16. | Netherlands | 1.1 | 0.9% |
| 17. | Sweden | 0.4 | 0.3% |
| 18. | Greece | 0.2 | 0.2% |
| 19. | Denmark | 0.2 | 0.2% |
| 20. | Australia | 0.1 | 0.1% |
| | Other | 9.8 | 8.1% |
| | **Total** | **121.3** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | n.a. | 121.3 | n.a. |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** *Data are in millions of minutes of outgoing public switched telecommunications traffic.* 1999 traffic data are not available. Data exclude cross-border traffic to Tunisia.

# Andorra

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Spain | 37.0 | 69.5% |
| 2. France | 9.0 | 16.9% |
| 3. Portugal | 2.5 | 4.7% |
| 4. United Kingdom | 1.1 | 2.1% |
| 5. Belgium | 0.3 | 0.6% |
| 6. Germany | 0.3 | 0.6% |
| 7. Denmark | 0.2 | 0.4% |
| 8. Italy | 0.2 | 0.4% |
| 9. Netherlands | 0.2 | 0.4% |
| 10. Switzerland | 0.2 | 0.4% |
| 11. United States | 0.2 | 0.4% |
| Other | 2.0 | 3.8% |
| **Total** | **53.2** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 30.1 | 32.2 | n.a. |
| Outgoing | 42.2 | 47.4 | 53.2 |
| Surplus (Deficit) | (12.1) | (15.2) | n.a. |
| Total Volume | 72.3 | 79.6 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Angola

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Portugal | 14.4 | 41.1% |
| 2. South Africa | 5.1 | 14.5% |
| 3. France | 1.6 | 4.6% |
| 4. United Kingdom | 1.4 | 4.0% |
| 5. United States | 1.3 | 3.6% |
| 6. Namibia | 1.0 | 3.0% |
| 7. Brazil | 1.0 | 2.9% |
| 8. Germany | 0.7 | 2.0% |
| 9. Belgium | 0.6 | 1.7% |
| 10. Gambia | 0.6 | 1.6% |
| 11. Netherlands | 0.5 | 1.3% |
| 12. Spain | 0.4 | 1.2% |
| 13. Zimbabwe | 0.4 | 1.1% |
| 14. Switzerland | 0.4 | 1.0% |
| 15. Guinea | 0.3 | 1.0% |
| 16. Mali | 0.3 | 0.9% |
| 17. Italy | 0.3 | 0.9% |
| 18. Congo, Dem. Rep. | 0.3 | 0.8% |
| 19. Nigeria | 0.2 | 0.6% |
| 20. Russia | 0.2 | 0.6% |
| Other | 4.0 | 11.6% |
| **Total** | **35.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 18.8 | 22.3 | 33.1 |
| Outgoing | 21.9 | 27.3 | 35.0 |
| Surplus (Deficit) | (3.1) | (5.0) | (1.9) |
| Total Volume | 40.7 | 49.6 | 68.0 |

**Note:** *Data are in millions of minutes of outgoing public switched telecommunications traffic.*

# Argentina

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 70.8 | 18.8% |
| 2. Uruguay | 46.0 | 12.2% |
| 3. Brazil | 43.6 | 11.5% |
| 4. Chile | 32.2 | 8.5% |
| 5. Paraguay | 28.9 | 7.7% |
| 6. Bolivia | 25.6 | 6.8% |
| 7. Spain | 25.3 | 6.7% |
| 8. Italy | 17.2 | 4.6% |
| 9. Peru | 14.7 | 3.9% |
| 10. Mexico | 8.0 | 2.1% |
| 11. France | 7.9 | 2.1% |
| 12. Germany | 6.3 | 1.7% |
| 13. United Kingdom | 5.8 | 1.5% |
| 14. Colombia | 4.2 | 1.1% |
| 15. Venezuela | 4.0 | 1.1% |
| 16. Canada | 3.9 | 1.0% |
| 17. Switzerland | 2.3 | 0.6% |
| 18. China | 1.9 | 0.5% |
| 19. Dominican Republic | 1.2 | 0.3% |
| 20. Cuba | 1.1 | 0.3% |
| Other | 26.7 | 7.1% |
| **Total** | **377.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 444.2 | n.a. | n.a. |
| Outgoing | 223.4 | 358.7 | 377.6 |
| Surplus (Deficit) | 220.8 | n.a. | n.a. |
| Total Volume | 667.6 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Armenia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 24.1 | 71.3% |
| 2. | Ukraine | 2.3 | 6.8% |
| 3. | Georgia | 1.5 | 4.4% |
| 4. | United States | 1.1 | 3.3% |
| 5. | Belarus | 0.4 | 1.1% |
| 6. | Germany | 0.4 | 1.1% |
| 7. | Greece | 0.4 | 1.0% |
| 8. | France | 0.3 | 1.0% |
| 9. | Kazakhstan | 0.3 | 0.9% |
| 10. | Iran | 0.2 | 0.6% |
| 11. | United Kingdom | 0.2 | 0.5% |
| 12. | Uzbekistan | 0.2 | 0.5% |
| 13. | Turkey | 0.2 | 0.5% |
| 14. | United Arab Emirates | 0.2 | 0.5% |
| 15. | Turkmenistan | 0.1 | 0.4% |
| 16. | Netherlands | 0.1 | 0.4% |
| 17. | Bulgaria | 0.1 | 0.3% |
| 18. | Belgium | 0.1 | 0.3% |
| 19. | Italy | 0.1 | 0.3% |
| 20. | Poland | 0.1 | 0.3% |
| | Other | 1.5 | 4.5% |
| | **Total** | **33.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 94.0 | 89.8 |
| Outgoing | 48.8 | 56.6 | 33.7 |
| Surplus (Deficit) | n.a. | 37.4 | 56.0 |
| Total Volume | n.a. | 150.7 | 123.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Australia

## Largest Telecommunications Routes, FY 1999/00

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United Kingdom | 325.0 | 15.4% |
| 2. | United States | 300.0 | 14.2% |
| 3. | New Zealand | 280.0 | 13.2% |
| 4. | Japan | 90.0 | 4.3% |
| 5. | Singapore | 90.0 | 4.3% |
| 6. | Indonesia | 85.0 | 4.0% |
| 7. | Hong Kong | 75.0 | 3.5% |
| 8. | China | 55.0 | 2.6% |
| 9. | Canada | 45.0 | 2.1% |
| 10. | Philippines | 45.0 | 2.1% |
| 11. | Taiwan | 45.0 | 2.1% |
| 12. | Germany | 40.0 | 1.9% |
| 13. | Malaysia | 40.0 | 1.9% |
| 14. | Argentina | 40.0 | 1.9% |
| | Other | 560.0 | 26.5% |
| | **Total** | **2,115.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 1,250.0 | n.a. | n.a. |
| Outgoing | 1,510.0 | 1,690.0 | 2,115.0 |
| Surplus (Deficit) | (260.0) | n.a. | n.a. |
| Total Volume | 2,760.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Fiscal year ends 30 June.

# Austria

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 625.0 | 46.3% |
| 2. Italy | 80.0 | 5.9% |
| 3. Yugoslavia | 60.0 | 4.4% |
| 4. Hungary | 53.0 | 3.9% |
| 5. United Kingdom | 40.0 | 3.0% |
| 6. Poland | 36.0 | 2.7% |
| 7. Netherlands | 34.0 | 2.5% |
| 8. Turkey | 34.0 | 2.5% |
| 9. Croatia | 32.0 | 2.4% |
| 10. United States | 31.0 | 2.3% |
| 11. France | 30.0 | 2.2% |
| 12. Czech Republic | 30.0 | 2.2% |
| 13. Slovak Republic | 20.0 | 1.5% |
| 14. Romania | 19.0 | 1.4% |
| 15. Slovenia | 19.0 | 1.4% |
| *Other* | *207.0* | *15.3%* |
| **Total** | **1,350.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 957.7 | n.a. | n.a. |
| Outgoing | 995.5 | 1,160.0 | 1,350.0 |
| Surplus (Deficit) | (37.8) | n.a. | n.a. |
| Total Volume | 1,953.2 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Traffic figures exclude most cross-border traffic to Switzerland

# Azerbaijan

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 17.3 | 53.7% |
| 2. | Turkey | 3.1 | 9.6% |
| 3. | Ukraine | 1.8 | 5.6% |
| 4. | Georgia | 1.3 | 4.0% |
| 5. | Iran | 0.9 | 2.8% |
| 6. | United Kingdom | 0.8 | 2.5% |
| 7. | Kazakhstan | 0.8 | 2.5% |
| 8. | United States | 0.6 | 1.9% |
| 9. | Germany | 0.5 | 1.6% |
| 10. | United Arab Emirates | 0.5 | 1.6% |
| 11. | Belarus | 0.4 | 1.2% |
| 12. | Uzbekistan | 0.4 | 1.2% |
| 13. | Turkmenistan | 0.3 | 0.9% |
| 14. | France | 0.2 | 0.6% |
| 15. | Switzerland | 0.1 | 0.3% |
| 16. | Italy | 0.1 | 0.3% |
| 17. | Moldova | 0.1 | 0.3% |
| 18. | Netherlands | 0.1 | 0.3% |
| 19. | Norway | 0.1 | 0.3% |
| 20. | Poland | 0.1 | 0.3% |
| | Other | 2.7 | 8.1% |
| | **Total** | **32.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 46.0 | 68.6 |
| Outgoing | n.a. | 42.9 | 32.2 |
| Surplus (Deficit) | n.a. | 3.2 | 36.4 |
| Total Volume | n.a. | 88.9 | 100.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Bahamas

## Largest Telecommunications Routes, 1998

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 49.8 | 78.3% |
| 2. Canada | 3.5 | 5.5% |
| 3. Jamaica | 1.5 | 2.3% |
| 4. United Kingdom | 1.4 | 2.2% |
| 5. Switzerland | 0.6 | 0.9% |
| 6. Haiti | 0.4 | 0.6% |
| 7. Turks & Caicos Islands | 0.4 | 0.6% |
| 8. Mexico | 0.4 | 0.6% |
| 9. France | 0.4 | 0.6% |
| 10. Germany | 0.4 | 0.6% |
| 11. Trinidad & Tobago | 0.2 | 0.3% |
| 12. Cayman Islands | 0.2 | 0.3% |
| 13. Italy | 0.2 | 0.3% |
| 14. Brazil | 0.2 | 0.3% |
| 15. Spain | 0.2 | 0.3% |
| 16. Bermuda | 0.2 | 0.2% |
| 17. Dominican Republic | 0.1 | 0.2% |
| 18. China | 0.1 | 0.2% |
| 19. Colombia | 0.1 | 0.2% |
| 20. Guyana | 0.1 | 0.2% |
| Other | 3.3 | 5.2% |
| **Total** | **63.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 90.0 | n.a. |
| Outgoing | 62.7 | 63.5 | n.a. |
| Surplus (Deficit) | n.a. | 26.5 | n.a. |
| Total Volume | n.a. | 153.5 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1999 traffic data are not available.

# Bahrain

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | India | 27.4 | 20.4% |
| 2. | Saudi Arabia | 17.6 | 13.1% |
| 3. | United Arab Emirates | 14.9 | 11.1% |
| 4. | United Kingdom | 8.6 | 6.4% |
| 5. | Pakistan | 6.3 | 4.7% |
| 6. | Kuwait | 5.6 | 4.1% |
| 7. | United States | 5.0 | 3.7% |
| 8. | Egypt | 4.9 | 3.6% |
| 9. | Qatar | 4.5 | 3.3% |
| 10. | Philippines | 3.5 | 2.6% |
| 11. | Oman | 2.2 | 1.7% |
| 12. | Bangladesh | 2.1 | 1.5% |
| 13. | Jordan | 2.0 | 1.5% |
| 14. | Morocco | 1.8 | 1.4% |
| 15. | Sri Lanka | 1.7 | 1.2% |
| 16. | Syria | 1.2 | 0.9% |
| 17. | Lebanon | 1.0 | 0.8% |
| 18. | France | 1.0 | 0.8% |
| 19. | Yemen | 0.9 | 0.7% |
| 20. | Germany | 0.8 | 0.6% |
| | Other | 21.2 | 15.8% |
| | **Total** | **134.1** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 85.4 | 102.1 | 106.5 |
| Outgoing | 106.6 | 124.4 | 134.1 |
| Surplus (Deficit) | (21.2) | (22.3) | (27.5) |
| Total Volume | 192.0 | 226.5 | 240.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Bangladesh

## Largest Telecommunications Routes, 1998

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | India | 7.1 | 17.0% |
| 2. | United Kingdom | 5.1 | 12.2% |
| 3. | United States | 5.0 | 12.1% |
| 4. | Saudi Arabia | 3.5 | 8.5% |
| 5. | Singapore | 2.8 | 6.8% |
| 6. | United Arab Emirates | 2.4 | 5.8% |
| 7. | Hong Kong | 1.8 | 4.3% |
| 8. | Pakistan | 1.6 | 3.9% |
| 9. | Malaysia | 1.3 | 3.0% |
| 10. | Korea, Rep. | 1.2 | 2.8% |
| 11. | China | 1.0 | 2.3% |
| 12. | Italy | 0.9 | 2.1% |
| 13. | Japan | 0.9 | 2.1% |
| 14. | Canada | 0.9 | 2.0% |
| 15. | Germany | 0.8 | 2.0% |
| 16. | Thailand | 0.7 | 1.8% |
| 17. | France | 0.7 | 1.7% |
| 18. | Australia | 0.6 | 1.4% |
| 19. | Taiwan | 0.6 | 1.3% |
| 20. | Indonesia | 0.3 | 0.7% |
| | Other | 2.7 | 6.4% |
| | **Total** | **41.8** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 187.0 | 196.2 | n.a. |
| Outgoing | 46.9 | 41.8 | n.a. |
| Surplus (Deficit) | 140.1 | 154.4 | n.a. |
| Total Volume | 233.9 | 237.9 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1999 traffic data are not available.

# Belarus

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Russia | 91.8 | 56.9% |
| 2. Ukraine | 21.9 | 13.6% |
| 3. Moldova | 1.9 | 1.2% |
| 4. Kazakhstan | 1.7 | 1.1% |
| 5. Azerbaijan | 0.9 | 0.6% |
| 6. Armenia | 0.9 | 0.6% |
| 7. Uzbekistan | 0.7 | 0.4% |
| 8. Georgia | 0.6 | 0.4% |
| 9. Kyrgyzstan | 0.2 | 0.1% |
| 10. Tajikistan | 0.2 | 0.1% |
| 11. Turkmenistan | 0.2 | 0.1% |
| Other | 40.2 | 24.9% |
| **Total** | **161.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 185.2 | 193.5 | 195.6 |
| Outgoing | 148.6 | 176.1 | 161.2 |
| Surplus (Deficit) | 36.6 | 17.3 | 34.4 |
| Total Volume | 333.8 | 369.6 | 356.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. The "Other" category may include routes to non-members of the Commonwealth of Independent States that rank among the top destinations for outgoing traffic.

# Belgium

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 345.0 | 21.7% |
| 2. Netherlands | 325.0 | 20.4% |
| 3. Germany | 190.0 | 11.9% |
| 4. United Kingdom | 155.0 | 9.7% |
| 5. Italy | 80.0 | 5.0% |
| 6. Luxembourg | 55.0 | 3.5% |
| 7. United States | 55.0 | 3.5% |
| 8. Spain | 52.0 | 3.3% |
| 9. Switzerland | 34.0 | 2.1% |
| 10. Sweden | 20.0 | 1.3% |
| Other | 279.0 | 17.5% |
| **Total** | **1,590.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 1,420.0 | n.a. | n.a. |
| Outgoing | 1,340.0 | 1,460.0 | 1,590.0 |
| Surplus (Deficit) | 80.0 | n.a. | n.a. |
| Total Volume | 2,760.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic

# Benin

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 2,840.0 | 27.1% |
| 2. | Togo | 1,296.0 | 12.3% |
| 3. | Côte d'Ivoire | 1,102.0 | 10.5% |
| 4. | Nigeria | 776.0 | 7.4% |
| 5. | Niger | 515.0 | 4.9% |
| 6. | United States | 513.0 | 4.9% |
| 7. | Gabon | 424.0 | 4.0% |
| 8. | Senegal | 397.0 | 3.8% |
| 9. | Burkina Faso | 338.0 | 3.2% |
| 10. | Germany | 269.0 | 2.6% |
| 11. | United Kingdom | 205.0 | 2.0% |
| 12. | Belgium | 200.0 | 1.9% |
| 13. | Cameroon | 196.0 | 1.9% |
| 14. | Ghana | 180.0 | 1.7% |
| 15. | Mali | 138.0 | 1.3% |
| 16. | Italy | 137.0 | 1.3% |
| 17. | Switzerland | 132.0 | 1.3% |
| 18. | Canada | 111.0 | 1.1% |
| 19. | Netherlands | 83.0 | 0.8% |
| 20. | Lebanon | 64.0 | 0.6% |
| | Other | 695.0 | 6.6% |
| | **Total** | **10,495.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 16.4 | 15.1 |
| Outgoing | 8.1 | 11.4 | 10.5 |
| Surplus (Deficit) | n.a. | 5.0 | 4.6 |
| Total Volume | n.a. | 27.8 | 25.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Bolivia

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 6.6 | 22.3% |
| 2. Argentina | 5.3 | 17.7% |
| 3. Peru | 3.5 | 11.6% |
| 4. Brazil | 3.4 | 11.3% |
| 5. Chile | 3.0 | 10.2% |
| 6. Italy | 0.6 | 2.1% |
| 7. Colombia | 0.6 | 2.1% |
| 8. Cuba | 0.5 | 1.7% |
| 9. Ecuador | 0.5 | 1.7% |
| 10. Spain | 0.5 | 1.6% |
| 11. Germany | 0.5 | 1.6% |
| 12. Paraguay | 0.4 | 1.5% |
| 13. Canada | 0.4 | 1.4% |
| 14. Mexico | 0.4 | 1.4% |
| 15. Venezuela | 0.4 | 1.3% |
| 16. United Kingdom | 0.4 | 1.2% |
| 17. Japan | 0.3 | 0.9% |
| 18. China | 0.2 | 0.8% |
| 19. Uruguay | 0.2 | 0.7% |
| 20. France | 0.2 | 0.7% |
| Other | 1.8 | 6.1% |
| **Total** | **29.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 69.3 | 76.4 | 82.2 |
| Outgoing | 22.7 | 31.6 | 29.7 |
| Surplus (Deficit) | 46.6 | 44.8 | 52.5 |
| Total Volume | 92.0 | 108.0 | 111.9 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic

# Bosnia-Herzegovina

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Croatia | 27.8 | 28.6% |
| 2. Germany | 17.9 | 18.5% |
| 3. Yugoslavia | 11.3 | 11.6% |
| 4. Slovenia | 7.5 | 7.7% |
| 5. United States | 6.2 | 6.3% |
| 6. Austria | 5.7 | 5.9% |
| 7. Switzerland | 3.5 | 3.6% |
| 8. Italy | 2.8 | 2.9% |
| 9. Hungary | 2.4 | 2.4% |
| 10. Sweden | 2.3 | 2.4% |
| 11. United Kingdom | 1.8 | 1.9% |
| 12. Netherlands | 1.8 | 1.8% |
| 13. France | 1.7 | 1.8% |
| 14. Turkey | 1.4 | 1.4% |
| 15. Macedonia | 1.1 | 1.2% |
| 16. Norway | 1.0 | 1.0% |
| 17. Czech Republic | 0.3 | 0.3% |
| 18. Slovak Republic | 0.2 | 0.2% |
| Other | 0.6 | 0.6% |
| **Total** | **97.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 159.2 | 200.5 |
| Outgoing | 66.2 | 94.9 | 97.2 |
| Surplus (Deficit) | n.a. | 64.3 | 103.3 |
| Total Volume | n.a. | 254.1 | 297.7 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data exclude cross-border traffic to Albania.

# Brazil

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 183.6 | 31.9% |
| 2. Argentina | 43.1 | 7.5% |
| 3. Portugal | 26.3 | 4.6% |
| 4. Italy | 21.5 | 3.7% |
| 5. Spain | 20.9 | 3.6% |
| 6. United Kingdom | 20.7 | 3.6% |
| 7. Germany | 18.9 | 3.3% |
| 8. France | 14.3 | 2.5% |
| 9. Japan | 14.1 | 2.4% |
| 10. Uruguay | 11.4 | 2.0% |
| 11. Chile | 10.6 | 1.8% |
| 12. Paraguay | 10.6 | 1.8% |
| 13. Canada | 9.0 | 1.6% |
| 14. Switzerland | 8.6 | 1.5% |
| 15. Mexico | 6.7 | 1.2% |
| 16. Netherlands | 5.0 | 0.9% |
| 17. Bolivia | 5.0 | 0.9% |
| 18. Peru | 3.6 | 0.6% |
| 19. Israel | 3.3 | 0.6% |
| 20. Venezuela | 2.8 | 0.5% |
| Other | 135.0 | 23.5% |
| **Total** | **574.8** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 761.3 | 806.9 | 838.5 |
| Outgoing | 459.1 | 545.8 | 574.8 |
| Surplus (Deficit) | 302.2 | 261.1 | 263.7 |
| Total Volume | 1,220.4 | 1,352.7 | 1,413.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Brunei

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Singapore | 3,352.0 | 17.9% |
| 2. | Malaysia | 3,261.0 | 17.4% |
| 3. | Philippines | 2,690.0 | 14.3% |
| 4. | Indonesia | 1,997.0 | 10.6% |
| 5. | United Kingdom | 1,885.0 | 10.0% |
| 6. | Australia | 975.0 | 5.2% |
| 7. | Thailand | 948.0 | 5.1% |
| 8. | India | 824.0 | 4.4% |
| 9. | United States | 326.0 | 1.7% |
| 10. | Hong Kong | 251.0 | 1.3% |
| 11. | New Zealand | 200.0 | 1.1% |
| 12. | Nepal | 169.0 | 0.9% |
| 13. | Japan | 164.0 | 0.9% |
| 14. | Canada | 118.0 | 0.6% |
| 15. | Taiwan | 87.0 | 0.5% |
| 16. | France | 83.0 | 0.4% |
| 17. | Germany | 83.0 | 0.4% |
| 18. | China | 76.0 | 0.4% |
| 19. | Saudi Arabia | 71.0 | 0.4% |
| 20. | United Arab Emirates | 61.0 | 0.3% |
| | Other | 1,141.0 | 7.1% |
| | **Total** | **18,763.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 22.0 | 25.5 | 21.7 |
| Outgoing | 35.6 | 23.4 | 18.8 |
| Surplus (Deficit) | (13.6) | 2.1 | 2.9 |
| Total Volume | 57.6 | 48.9 | 40.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data exclude traffic originated on mobile telephones.

# Bulgaria

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Greece | 15.0 | 15.2% |
| 2. | Germany | 13.0 | 13.1% |
| 3. | Turkey | 13.0 | 13.1% |
| 4. | Yugoslavia | 9.0 | 9.1% |
| 5. | United States | 7.0 | 7.1% |
| 6. | Italy | 5.0 | 5.1% |
| 7. | France | 4.0 | 4.0% |
| 8. | Romania | 4.0 | 4.0% |
| 9. | Russia | 4.0 | 4.0% |
| 10. | United Kingdom | 4.0 | 4.0% |
| 11. | Macedonia | 4.0 | 4.0% |
| 12. | Austria | 3.0 | 3.0% |
| 13. | Ukraine | 3.0 | 3.0% |
| 14. | Netherlands | 2.0 | 2.0% |
| 15. | Czech Republic | 2.0 | 2.0% |
| | Other | 7.0 | 7.1% |
| | **Total** | **98.9** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 135.0 | 201.0 | n.a. |
| Outgoing | 76.0 | 96.0 | 98.9 |
| Surplus (Deficit) | 59.0 | 105.0 | n.a. |
| Total Volume | 211.0 | 297.0 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Burkina Faso

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 2,754.7 | 25.2% |
| 2. Côte d'Ivoire | 2,459.6 | 22.5% |
| 3. Togo | 707.0 | 6.5% |
| 4. United States | 596.7 | 5.5% |
| 5. Australia | 539.9 | 4.9% |
| 6. Senegal | 460.1 | 4.2% |
| 7. Mali | 404.9 | 3.7% |
| 8. Niger | 310.1 | 2.8% |
| 9. Benin | 297.5 | 2.7% |
| 10. United Kingdom | 287.4 | 2.6% |
| 11. Belgium | 263.5 | 2.4% |
| 12. Ghana | 201.0 | 1.8% |
| 13. Italy | 163.1 | 1.5% |
| 14. Germany | 155.7 | 1.4% |
| 15. Switzerland | 127.0 | 1.2% |
| 16. Canada | 110.3 | 1.0% |
| 17. Nigeria | 90.7 | 0.8% |
| 18. Gabon | 82.4 | 0.8% |
| 19. Netherlands | 78.4 | 0.7% |
| 20. Papua New Guinea | 78.4 | 0.7% |
| Other | 800.0 | 7.3% |
| **Total** | **10,942.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | 16.3 |
| Outgoing | 7.8 | 8.7 | 10.9 |
| Surplus (Deficit) | n.a. | n.a. | 5.4 |
| Total Volume | n.a. | n.a. | 27.2 |

**Note:** *Data are in millions of minutes of outgoing public switched telecommunications traffic.*

# Burundi

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Belgium | 571.0 | 23.2% |
| 2. | France | 252.0 | 10.3% |
| 3. | Kenya | 222.0 | 9.0% |
| 4. | Italy | 112.0 | 4.6% |
| 5. | Canada | 110.0 | 4.5% |
| 6. | United States | 108.0 | 4.4% |
| 7. | United Kingdom | 101.0 | 4.1% |
| 8. | Switzerland | 88.0 | 3.6% |
| 9. | Tanzania | 73.0 | 3.0% |
| 10. | South Africa | 72.0 | 2.9% |
| 11. | Germany | 59.0 | 2.4% |
| 12. | Netherlands | 58.0 | 2.4% |
| 13. | Greece | 47.0 | 1.9% |
| 14. | Uganda | 36.0 | 1.5% |
| 15. | Rwanda | 32.0 | 1.3% |
| 16. | Senegal | 28.0 | 1.1% |
| 17. | Côte d'Ivoire | 24.0 | 1.0% |
| 18. | Ethiopia | 22.0 | 0.9% |
| 19. | China | 21.0 | 0.9% |
| 20. | Cameroon | 17.0 | 0.7% |
| | Other | 420.0 | 17.1% |
| | **Total** | **2,458.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 3.6 | 3.4 |
| Outgoing | n.a. | 2.4 | 2.5 |
| Surplus (Deficit) | n.a. | 1.1 | 1.0 |
| Total Volume | n.a. | 6.0 | 5.9 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Canada

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 3,925.0 | 69.1% |
| 2. | United Kingdom | 295.0 | 5.2% |
| 3. | Hong Kong | 100.0 | 1.8% |
| 4. | Germany | 85.0 | 1.5% |
| 5. | France | 80.0 | 1.4% |
| 6. | India | 70.0 | 1.2% |
| 7. | Italy | 55.0 | 1.0% |
| 8. | Australia | 45.0 | 0.8% |
| 9. | Philippines | 45.0 | 0.8% |
| 10. | Japan | 42.0 | 0.7% |
| 11. | Netherlands | 33.0 | 0.6% |
| 12. | Taiwan | 33.0 | 0.6% |
| 13. | Vietnam | 33.0 | 0.6% |
| 14. | Jamaica | 27.0 | 0.5% |
| 15. | Korea, Rep. | 27.0 | 0.5% |
| 16. | Mexico | 27.0 | 0.5% |
| 17. | Switzerland | 27.0 | 0.5% |
| 18. | Sri Lanka | 27.0 | 0.5% |
| | Other | 704.0 | 12.4% |
| | **Total** | **5,680.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 4,635.1 | n.a. | n.a. |
| Outgoing | 4,286.3 | 4,805.0 | 5,680.0 |
| Surplus (Deficit) | 348.8 | n.a. | n.a. |
| Total Volume | 8,921.4 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Central African Rep.

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 1,901.0 | 43.9% |
| 2. | Cameroon | 446.0 | 10.3% |
| 3. | Chad | 248.0 | 5.7% |
| 4. | Côte d'Ivoire | 214.0 | 4.9% |
| 5. | Senegal | 179.0 | 4.1% |
| 6. | United States | 143.0 | 3.3% |
| 7. | Lebanon | 114.0 | 2.6% |
| 8. | Togo | 92.0 | 2.1% |
| 9. | Belgium | 87.0 | 2.0% |
| 10. | Gabon | 74.0 | 1.7% |
| 11. | Egypt | 52.0 | 1.2% |
| 12. | Benin | 49.0 | 1.1% |
| 13. | Mali | 46.0 | 1.1% |
| 14. | Burkina Faso | 43.0 | 1.0% |
| 15. | Italy | 43.0 | 1.0% |
| 16. | Canada | 36.0 | 0.8% |
| 17. | Germany | 34.0 | 0.8% |
| 18. | Nigeria | 33.0 | 0.8% |
| 19. | Switzerland | 33.0 | 0.8% |
| 20. | Morocco | 26.0 | 0.6% |
| | Other | 205.0 | 4.7% |
| | **Total** | **4,330.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 3.6 | n.a. |
| Outgoing | 3.6 | 3.5 | 4.3 |
| Surplus (Deficit) | n.a. | 0.1 | n.a. |
| Total Volume | n.a. | 7.1 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Chad

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 1,095.0 | 38.6% |
| 2. | Cameroon | 441.0 | 15.5% |
| 3. | Saudi Arabia | 274.0 | 9.7% |
| 4. | United States | 145.0 | 5.1% |
| 5. | Central African Rep. | 109.0 | 3.8% |
| 6. | Côte d'Ivoire | 97.0 | 3.4% |
| 7. | Nigeria | 87.0 | 3.1% |
| 8. | Sudan | 70.0 | 2.5% |
| 9. | Egypt | 67.0 | 2.4% |
| 10. | Canada | 60.0 | 2.1% |
| 11. | Senegal | 56.0 | 2.0% |
| 12. | Belgium | 55.0 | 1.9% |
| 13. | Benin | 49.0 | 1.7% |
| 14. | Germany | 46.0 | 1.6% |
| 15. | Gabon | 39.0 | 1.4% |
| 16. | Switzerland | 34.0 | 1.2% |
| 17. | Burkina Faso | 34.0 | 1.2% |
| 18. | Italy | 32.0 | 1.1% |
| 19. | Togo | 28.0 | 1.0% |
| 20. | Libya | 19.0 | 0.7% |
| | Other | 137.0 | 4.8% |
| | **Total** | **2,837.0** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 2.8 | 3.2 | 2.8 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Chile

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 100.0 | 37.0% |
| 2. Argentina | 31.0 | 11.5% |
| 3. Spain | 14.3 | 5.3% |
| 4. Peru | 10.7 | 4.0% |
| 5. Brazil | 10.0 | 3.7% |
| 6. Germany | 6.5 | 2.4% |
| 7. Canada | 6.2 | 2.3% |
| 8. Japan | 6.0 | 2.2% |
| 9. Bolivia | 5.4 | 2.0% |
| 10. France | 4.4 | 1.6% |
| 11. Mexico | 4.3 | 1.6% |
| 12. United Kingdom | 3.7 | 1.4% |
| 13. Ecuador | 3.5 | 1.3% |
| 14. Venezuela | 3.5 | 1.3% |
| 15. Italy | 3.4 | 1.3% |
| 16. Sweden | 3.1 | 1.1% |
| 17. Colombia | 2.2 | 0.8% |
| 18. Australia | 2.0 | 0.7% |
| 19. Uruguay | 1.9 | 0.7% |
| 20. Paraguay | 1.4 | 0.5% |
| Other | 46.5 | 17.2% |
| **Total** | **270.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 242.0 | 259.4 | 270.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# China

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Hong Kong | 1,020.0 | 52.3% |
| 2. Taiwan | 205.0 | 10.5% |
| 3. Japan | 130.0 | 6.7% |
| 4. United States | 50.0 | 2.6% |
| 5. Korea, Rep. | 45.0 | 2.3% |
| 6. Macau | 40.0 | 2.1% |
| 7. Singapore | 35.0 | 1.8% |
| 8. Australia | 18.0 | 0.9% |
| 9. Canada | 18.0 | 0.9% |
| 10. Germany | 18.0 | 0.9% |
| 11. United Kingdom | 16.0 | 0.8% |
| 12. France | 12.0 | 0.6% |
| 13. Italy | 10.0 | 0.5% |
| 14. Malaysia | 9.0 | 0.5% |
| 15. Russia | 9.0 | 0.5% |
| Other | 315.0 | 16.2% |
| **Total** | **1,950.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 1,631.8 | 1,711.5 | 1,950.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Costa Rica

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 34.7 | 36.8% |
| 2. | Nicaragua | 19.0 | 20.2% |
| 3. | Panama | 5.9 | 6.3% |
| 4. | Mexico | 5.6 | 5.9% |
| 5. | Guatemala | 4.6 | 4.9% |
| 6. | El Salvador | 3.8 | 4.1% |
| 7. | Honduras | 2.8 | 2.9% |
| 8. | Colombia | 2.6 | 2.8% |
| 9. | Canada | 1.6 | 1.7% |
| 10. | Spain | 1.3 | 1.4% |
| 11. | Italy | 1.1 | 1.2% |
| 12. | Cuba | 1.0 | 1.1% |
| 13. | Germany | 1.0 | 1.0% |
| 14. | Venezuela | 0.9 | 1.0% |
| 15. | Dominican Republic | 0.9 | 1.0% |
| 16. | Puerto Rico | 0.8 | 0.8% |
| 17. | Peru | 0.8 | 0.8% |
| 18. | Argentina | 0.7 | 0.7% |
| 19. | Chile | 0.6 | 0.6% |
| 20. | Brazil | 0.6 | 0.6% |
| | Other | 3.9 | 4.2% |
| | **Total** | **94.1** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 111.6 | 112.9 | 109.0 |
| Outgoing | 66.9 | 82.7 | 94.1 |
| Surplus (Deficit) | 44.7 | 30.2 | 14.9 |
| Total Volume | 178.5 | 195.6 | 203.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Côte d'Ivoire

## Largest Telecommunications Routes, 1998

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 17.3 | 30.2% |
| 2. | Senegal | 4.4 | 7.6% |
| 3. | United States | 3.6 | 6.2% |
| 4. | Italy | 3.1 | 5.5% |
| 5. | Burkina Faso | 2.3 | 4.0% |
| 6. | Mali | 2.2 | 3.9% |
| 7. | Nigeria | 2.1 | 3.7% |
| 8. | Lebanon | 1.8 | 3.2% |
| 9. | United Kingdom | 1.6 | 2.7% |
| 10. | Benin | 1.4 | 2.4% |
| 11. | Togo | 1.2 | 2.1% |
| 12. | Gabon | 1.1 | 2.0% |
| 13. | Belgium | 1.0 | 1.8% |
| 14. | Germany | 1.0 | 1.7% |
| 15. | Congo, Rep. | 0.9 | 1.6% |
| 16. | Cameroon | 0.9 | 1.6% |
| 17. | Switzerland | 0.9 | 1.6% |
| 18. | Ghana | 0.8 | 1.4% |
| 19. | Morocco | 0.8 | 1.3% |
| 20. | Canada | 0.8 | 1.3% |
| | Other | 8.1 | 14.2% |
| | **Total** | **57.3** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 50.6 | 46.6 | n.a. |
| Outgoing | 40.1 | 57.3 | 71.3 |
| Surplus (Deficit) | 10.5 | (10.7) | n.a. |
| Total Volume | 90.7 | 103.9 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1999 route data are not available.

# Cuba

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 6.7 | 20.5% |
| 2. | Spain | 6.2 | 19.1% |
| 3. | Canada | 4.6 | 14.2% |
| 4. | Italy | 4.3 | 13.3% |
| 5. | Mexico | 2.7 | 8.4% |
| 6. | France | 1.0 | 3.0% |
| 7. | Brazil | 0.7 | 2.3% |
| 8. | Colombia | 0.7 | 2.0% |
| 9. | Argentina | 0.6 | 1.9% |
| 10. | Panama | 0.6 | 1.8% |
| 11. | Germany | 0.6 | 1.8% |
| 12. | Venezuela | 0.6 | 1.7% |
| 13. | United Kingdom | 0.5 | 1.6% |
| 14. | Chile | 0.5 | 1.6% |
| 15. | Dominican Republic | 0.5 | 1.6% |
| 16. | Puerto Rico | 0.4 | 1.3% |
| 17. | Switzerland | 0.3 | 0.9% |
| 18. | Costa Rica | 0.2 | 0.7% |
| 19. | Barbados | 0.1 | 0.4% |
| 20. | Japan | 0.1 | 0.3% |
| | Other | 0.5 | 1.6% |
| | **Total** | **32.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 161.2 | 203.0 | 225.3 |
| Outgoing | 27.8 | 29.0 | 32.6 |
| Surplus (Deficit) | 133.4 | 174.0 | 192.7 |
| Total Volume | 189.0 | 232.1 | 257.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Cyprus

## Largest Telecommunications Routes, 1999

| Destination | | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Greece | 46.8 | 27.8% |
| 2. | United Kingdom | 36.5 | 21.7% |
| 3. | Egypt | 11.8 | 7.0% |
| 4. | Lebanon | 10.4 | 6.2% |
| 5. | Russia | 7.3 | 4.4% |
| 6. | Germany | 4.8 | 2.8% |
| 7. | United States | 4.0 | 2.4% |
| 8. | Bulgaria | 4.0 | 2.4% |
| 9. | Romania | 3.5 | 2.1% |
| 10. | Ukraine | 3.1 | 1.8% |
| 11. | Yugoslavia | 2.9 | 1.7% |
| 12. | Italy | 2.4 | 1.4% |
| 13. | France | 2.1 | 1.3% |
| 14. | Syria | 2.1 | 1.3% |
| 15. | Sweden | 1.8 | 1.1% |
| 16. | Switzerland | 1.8 | 1.0% |
| 17. | Netherlands | 1.8 | 1.0% |
| 18. | Israel | 1.6 | 1.0% |
| 19. | Belgium | 1.1 | 0.7% |
| 20. | Australia | 1.0 | 0.6% |
| | Other | 17.5 | 10.4% |
| | **Total** | **168.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 115.2 | 120.6 | 134.1 |
| Outgoing | 154.4 | 182.0 | 168.2 |
| Surplus (Deficit) | (39.2) | (61.4) | (34.0) |
| Total Volume | 269.6 | 302.7 | 302.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Czech Republic

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 90.0 | 24.7% |
| 2. Slovak Republic | 75.0 | 20.6% |
| 3. Austria | 26.0 | 7.1% |
| 4. United Kingdom | 20.0 | 5.5% |
| 5. Poland | 15.0 | 4.1% |
| 6. Italy | 13.0 | 3.6% |
| 7. France | 12.0 | 3.3% |
| 8. United States | 11.0 | 3.0% |
| 9. Netherlands | 10.0 | 2.7% |
| 10. Ukraine | 10.0 | 2.7% |
| Other | 82.0 | 22.5% |
| **Total** | **364.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 355.0 | 406.9 | 452.2 |
| Outgoing | 306.1 | 317.4 | 364.0 |
| Surplus (Deficit) | 48.9 | 89.5 | 88.2 |
| Total Volume | 661.1 | 724.4 | 816.2 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data based on billing point of traffic.

# Denmark

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 135.0 | 16.9% |
| 2. Sweden | 124.0 | 15.5% |
| 3. United Kingdom | 100.0 | 12.5% |
| 4. Norway | 76.0 | 9.5% |
| 5. United States | 37.0 | 4.6% |
| 6. Netherlands | 34.0 | 4.3% |
| 7. France | 30.0 | 3.8% |
| 8. Italy | 24.0 | 3.0% |
| 9. Spain | 17.0 | 2.1% |
| 10. Switzerland | 17.0 | 2.1% |
| 11. Belgium | 16.0 | 2.0% |
| 12. Finland | 15.0 | 1.9% |
| 13. Poland | 14.0 | 1.8% |
| 14. Faroe Islands | 12.0 | 1.5% |
| 15. Turkey | 9.0 | 1.1% |
| Other | 140.0 | 17.5% |
| **Total** | **800.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 682.0 | n.a. | n.a. |
| Outgoing | 607.5 | 710.0 | 800.0 |
| Surplus (Deficit) | 74.5 | n.a. | n.a. |
| Total Volume | 1,289.5 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data based on billing point of traffic.

# Dominican Republic

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 137.1 | 73.8% |
| 2. Spain | 7.1 | 3.8% |
| 3. Italy | 4.4 | 2.3% |
| 4. Canada | 2.7 | 1.4% |
| 5. Germany | 2.6 | 1.4% |
| 6. Cuba | 2.1 | 1.1% |
| 7. Venezuela | 2.1 | 1.1% |
| 8. Mexico | 1.8 | 1.0% |
| 9. France | 1.5 | 0.8% |
| 10. Switzerland | 1.4 | 0.8% |
| 11. Netherlands Antilles | 1.2 | 0.7% |
| 12. Haiti | 1.2 | 0.6% |
| 13. Argentina | 1.2 | 0.6% |
| 14. Colombia | 1.2 | 0.6% |
| 15. Panama | 1.0 | 0.5% |
| 16. United Kingdom | 0.9 | 0.5% |
| 17. Netherlands | 0.7 | 0.4% |
| 18. Costa Rica | 0.7 | 0.4% |
| 19. Chile | 0.4 | 0.2% |
| 20. Brazil | 0.3 | 0.2% |
| Other | 14.3 | 7.7% |
| **Total** | **185.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 476.9 | 730.5 | 920.0 |
| Outgoing | 142.0 | 157.5 | 185.7 |
| Surplus (Deficit) | 334.9 | 573.0 | 734.3 |
| Total Volume | 618.9 | 888.0 | 1,105.7 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Egypt

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Saudi Arabia | 28.9 | 16.9% |
| 2. | Italy | 13.3 | 7.8% |
| 3. | United Kingdom | 12.6 | 7.4% |
| 4. | United States | 12.0 | 7.0% |
| 5. | United Arab Emirates | 11.6 | 6.8% |
| 6. | Germany | 10.0 | 5.9% |
| 7. | France | 9.4 | 5.5% |
| 8. | Kuwait | 8.4 | 4.9% |
| 9. | Lebanon | 4.8 | 2.8% |
| 10. | Yemen | 3.7 | 2.2% |
| 11. | Jordan | 3.6 | 2.1% |
| 12. | Canada | 3.5 | 2.1% |
| 13. | Switzerland | 3.0 | 1.8% |
| 14. | Netherlands | 2.7 | 1.6% |
| 15. | Syria | 2.5 | 1.5% |
| 16. | Greece | 2.3 | 1.4% |
| 17. | Spain | 2.3 | 1.3% |
| 18. | Libya | 2.1 | 1.3% |
| 19. | Qatar | 2.1 | 1.2% |
| 20. | Belgium | 1.9 | 1.1% |
| | Other | 30.2 | 17.6% |
| | **Total** | **171.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 451.2 | 475.3 | 554.6 |
| Outgoing | 119.3 | 127.3 | 171.0 |
| Surplus (Deficit) | 332.0 | 348.0 | 383.6 |
| Total Volume | 570.5 | 602.6 | 725.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# El Salvador

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 24.0 | 51.1% |
| 2. | Guatemala | 6.8 | 14.5% |
| 3. | Honduras | 2.9 | 6.2% |
| 4. | Mexico | 2.9 | 6.2% |
| 5. | Costa Rica | 2.8 | 6.0% |
| 6. | Nicaragua | 1.6 | 3.4% |
| 7. | Canada | 0.8 | 1.7% |
| 8. | Panama | 0.8 | 1.7% |
| 9. | Colombia | 0.4 | 0.9% |
| 10. | Spain | 0.4 | 0.9% |
| 11. | Argentina | 0.2 | 0.4% |
| 12. | Brazil | 0.2 | 0.4% |
| 13. | Chile | 0.2 | 0.4% |
| 14. | France | 0.2 | 0.4% |
| 15. | Germany | 0.2 | 0.4% |
| 16. | Peru | 0.2 | 0.4% |
| 17. | Venezuela | 0.2 | 0.4% |
| 18. | Italy | 0.2 | 0.4% |
| 19. | Dominican Republic | 0.1 | 0.2% |
| 20. | United Kingdom | 0.1 | 0.2% |
| | Others | 1.8 | 3.8% |
| | **Total** | **47.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 168.2 | 149.2 | n.a. |
| Outgoing | 34.3 | 43.1 | 47.0 |
| Surplus (Deficit) | 133.9 | 106.1 | n.a. |
| Total Volume | 202.5 | 192.3 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1998 data are for ANTEL only.

# Eritrea

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Italy | 408.1 | 16.3% |
| 2. | Saudi Arabia | 301.0 | 12.0% |
| 3. | United States | 289.6 | 11.6% |
| 4. | United Kingdom | 158.6 | 6.3% |
| 5. | United Arab Emirates | 148.0 | 5.9% |
| 6. | Germany | 135.1 | 5.4% |
| 7. | Egypt | 87.4 | 3.5% |
| 8. | Korea, Rep. | 85.8 | 3.4% |
| 9. | Kenya | 80.1 | 3.2% |
| 10. | Libya | 61.6 | 2.5% |
| 11. | Sudan | 53.4 | 2.1% |
| 12. | Sweden | 46.3 | 1.8% |
| 13. | Switzerland | 41.0 | 1.6% |
| 14. | Netherlands | 39.9 | 1.6% |
| 15. | Canada | 34.4 | 1.4% |
| 16. | China | 32.0 | 1.3% |
| 17. | Yemen | 32.0 | 1.3% |
| 18. | France | 31.0 | 1.2% |
| 19. | India | 28.0 | 1.1% |
| 20. | Denmark | 26.3 | 1.0% |
| | Other | 387.9 | 15.5% |
| | **Total** | **2,507.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 12.6 | 13.8 |
| Outgoing | n.a. | 3.1 | 2.5 |
| Surplus (Deficit) | n.a. | 9.5 | 11.3 |
| Total Volume | n.a. | 15.7 | 16.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic

# Estonia

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Finland | 21.0 | 28.2% |
| 2. Russia | 14.6 | 19.6% |
| 3. Sweden | 5.9 | 8.0% |
| 4. Latvia | 5.3 | 7.1% |
| 5. Germany | 4.6 | 6.1% |
| 6. Ukraine | 3.1 | 4.1% |
| 7. Lithuania | 2.9 | 3.9% |
| 8. United Kingdom | 2.2 | 2.9% |
| 9. Denmark | 1.8 | 2.4% |
| 10. United States | 1.4 | 1.9% |
| 11. Norway | 1.2 | 1.6% |
| 12. Belarus | 1.1 | 1.5% |
| 13. Italy | 0.9 | 1.3% |
| 14. Poland | 0.9 | 1.2% |
| 15. Netherlands | 0.9 | 1.2% |
| 16. France | 0.8 | 1.1% |
| 17. Belgium | 0.6 | 0.8% |
| 18. Spain | 0.5 | 0.7% |
| 19. Switzerland | 0.4 | 0.6% |
| 20. Austria | 0.4 | 0.5% |
| Other | 4.1 | 5.5% |
| **Total** | **74.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 67.0 | 79.2 | 84.8 |
| Outgoing | 66.3 | 75.1 | 74.6 |
| Surplus (Deficit) | 0.7 | 4.1 | 10.2 |
| Total Volume | 133.3 | 154.3 | 159.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Ethiopia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 1,722.0 | 13.6% |
| 2. | Djibouti | 1,412.2 | 11.2% |
| 3. | United Kingdom | 931.4 | 7.2% |
| 4. | Kenya | 832.7 | 6.4% |
| 5. | Israel | 723.1 | 5.6% |
| 6. | Saudi Arabia | 703.8 | 5.6% |
| 7. | Germany | 506.3 | 4.0% |
| 8. | Algeria | 444.9 | 3.2% |
| 9. | France | 439.2 | 3.2% |
| 10. | United Arab Emirates | 430.8 | 3.2% |
| 11. | Switzerland | 277.8 | 2.4% |
| 12. | South Africa | 263.5 | 2.4% |
| 13. | Sweden | 259.6 | 2.4% |
| 14. | Netherlands | 255.7 | 2.4% |
| 15. | India | 247.3 | 1.6% |
| 16. | Yemen | 189.0 | 1.6% |
| 17. | Egypt | 170.0 | 1.6% |
| 18. | Canada | 161.2 | 1.6% |
| 19. | Greece | 124.8 | 0.8% |
| 20. | Uganda | 121.0 | 0.8% |
| | Other | 2,237.3 | 19.2% |
| | **Total** | **12,453.4** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 39.6 | n.a. | 46.5 |
| Outgoing | 10.7 | 13.7 | 12.5 |
| Surplus (Deficit) | 28.9 | n.a. | 34.0 |
| Total Volume | 50.3 | n.a. | 59.0 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Finland

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Sweden | 135.0 | 31.8% |
| 2. | Germany | 38.0 | 9.0% |
| 3. | United Kingdom | 37.0 | 8.7% |
| 4. | Estonia | 31.0 | 7.3% |
| 5. | Russia | 28.0 | 6.6% |
| 6. | Norway | 18.0 | 4.2% |
| 7. | United States | 16.0 | 3.8% |
| 8. | Denmark | 12.0 | 2.8% |
| 9. | France | 12.0 | 2.8% |
| 10. | Netherlands | 8.0 | 1.9% |
| | Other | 89.0 | 21.0% |
| | **Total** | **423.9** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 371.1 | 410.8 | 423.9 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1999 data exclude an estimated 25 million minutes outgoing Voice over IP traffic.

# France

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Germany | 565.0 | 11.4% |
| 2. | United Kingdom | 555.0 | 11.2% |
| 3. | Belgium | 405.0 | 8.2% |
| 4. | Italy | 400.0 | 8.1% |
| 5. | United States | 350.0 | 7.1% |
| 6. | Switzerland | 330.0 | 6.7% |
| 7. | Spain | 315.0 | 6.4% |
| 8. | Morocco | 205.0 | 4.1% |
| 9. | Portugal | 185.0 | 3.7% |
| 10. | Netherlands | 170.0 | 3.4% |
| 11. | Algeria | 160.0 | 3.2% |
| 12. | Canada | 120.0 | 2.4% |
| 13. | Tunisia | 110.0 | 2.2% |
| 14. | Turkey | 65.0 | 1.3% |
| 15. | Poland | 59.0 | 1.2% |
| 16. | Luxembourg | 55.0 | 1.1% |
| 17. | Sweden | 40.0 | 0.8% |
| 18. | Austria | 34.0 | 0.7% |
| 19. | Greece | 34.0 | 0.7% |
| 20. | Denmark | 33.0 | 0.7% |
| | Other | 760.0 | 15.4% |
| | **Total** | **4,950.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 3,609.0 | n.a. | n.a. |
| Outgoing | 3,545.0 | 4,115.0 | 4,950.0 |
| Surplus (Deficit) | 64.0 | n.a. | n.a. |
| Total Volume | 7,154.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# French Polynesia

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 9,380.0 | 64.1% |
| 2. United States | 1,507.0 | 10.3% |
| 3. New Caledonia | 806.0 | 5.5% |
| 4. New Zealand | 438.0 | 3.0% |
| 5. Australia | 384.0 | 2.6% |
| 6. Italy | 164.0 | 1.1% |
| 7. Cook Islands | 156.0 | 1.1% |
| 8. Japan | 133.0 | 0.9% |
| 9. United Kingdom | 99.0 | 0.7% |
| 10. Réunion | 95.0 | 0.6% |
| 11. Germany | 90.0 | 0.6% |
| 12. China | 79.0 | 0.5% |
| 13. Philippines | 59.0 | 0.4% |
| Other | 1,240.0 | 8.5% |
| **Total** | **14,630.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | n.a. | 12.3 | 14.6 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic

# Georgia

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Russia | 28.6 | 61.2% |
| 2. Ukraine | 3.6 | 7.7% |
| 3. Armenia | 2.0 | 4.3% |
| 4. Azerbaijan | 2.0 | 4.3% |
| 5. Kazakhstan | 0.5 | 1.1% |
| 6. Belarus | 0.5 | 1.1% |
| 7. Uzbekistan | 0.3 | 0.6% |
| 8. Moldova | 0.2 | 0.4% |
| 9. Turkmenistan | 0.2 | 0.4% |
| 10. Kyrgyzstan | 0.1 | 0.2% |
| Other | 8.8 | 18.8% |
| **Total** | **46.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 65.9 | 72.0 | 65.7 |
| Outgoing | 38.5 | n.a. | 46.7 |
| Surplus (Deficit) | 27.4 | | 19.0 |
| Total Volume | 104.4 | n.a. | 112.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic The "Other" category may include routes to non-members of the Commonwealth of Independent States that rank among the top destinations for outgoing traffic.

# Germany

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Switzerland | 650.0 | 9.3% |
| 2. | United Kingdom | 605.0 | 8.7% |
| 3. | Italy | 590.0 | 8.5% |
| 4. | Austria | 555.0 | 8.0% |
| 5. | France | 540.0 | 7.8% |
| 6. | United States | 455.0 | 6.5% |
| 7. | Poland | 445.0 | 6.4% |
| 8. | Netherlands | 440.0 | 6.3% |
| 9. | Turkey | 420.0 | 6.0% |
| 10. | Spain | 280.0 | 4.0% |
| 11. | Belgium | 160.0 | 2.3% |
| 12. | Denmark | 140.0 | 2.0% |
| 13. | Czech Republic | 140.0 | 2.0% |
| 14. | Greece | 135.0 | 1.9% |
| 15. | Croatia | 115.0 | 1.7% |
| 16. | Yugoslavia | 105.0 | 1.5% |
| 17. | Hungary | 86.0 | 1.2% |
| 18. | Portugal | 80.0 | 1.1% |
| 19. | Romania | 72.0 | 1.0% |
| 20. | Sweden | 67.0 | 1.0% |
| | Other | 885.0 | 12.7% |
| | **Total** | **6,965.0** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 5,618.0 | n.a. | n.a. |
| Outgoing | 4,813.0 | 5,870.0 | 6,965.0 |
| Surplus (Deficit) | 805.0 | n.a. | n.a. |
| Total Volume | 10,431.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Ghana

## Largest Telecommunications Routes, 1999

| Destination | | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United Kingdom | 12.2 | 40.4% |
| 2. | United States | 7.4 | 24.5% |
| 3. | Germany | 1.9 | 6.3% |
| 4. | Italy | 1.2 | 4.0% |
| 5. | South Africa | 1.0 | 3.5% |
| 6. | Canada | 1.0 | 3.4% |
| 7. | France | 1.0 | 3.2% |
| 8. | Japan | 0.7 | 2.4% |
| 9. | Netherlands | 0.7 | 2.3% |
| 10. | Togo | 0.5 | 1.5% |
| 11. | Belgium | 0.3 | 0.9% |
| 12. | Benin | 0.2 | 0.5% |
| 13. | Egypt | 0.1 | 0.4% |
| 14. | Burkina Faso | 0.1 | 0.4% |
| 15. | Liberia | 0.1 | 0.3% |
| 16. | Senegal | 0.1 | 0.3% |
| 17. | Zimbabwe | 0.1 | 0.3% |
| 18. | Niger | 0.1 | 0.2% |
| 19. | Kenya | 0.1 | 0.2% |
| 20. | Gambia | 0.1 | 0.2% |
| | Other | 1.5 | 5.0% |
| | **Total** | **30.1** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 79.2 | 100.8 | 118.4 |
| Outgoing | 21.9 | 28.9 | 30.1 |
| Surplus (Deficit) | 57.3 | 72.0 | 88.2 |
| Total Volume | 101.1 | 129.7 | 148.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic

# Gibraltar

## Largest Telecommunications Routes, FY 1999/00

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United Kingdom | 7.0 | 42.9% |
| 2. | Spain | 6.1 | 37.2% |
| 3. | Morocco | 0.6 | 3.5% |
| 4. | United States | 0.3 | 1.7% |
| 5. | Switzerland | 0.3 | 1.6% |
| 6. | Germany | 0.2 | 1.1% |
| 7. | France | 0.2 | 1.0% |
| 8. | Denmark | 0.1 | 0.9% |
| 9. | Ireland | 0.1 | 0.8% |
| 10. | Portugal | 0.1 | 0.8% |
| 11. | Netherlands | 0.1 | 0.7% |
| 12. | Russia | 0.1 | 0.6% |
| 13. | Hong Kong | 0.1 | 0.6% |
| 14. | Greece | 0.1 | 0.5% |
| 15. | Italy | 0.1 | 0.5% |
| 16. | India | 0.1 | 0.4% |
| 17. | Belgium | 0.1 | 0.4% |
| 18. | Canada | 0.1 | 0.4% |
| 19. | Sweden | 0.1 | 0.4% |
| 20. | South Africa | 0.1 | 0.3% |
| | Other | 0.6 | 3.7% |
| | **Total** | **16.4** | |



## National Traffic Balance

| Minutes | FY 1997/00 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | n.a. | 21.6 |
| Outgoing | 13.7 | 14.4 | 16.4 |
| Surplus (Deficit) | n.a. | n.a. | 5.3 |
| Total Volume | n.a. | n.a. | 38.0 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Greece

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 112.2 | 15.5% |
| 2. United Kingdom | 106.5 | 14.7% |
| 3. Italy | 59.9 | 8.3% |
| 4. United States | 39.8 | 5.5% |
| 5. Albania | 36.7 | 5.1% |
| 6. France | 29.1 | 4.0% |
| 7. Cyprus | 27.8 | 3.8% |
| 8. Bulgaria | 24.6 | 3.4% |
| 9. Romania | 21.0 | 2.9% |
| 10. Netherlands | 17.9 | 2.5% |
| 11. Belgium | 14.3 | 2.0% |
| 12. Sweden | 12.8 | 1.8% |
| 13. Switzerland | 12.8 | 1.8% |
| 14. Ukraine | 11.4 | 1.6% |
| 15. Australia | 10.1 | 1.4% |
| 16. Yugoslavia | 10.1 | 1.4% |
| 17. Austria | 10.0 | 1.4% |
| 18. Russia | 10.0 | 1.4% |
| 19. Turkey | 9.6 | 1.3% |
| 20. Canada | 9.2 | 1.3% |
| Other | 139.9 | 19.3% |
| **Total** | **725.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 634.6 | 710.1 | 794.2 |
| Outgoing | 593.7 | 681.3 | 725.7 |
| Surplus (Deficit) | 40.9 | 28.8 | 68.5 |
| Total Volume | 1,228.3 | 1,391.4 | 1,519.9 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data exclude cross-border traffic to Macedonia.

# Guatemala

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 38.8 | 46.5% |
| 2. Mexico | 10.8 | 12.9% |
| 3. El Salvador | 10.0 | 12.0% |
| 4. Costa Rica | 4.8 | 5.8% |
| 5. Honduras | 4.8 | 5.8% |
| 6. Nicaragua | 2.7 | 3.3% |
| 7. Panama | 1.6 | 2.0% |
| 8. Colombia | 1.4 | 1.7% |
| 9. Canada | 1.1 | 1.3% |
| 10. Spain | 1.0 | 1.2% |
| 11. Korea, Rep. | 0.6 | 0.7% |
| 12. Italy | 0.6 | 0.7% |
| 13. Germany | 0.5 | 0.6% |
| 14. Venezuela | 0.5 | 0.6% |
| 15. Argentina | 0.5 | 0.6% |
| 16. Peru | 0.4 | 0.5% |
| 17. Brazil | 0.4 | 0.4% |
| 18. France | 0.3 | 0.4% |
| 19. Belize | 0.3 | 0.4% |
| 20. Dominican Republic | 0.3 | 0.4% |
| Other | 1.9 | 2.3% |
| **Total** | **83.3** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | 1999 |
|---|---|---|---|
| Incoming | 165.0 | n.a. | 208.6 |
| Outgoing | 48.5 | 60.0 | 83.3 |
| Surplus (Deficit) | 116.5 | n.a. | 125.3 |
| Total Volume | 213.5 | n.a. | 291.9 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Guyana

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 7,590.1 | 47.3% |
| 2. Canada | 2,087.9 | 13.0% |
| 3. Trinidad & Tobago | 1,558.5 | 9.7% |
| 4. Barbados | 879.6 | 5.5% |
| 5. United Kingdom | 630.0 | 3.9% |
| 6. Suriname | 279.0 | 1.7% |
| 7. Jamaica | 241.7 | 1.5% |
| 8. Antigua & Barbuda | 206.1 | 1.3% |
| 9. Venezuela | 100.5 | 0.6% |
| 10. Saint Kitts & Nevis | 87.4 | 0.5% |
| 11. Netherlands Antilles | 83.9 | 0.5% |
| 12. China | 82.0 | 0.5% |
| 13. French Guiana | 75.4 | 0.5% |
| 14. Brazil | 72.9 | 0.5% |
| 15. Grenada | 70.2 | 0.4% |
| 16. Saint Vincent & the Grenadines | 68.2 | 0.4% |
| 17. Bahamas | 46.9 | 0.3% |
| 18. Dominica | 32.4 | 0.2% |
| 19. Turks & Caicos Islands | 28.6 | 0.2% |
| 20. Dominican Republic | 26.9 | 0.2% |
| Other | 1,812.8 | 11.3% |
| **Total** | **16,061.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 142.4 | 93.8 | 101.0 |
| Outgoing | 24.1 | 14.3 | 16.1 |
| Surplus (Deficit) | 118.3 | 79.5 | 84.9 |
| Total Volume | 166.5 | 108.1 | 117.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Hong Kong

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. China | 1,263.7 | 46.5% |
| 2. United States | 240.3 | 8.8% |
| 3. Philippines | 189.1 | 7.0% |
| 4. Canada | 174.3 | 6.4% |
| 5. United Kingdom | 125.0 | 4.6% |
| 6. Taiwan | 112.7 | 4.1% |
| 7. Australia | 106.4 | 3.9% |
| 8. Japan | 80.0 | 2.9% |
| 9. Singapore | 79.5 | 2.9% |
| Other | 349.3 | 12.8% |
| **Total** | **2,720.3** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 2,100.3 | 1,833.0 | 1,747.2 |
| Outgoing | 1,718.0 | 1,879.8 | 2,720.3 |
| Surplus (Deficit) | 382.3 | (46.8) | (973.1) |
| Total Volume | 3,818.3 | 3,712.8 | 4,467.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Fiscal year ends 31 March.

# Hungary

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Germany | 88.5 | 25.7% |
| 2. | Austria | 39.2 | 11.4% |
| 3. | Romania | 30.0 | 8.7% |
| 4. | Yugoslavia | 19.5 | 5.7% |
| 5. | Italy | 16.8 | 4.9% |
| 6. | United Kingdom | 16.1 | 4.7% |
| 7. | United States | 14.1 | 4.1% |
| 8. | France | 11.0 | 3.2% |
| 9. | Netherlands | 8.0 | 2.3% |
| 10. | Switzerland | 7.6 | 2.2% |
| | Other | 93.1 | 27.1% |
| | **Total** | **343.9** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 324.6 | 374.5 | n.a. |
| Outgoing | 287.1 | 296.3 | 343.9 |
| Surplus (Deficit) | 37.5 | 78.2 | n.a. |
| Total Volume | 611.7 | 670.8 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data based on billing point of traffic.

# India

## Largest Telecommunications Routes, FY 1999/00

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Saudi Arabia | 91.2 | 19.3% |
| 2. | United States | 59.9 | 12.7% |
| 3. | United Arab Emirates | 42.2 | 8.9% |
| 4. | United Kingdom | 42.0 | 8.9% |
| 5. | Singapore | 21.2 | 4.5% |
| 6. | Kuwait | 16.1 | 3.4% |
| 7. | Oman | 15.4 | 3.2% |
| 8. | Germany | 14.3 | 3.0% |
| 9. | Canada | 9.2 | 1.9% |
| 10. | Sri Lanka | 9.2 | 1.9% |
| 11. | Australia | 8.7 | 1.8% |
| 12. | Hong Kong | 8.4 | 1.8% |
| 13. | Japan | 8.2 | 1.7% |
| 14. | France | 8.1 | 1.7% |
| 15. | Italy | 7.6 | 1.6% |
| 16. | Malaysia | 6.6 | 1.4% |
| 17. | Qatar | 6.3 | 1.3% |
| 18. | Pakistan | 5.0 | 1.1% |
| 19. | Bangladesh | 4.5 | 1.0% |
| 20. | Philippines | 4.5 | 0.9% |
| | Other | 84.7 | 17.9% |
| | **Total** | **473.3** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 1,256.6 | 1,498.8 | 1,772.5 |
| Outgoing | 420.5 | 436.2 | 473.3 |
| Surplus (Deficit) | 836.1 | 1,062.6 | 1,299.2 |
| Total Volume | 1,677.1 | 1,935.0 | 2,245.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Fiscal year ends 31 March. Data exclude some cross-border traffic with Bangladesh, Nepal, and Pakistan.

# Indonesia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Singapore | 62.8 | 23.3% |
| 2. | Malaysia | 29.2 | 10.8% |
| 3. | Australia | 27.8 | 10.3% |
| 4. | United States | 23.6 | 8.8% |
| 5. | Japan | 20.3 | 7.5% |
| 6. | Taiwan | 11.6 | 4.3% |
| 7. | Hong Kong | 9.2 | 3.4% |
| 8. | Korea, Rep. | 9.0 | 3.3% |
| 9. | United Kingdom | 7.8 | 2.9% |
| 10. | India | 6.4 | 2.4% |
| 11. | China | 5.8 | 2.1% |
| 12. | Thailand | 5.2 | 1.9% |
| 13. | Germany | 5.0 | 1.9% |
| 14. | Philippines | 4.6 | 1.7% |
| 15. | Netherlands | 4.0 | 1.5% |
| 16. | France | 3.3 | 1.2% |
| 17. | Brunei | 2.2 | 0.8% |
| 18. | Italy | 2.0 | 0.7% |
| 19. | Canada | 1.9 | 0.7% |
| 20. | Switzerland | 1.2 | 0.5% |
| | Other | 26.6 | 9.9% |
| | **Total** | **269.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 456.0 | 434.2 | n.a. |
| Outgoing | 351.6 | 324.5 | 269.6 |
| Surplus (Deficit) | 104.4 | 109.7 | n.a. |
| Total Volume | 807.6 | 758.7 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. 1999 outgoing traffic data exclude at least 50 million minutes of calls sent illegally over international private lines.

# Iran

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United Arab Emirates | 23.1 | 11.5% |
| 2. | Germany | 19.2 | 9.6% |
| 3. | United States | 19.1 | 9.5% |
| 4. | Pakistan | 16.0 | 8.0% |
| 5. | Turkey | 11.0 | 5.5% |
| 6. | United Kingdom | 10.2 | 5.1% |
| 7. | Kuwait | 9.9 | 4.9% |
| 8. | Sweden | 6.8 | 3.4% |
| 9. | Japan | 4.4 | 2.2% |
| 10. | Azerbaijan | 3.9 | 1.9% |
| 11. | Italy | 3.8 | 1.9% |
| 12. | France | 3.5 | 1.7% |
| 13. | Algeria | 3.2 | 1.6% |
| 14. | Netherlands | 2.6 | 1.3% |
| 15. | Austria | 2.3 | 1.2% |
| 16. | Qatar | 2.2 | 1.1% |
| 17. | Canada | 2.2 | 1.1% |
| 18. | Switzerland | 2.1 | 1.0% |
| 19. | Russia | 2.0 | 1.0% |
| 20. | India | 1.7 | 0.9% |
| | Other | 51.1 | 25.5% |
| | **Total** | **200.4** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 130.2 | 185.7 | 216.3 |
| Outgoing | 160.7 | 177.0 | 200.4 |
| Surplus (Deficit) | (30.5) | 8.8 | 15.9 |
| Total Volume | 290.9 | 362.7 | 416.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic

# Ireland

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United Kingdom | 700.0 | 69.0% |
| 2. United States | 90.0 | 8.9% |
| 3. France | 29.0 | 2.9% |
| 4. Germany | 29.0 | 2.9% |
| 5. Netherlands | 25.0 | 2.5% |
| 6. Canada | 14.0 | 1.4% |
| 7. Italy | 12.0 | 1.2% |
| 8. Spain | 10.0 | 1.0% |
| 9. Belgium | 8.0 | 0.8% |
| 10. Australia | 7.0 | 0.7% |
| Other | 91.0 | 9.0% |
| **Total** | **1,015.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 695.0 | 885.0 | 1,015.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Fiscal year ends 31 March.

# Israel

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 200.0 | 24.9% |
| 2. United Kingdom | 67.0 | 8.3% |
| 3. Canada | 50.0 | 6.2% |
| 4. France | 43.0 | 5.3% |
| 5. Germany | 43.0 | 5.3% |
| 6. Italy | 30.0 | 3.7% |
| 7. Russia | 27.0 | 3.4% |
| 8. Jordan | 26.0 | 3.2% |
| 9. Ukraine | 25.0 | 3.1% |
| 10. Netherlands | 16.0 | 2.0% |
| Other | 277.0 | 34.5% |
| **Total** | **804.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 425.0 | 424.0 | n.a. |
| Outgoing | 459.0 | 661.0 | 804.0 |
| Surplus (Deficit) | (34.0) | (237.0) | n.a. |
| Total Volume | 884.0 | 1,085.0 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data based on billing point of traffic

# Italy

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 465.0 | 15.0% |
| 2. France | 370.0 | 11.9% |
| 3. Switzerland | 270.0 | 8.7% |
| 4. United Kingdom | 260.0 | 8.4% |
| 5. United States | 210.0 | 6.8% |
| 6. Spain | 135.0 | 4.4% |
| 7. Romania | 90.0 | 2.9% |
| 8. Austria | 90.0 | 2.9% |
| 9. Belgium | 80.0 | 2.6% |
| 10. Netherlands | 65.0 | 2.1% |
| 11. Poland | 65.0 | 2.1% |
| 12. Greece | 60.0 | 1.9% |
| 13. Morocco | 58.0 | 1.9% |
| 14. Canada | 55.0 | 1.8% |
| 15. Albania | 43.0 | 1.4% |
| 16. Tunisia | 41.0 | 1.3% |
| 17. Croatia | 41.0 | 1.3% |
| 18. Chile | 30.0 | 1.0% |
| 19. Sweden | 27.0 | 0.9% |
| 20. Russia | 25.0 | 0.8% |
| Other | 620.0 | 20.0% |
| **Total** | **3,100.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 2,475.1 | n.a. | n.a. |
| Outgoing | 2,351.9 | 2,640.0 | 3,100.0 |
| Surplus (Deficit) | 123.2 | n.a. | n.a. |
| Total Volume | 4,827.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data exclude some traffic to France, Poland, Slovenia, and Switzerland

# Jamaica

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 44.5 | 67.0% |
| 2. | United Kingdom | 5.4 | 8.1% |
| 3. | Canada | 4.6 | 7.0% |
| 4. | Cayman Islands | 1.8 | 2.7% |
| 5. | Trinidad & Tobago | 1.4 | 2.2% |
| 6. | Bahamas | 1.1 | 1.6% |
| 7. | Barbados | 1.0 | 1.5% |
| 8. | Germany | 0.6 | 0.8% |
| 9. | Turks & Caicos Islands | 0.3 | 0.5% |
| 10. | Cuba | 0.3 | 0.5% |
| 11. | Saint Lucia | 0.3 | 0.4% |
| 12. | Antigua & Barbuda | 0.3 | 0.4% |
| 13. | Netherlands | 0.3 | 0.4% |
| 14. | India | 0.3 | 0.4% |
| 15. | Italy | 0.2 | 0.3% |
| 16. | Panama | 0.2 | 0.3% |
| 17. | Switzerland | 0.2 | 0.3% |
| 18. | Mexico | 0.2 | 0.3% |
| 19. | Saint Vincent & the Grenadines | 0.2 | 0.3% |
| 20. | Japan | 0.2 | 0.2% |
| | Other | 3.2 | 4.8% |
| | **Total** | **66.4** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 349.8 | 335.9 |
| Outgoing | n.a. | 60.1 | 66.4 |
| Surplus (Deficit) | n.a. | 289.7 | 269.5 |
| Total Volume | n.a. | 409.9 | 402.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic

# Japan

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 406.4 | 20.8% |
| 2. China | 285.1 | 14.6% |
| 3. Philippines | 174.8 | 8.9% |
| 4. Korea, Rep. | 167.0 | 8.5% |
| 5. Taiwan | 107.1 | 5.5% |
| 6. Brazil | 79.8 | 4.1% |
| 7. Thailand | 79.4 | 4.1% |
| 8. United Kingdom | 60.9 | 3.1% |
| 9. Hong Kong | 58.4 | 3.0% |
| 10. Singapore | 48.0 | 2.5% |
| 11. Australia | 42.9 | 2.2% |
| 12. Indonesia | 38.1 | 1.9% |
| 13. Seychelles | 35.8 | 1.8% |
| 14. Germany | 30.1 | 1.5% |
| 15. Malaysia | 28.2 | 1.4% |
| 16. Canada | 27.1 | 1.4% |
| 17. France | 27.0 | 1.4% |
| 18. Russia | 19.0 | 1.0% |
| 19. Vietnam | 15.7 | 0.8% |
| 20. India | 14.2 | 0.7% |
| Other | 211.6 | 10.8% |
| **Total** | **1,956.6** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 1,635.0 | 1,575.0 | 1,929.6 |
| Outgoing | 1,771.7 | 1,895.0 | 1,956.6 |
| Surplus (Deficit) | (136.7) | (320.0) | (27.0) |
| Total Volume | 3,406.7 | 3,470.0 | 3,886.2 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Fiscal year ends 31 March.

# Jordan

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Saudi Arabia | 20.5 | 15.5% |
| 2. Egypt | 15.1 | 11.4% |
| 3. United Arab Emirates | 11.4 | 8.6% |
| 4. Syria | 10.4 | 7.9% |
| 5. Iraq | 9.9 | 7.4% |
| 6. Israel | 9.1 | 6.9% |
| 7. United States | 8.5 | 6.4% |
| 8. Kuwait | 5.7 | 4.3% |
| 9. United Kingdom | 4.6 | 3.4% |
| 10. Qatar | 3.0 | 2.3% |
| 11. Germany | 2.6 | 1.9% |
| 12. Italy | 1.7 | 1.3% |
| 13. France | 1.7 | 1.3% |
| 14. Canada | 1.6 | 1.2% |
| 15. Oman | 1.5 | 1.1% |
| 16. Yemen | 1.4 | 1.1% |
| 17. Bahrain | 1.3 | 1.0% |
| 18. Turkey | 1.1 | 0.8% |
| 19. Switzerland | 0.7 | 0.6% |
| 20. India | 0.7 | 0.5% |
| Other | 20.0 | 15.1% |
| **Total** | **132.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 145.0 | 176.9 | n.a. |
| Outgoing | 91.9 | 122.6 | 132.5 |
| Surplus (Deficit) | 53.1 | 54.4 | n.a. |
| Total Volume | 236.9 | 299.5 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Kazakhstan

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Russia | 66.4 | 63.5% |
| 2. Uzbekistan | 7.2 | 6.9% |
| 3. Kyrgyzstan | 5.4 | 5.2% |
| 4. Ukraine | 3.5 | 3.3% |
| 5. Azerbaijan | 1.6 | 1.5% |
| 6. Belarus | 1.5 | 1.4% |
| 7. Tajikistan | 1.0 | 1.0% |
| 8. Armenia | 0.7 | 0.7% |
| 9. Turkmenistan | 0.7 | 0.7% |
| 10. Georgia | 0.6 | 0.6% |
| 11. Moldova | 0.3 | 0.3% |
| Other | 15.5 | 14.8% |
| **Total** | **104.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 137.5 | 149.8 |
| Outgoing | 114.7 | 118.9 | 104.5 |
| Surplus (Deficit) | n.a. | 18.6 | 45.3 |
| Total Volume | n.a. | 256.4 | 254.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. The "Other" category may include routes to non-members of the Commonwealth of Independent States that rank among the top destinations for outgoing traffic.

# Korea, Rep.

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 210.0 | 23.4% |
| 2. | Japan | 150.0 | 16.7% |
| 3. | China | 140.0 | 15.6% |
| 4. | Philippines | 26.0 | 2.9% |
| 5. | Hong Kong | 25.0 | 2.8% |
| 6. | Canada | 24.0 | 2.7% |
| 7. | Australia | 22.0 | 2.4% |
| 8. | Indonesia | 18.0 | 2.0% |
| 9. | Germany | 17.0 | 1.9% |
| 10. | Vietnam | 17.0 | 1.9% |
| 11. | Taiwan | 14.0 | 1.6% |
| 12. | Pakistan | 13.0 | 1.4% |
| 13. | Singapore | 13.0 | 1.4% |
| 14. | Thailand | 10.0 | 1.1% |
| 15. | United Kingdom | 10.0 | 1.1% |
| | Other | 189.0 | 21.0% |
| | **Total** | **898.0** | |



## National Traffic Balance

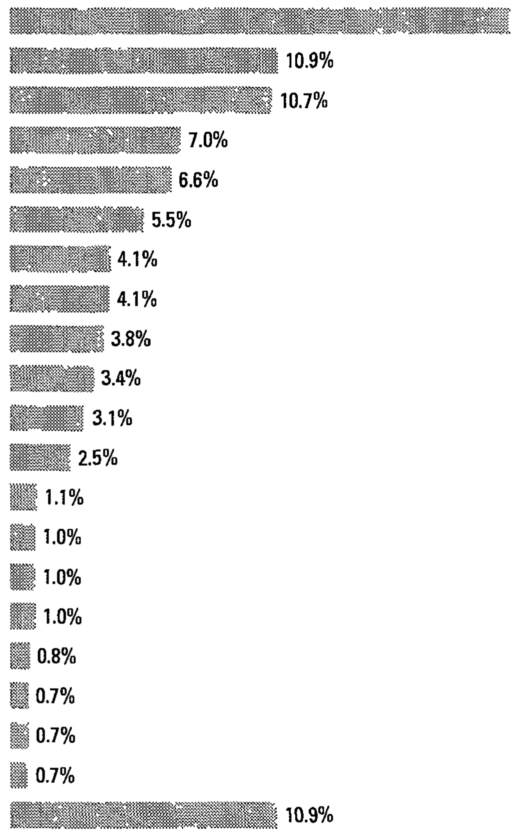
| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 782.0 | 719.4 | n.a. |
| Outgoing | 885.0 | 907.7 | 898.0 |
| Surplus (Deficit) | (103.0) | (188.3) | n.a. |
| Total Volume | 1,667.0 | 1,627.1 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1999 data are for Korea Telecom, DACOM and Onse only.

# Kuwait

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Egypt | 35.0 | 20.6% |
| 2. Saudi Arabia | 18.6 | 10.9% |
| 3. India | 18.2 | 10.7% |
| 4. Syria | 11.9 | 7.0% |
| 5. United Arab Emirates | 11.2 | 6.6% |
| 6. United States | 9.3 | 5.5% |
| 7. Iran | 7.0 | 4.1% |
| 8. Pakistan | 6.9 | 4.1% |
| 9. United Kingdom | 6.5 | 3.8% |
| 10. Jordan | 5.8 | 3.4% |
| 11. Lebanon | 5.2 | 3.1% |
| 12. Bahrain | 4.2 | 2.5% |
| 13. Qatar | 1.8 | 1.1% |
| 14. Philippines | 1.7 | 1.0% |
| 15. Canada | 1.7 | 1.0% |
| 16. Bangladesh | 1.7 | 1.0% |
| 17. Sri Lanka | 1.3 | 0.8% |
| 18. Oman | 1.2 | 0.7% |
| 19. France | 1.2 | 0.7% |
| 20. Germany | 1.1 | 0.7% |
| Other | 18.2 | 10.9% |
| **Total** | **170.0** | |





## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 135.0 | 120.0 |
| Outgoing | 160.5 | 173.1 | 170.0 |
| Surplus (Deficit) | n.a. | (38.1) | (50.0) |
| Total Volume | n.a. | 308.1 | 290.0 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Kyrgyzstan

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Russia | 10.3 | 43.8% |
| 2. Kazakhstan | 5.9 | 25.1% |
| 3. Uzbekistan | 2.7 | 11.5% |
| 4. Tajikistan | 0.5 | 2.1% |
| 5. Ukraine | 0.5 | 2.1% |
| 6. Belarus | 0.2 | 0.9% |
| 7. Turkmenistan | 0.2 | 0.9% |
| 8. Azerbaijan | 0.1 | 0.4% |
| Other | 2.9 | 12.3% |
| **Total** | **23.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 5.7 | 30.1 | n.a. |
| Outgoing | 28.6 | 30.4 | 23.5 |
| Surplus (Deficit) | (22.9) | (0.3) | n.a. |
| Total Volume | 34.3 | 60.5 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. The "Other" category may include routes to non-members of the Commonwealth of Independent States that rank among the top destinations for outgoing traffic.

# Latvia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 13.3 | 23.9% |
| 2. | Lithuania | 6.5 | 11.7% |
| 3. | Estonia | 5.3 | 9.4% |
| 4. | Germany | 3.9 | 6.9% |
| 5. | Belarus | 3.8 | 6.7% |
| 6. | Sweden | 2.9 | 5.2% |
| 7. | Ukraine | 2.6 | 4.8% |
| 8. | United Kingdom | 2.1 | 3.7% |
| 9. | Finland | 1.8 | 3.2% |
| 10. | Denmark | 1.4 | 2.6% |
| 11. | Poland | 1.4 | 2.4% |
| 12. | Norway | 0.8 | 1.4% |
| 13. | Netherlands | 0.7 | 1.3% |
| 14. | France | 0.7 | 1.3% |
| 15. | Italy | 0.7 | 1.2% |
| 16. | United States | 0.6 | 1.1% |
| 17. | Switzerland | 0.6 | 1.1% |
| 18. | Belgium | 0.5 | 0.9% |
| 19. | Austria | 0.4 | 0.7% |
| 20. | Israel | 0.3 | 0.6% |
| | Other | 5.5 | 10.0% |
| | **Total** | **55.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 81.8 | 87.2 | 90.0 |
| Outgoing | 44.0 | 55.4 | 55.6 |
| Surplus (Deficit) | 37.8 | 31.8 | 34.4 |
| Total Volume | 125.8 | 142.5 | 145.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Luxembourg

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 76.0 | 23.8% |
| 2. Germany | 75.0 | 23.5% |
| 3. Belgium | 73.0 | 22.9% |
| 4. Portugal | 20.0 | 6.3% |
| 5. United Kingdom | 18.0 | 5.6% |
| 6. Italy | 15.0 | 4.7% |
| 7. Netherlands | 11.0 | 3.4% |
| 8. Switzerland | 9.0 | 2.8% |
| 9. United States | 7.0 | 2.2% |
| 10. Spain | 5.0 | 1.6% |
| Other | 10.1 | 3.2% |
| **Total** | **319.1** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 208.0 | 242.6 | 277.5 |
| Outgoing | 282.9 | 293.8 | 319.1 |
| Surplus (Deficit) | (74.9) | (51.2) | (41.5) |
| Total Volume | 490.9 | 536.4 | 596.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Macau

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Hong Kong | 53.0 | 39.9% |
| 2. | China | 50.7 | 38.1% |
| 3. | Taiwan | 7.5 | 5.7% |
| 4. | United States | 4.1 | 3.1% |
| 5. | Portugal | 3.9 | 2.9% |
| 6. | Canada | 2.6 | 2.0% |
| 7. | Philippines | 1.9 | 1.5% |
| 8. | United Kingdom | 1.9 | 1.4% |
| 9. | Australia | 1.8 | 1.3% |
| 10. | Thailand | 1.1 | 0.8% |
| 11. | Singapore | 0.6 | 0.5% |
| 12. | Japan | 0.4 | 0.3% |
| 13. | Malaysia | 0.4 | 0.3% |
| 14. | Korea, Rep. | 0.3 | 0.2% |
| 15. | France | 0.3 | 0.2% |
| 16. | Vietnam | 0.2 | 0.2% |
| 17. | Indonesia | 0.2 | 0.1% |
| 18. | New Zealand | 0.2 | 0.1% |
| 19. | Cambodia | 0.1 | 0.1% |
| 20. | Germany | 0.1 | 0.1% |
| | Other | 1.5 | 1.2% |
| | **Total** | **132.8** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 92.2 | 95.1 | 97.7 |
| Outgoing | 119.0 | 125.2 | 132.8 |
| Surplus (Deficit) | (26.8) | (30.2) | (35.1) |
| Total Volume | 211.2 | 220.3 | 230.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Macedonia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Yugoslavia | 24.6 | 29.9% |
| 2. | Germany | 11.9 | 14.4% |
| 3. | Switzerland | 4.8 | 5.8% |
| 4. | Greece | 4.4 | 5.3% |
| 5. | Bulgaria | 4.3 | 5.3% |
| 6. | Italy | 3.9 | 4.7% |
| 7. | Slovenia | 3.3 | 4.0% |
| 8. | United States | 3.2 | 3.9% |
| 9. | Turkey | 3.0 | 3.7% |
| 10. | United Kingdom | 3.0 | 3.7% |
| 11. | Croatia | 2.4 | 3.0% |
| 12. | France | 2.3 | 2.9% |
| 13. | Austria | 2.0 | 2.5% |
| 14. | Albania | 1.4 | 1.7% |
| 15. | Australia | 1.0 | 1.3% |
| 16. | Bosnia-Herzegovina | 0.9 | 1.1% |
| 17. | Hungary | 0.8 | 1.0% |
| 18. | Belgium | 0.8 | 1.0% |
| 19. | Netherlands | 0.8 | 0.9% |
| 20. | Denmark | 0.5 | 0.6% |
| | Other | 2.8 | 3.5% |
| | **Total** | **82.3** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 85.0 | 91.7 | 152.5 |
| Outgoing | 51.7 | 37.1 | 82.3 |
| Surplus (Deficit) | 33.3 | 54.6 | 70.3 |
| Total Volume | 136.7 | 128.9 | 234.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data for 1998 exclude an estimated 20 million minutes of traffic to Yugoslavia.

# Madagascar

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 4,768.7 | 49.5% |
| 2. Réunion | 1,246.4 | 12.9% |
| 3. Mauritius | 606.8 | 6.3% |
| 4. Italy | 250.9 | 2.6% |
| 5. China | 211.2 | 2.2% |
| 6. South Africa | 197.4 | 2.0% |
| 7. India | 172.8 | 1.8% |
| 8. Comoros | 144.0 | 1.5% |
| 9. United States | 142.9 | 1.5% |
| 10. United Kingdom | 140.2 | 1.5% |
| 11. Belgium | 140.2 | 1.5% |
| 12. Switzerland | 126.8 | 1.3% |
| 13. Mayotte | 120.6 | 1.3% |
| 14. Germany | 118.4 | 1.2% |
| 15. Canada | 85.0 | 0.9% |
| 16. Thailand | 66.9 | 0.7% |
| 17. Kenya | 66.1 | 0.7% |
| 18. Hong Kong | 65.8 | 0.7% |
| 19. Japan | 53.7 | 0.6% |
| 20. Singapore | 44.4 | 0.5% |
| Other | 871.4 | 9.0% |
| **Total** | **9,640.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 12.6 | 15.8 | 9.7 |
| Outgoing | 7.6 | 9.5 | 9.6 |
| Surplus (Deficit) | 5.0 | 6.3 | 0.0 |
| Total Volume | 20.2 | 25.3 | 19.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Malaysia

## Largest Telecommunications Routes, FY 1999/00

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Singapore | 350.0 | 50.7% |
| 2. | Indonesia | 45.0 | 6.5% |
| 3. | Thailand | 40.0 | 5.8% |
| 4. | Japan | 29.0 | 4.2% |
| 5. | Australia | 25.0 | 3.6% |
| 6. | United States | 25.0 | 3.6% |
| 7. | United Kingdom | 24.0 | 3.5% |
| 8. | Hong Kong | 15.0 | 2.2% |
| 9. | Philippines | 12.0 | 1.7% |
| 10. | India | 11.0 | 1.6% |
| 11. | Taiwan | 11.0 | 1.6% |
| 12. | China | 7.0 | 1.0% |
| 13. | Germany | 6.0 | 0.9% |
| 14. | Bangladesh | 6.0 | 0.9% |
| 15. | Korea, Rep. | 4.0 | 0.6% |
| | Other | 80.0 | 11.6% |
| | **Total** | **690.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 592.0 | n.a. | n.a. |
| Outgoing | 588.5 | 685.0 | 690.0 |
| Surplus (Deficit) | 3.5 | n.a. | n.a. |
| Total Volume | 1,180.5 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Fiscal year ends 31 March. Totals for FY 1997/98 were for Telkom Malaysia only.

# Malta

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United Kingdom | 12.3 | 31.4% |
| 2. | Italy | 5.6 | 14.3% |
| 3. | Germany | 3.5 | 9.0% |
| 4. | Libya | 1.7 | 4.3% |
| 5. | France | 1.6 | 4.1% |
| 6. | United States | 1.4 | 3.6% |
| 7. | Netherlands | 1.4 | 3.5% |
| 8. | Australia | 0.9 | 2.4% |
| 9. | Switzerland | 0.8 | 2.0% |
| 10. | Belgium | 0.7 | 1.7% |
| 11. | Russia | 0.7 | 1.7% |
| 12. | Austria | 0.6 | 1.4% |
| 13. | Turkey | 0.5 | 1.4% |
| 14. | Sweden | 0.5 | 1.3% |
| 15. | Canada | 0.4 | 1.1% |
| 16. | Spain | 0.4 | 1.1% |
| 17. | Ireland | 0.4 | 1.1% |
| 18. | Greece | 0.4 | 1.1% |
| 19. | Tunisia | 0.3 | 0.9% |
| 20. | Norway | 0.3 | 0.9% |
| | Other | 4.7 | 11.9% |
| | **Total** | **39.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 37.0 | 43.4 | 50.2 |
| Outgoing | 34.4 | 37.3 | 39.0 |
| Surplus (Deficit) | 2.6 | 6.1 | 11.2 |
| Total Volume | 71.4 | 80.7 | 89.2 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Mauritania

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 3,464.4 | 41.7% |
| 2. Senegal | 1,378.7 | 16.6% |
| 3. United States | 1,216.2 | 14.6% |
| 4. Spain | 989.2 | 11.9% |
| 5. Morocco | 405.7 | 4.9% |
| 6. Côte d'Ivoire | 212.6 | 2.6% |
| 7. United Arab Emirates | 204.2 | 2.5% |
| 8. Gabon | 71.1 | 0.9% |
| 9. Canada | 33.7 | 0.4% |
| 10. Togo | 23.2 | 0.3% |
| 11. Tunisia | 23.0 | 0.3% |
| 12. Burkina Faso | 22.3 | 0.3% |
| 13. Benin | 19.5 | 0.2% |
| 14. Egypt | 17.4 | 0.2% |
| Other | 23.3 | 2.7% |
| **Total** | **8,304.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 9.4 | n.a. |
| Outgoing | 5.5 | 6.3 | 8.3 |
| Surplus (Deficit) | n.a. | 3.1 | n.a. |
| Total Volume | n.a. | 15.7 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Mauritius

## Largest Telecommunications Routes, FY 1999/00

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 6.2 | 19.7% |
| 2. | United Kingdom | 4.8 | 15.4% |
| 3. | Réunion | 3.2 | 10.2% |
| 4. | South Africa | 3.0 | 9.5% |
| 5. | India | 2.1 | 6.6% |
| 6. | Italy | 1.2 | 3.8% |
| 7. | Australia | 1.0 | 3.1% |
| 8. | Madagascar | 0.9 | 2.9% |
| 9. | Germany | 0.9 | 2.9% |
| 10. | Switzerland | 0.6 | 2.0% |
| 11. | China | 0.6 | 1.9% |
| 12. | Singapore | 0.6 | 1.9% |
| 13. | United States | 0.6 | 1.8% |
| 14. | Hong Kong | 0.5 | 1.7% |
| 15. | Belgium | 0.5 | 1.5% |
| 16. | Seychelles | 0.4 | 1.4% |
| 17. | Canada | 0.3 | 1.1% |
| 18. | Taiwan | 0.2 | 0.7% |
| 19. | Malaysia | 0.2 | 0.6% |
| 20. | Kenya | 0.2 | 0.5% |
| | Other | 3.4 | 10.8% |
| | **Total** | **31.4** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 35.0 | 39.5 | 43.3 |
| Outgoing | 24.6 | 29.7 | 31.4 |
| Surplus (Deficit) | 10.4 | 9.8 | 11.9 |
| Total Volume | 59.6 | 69.2 | 74.7 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Fiscal year ends 30 June.

# Mexico

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 1,364.6 | 87.3% |
| 2. Canada | 21.4 | 1.4% |
| 3. Spain | 15.9 | 1.0% |
| 4. France | 10.5 | 0.7% |
| 5. Guatemala | 10.2 | 0.7% |
| 6. Cuba | 9.9 | 0.6% |
| 7. Colombia | 9.8 | 0.6% |
| 8. Germany | 9.0 | 0.6% |
| 9. Argentina | 8.5 | 0.5% |
| 10. United Kingdom | 7.7 | 0.5% |
| Other | 95.5 | 6.1% |
| **Total** | **1,563.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 2,819.3 | 3,060.0 | 4,007.5 |
| Outgoing | 1,213.6 | 1,310.0 | 1,563.0 |
| Surplus (Deficit) | 1,605.7 | 1,750.0 | 2,444.5 |
| Total Volume | 4,032.9 | 4,370.0 | 5,570.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Moldova

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 15.4 | 31.4% |
| 2. | Ukraine | 13.8 | 28.1% |
| 3. | Romania | 5.9 | 11.9% |
| 4. | Greece | 1.8 | 3.7% |
| 5. | Germany | 1.6 | 3.3% |
| 6. | Italy | 1.5 | 3.1% |
| 7. | Belarus | 1.5 | 3.1% |
| 8. | Turkey | 1.4 | 2.8% |
| 9. | United States | 0.6 | 1.1% |
| 10. | Israel | 0.5 | 1.0% |
| 11. | Bulgaria | 0.5 | 1.0% |
| 12. | France | 0.5 | 0.9% |
| 13. | China | 0.3 | 0.7% |
| 14. | Poland | 0.3 | 0.6% |
| 15. | Portugal | 0.3 | 0.6% |
| 16. | United Kingdom | 0.3 | 0.6% |
| 17. | Hungary | 0.3 | 0.6% |
| 18. | Czech Republic | 0.3 | 0.5% |
| 19. | Austria | 0.2 | 0.4% |
| 20. | Spain | 0.2 | 0.4% |
| | Other | 2.0 | 4.1% |
| | **Total** | **49.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 80.2 | 90.3 | 101.1 |
| Outgoing | 55.6 | 55.8 | 49.0 |
| Surplus (Deficit) | 24.6 | 34.4 | 52.1 |
| Total Volume | 135.8 | 146.1 | 150.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Mongolia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 834.5 | 20.9% |
| 2. | China | 772.7 | 19.4% |
| 3. | United States | 432.6 | 10.8% |
| 4. | Japan | 402.6 | 10.1% |
| 5. | Korea, Rep. | 367.1 | 9.2% |
| 6. | Germany | 293.4 | 7.4% |
| 7. | United Kingdom | 135.1 | 3.4% |
| 8. | Hong Kong | 86.4 | 2.2% |
| 9. | Singapore | 58.7 | 1.5% |
| 10. | Australia | 52.0 | 1.3% |
| 11. | France | 45.5 | 1.1% |
| 12. | India | 28.1 | 0.7% |
| 13. | Philippines | 27.1 | 0.7% |
| 14. | Taiwan | 26.4 | 0.7% |
| 15. | Thailand | 16.1 | 0.4% |
| 16. | Malaysia | 10.5 | 0.3% |
| 17. | Vietnam | 9.2 | 0.2% |
| 18. | Indonesia | 9.1 | 0.2% |
| 19. | Pakistan | 7.9 | 0.2% |
| 20. | New Zealand | 5.7 | 0.1% |
| | Other | 368.5 | 9.2% |
| | **Total** | **3,989.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 10.2 | 11.4 | 18.1 |
| Outgoing | 2.9 | 3.9 | 4.0 |
| Surplus (Deficit) | 7.3 | 7.5 | 14.1 |
| Total Volume | 13.1 | 15.3 | 22.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Morocco

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 90.0 | 41.0% |
| 2. Spain | 20.0 | 9.1% |
| 3. United Kingdom | 17.0 | 7.7% |
| 4. Italy | 16.0 | 7.3% |
| 5. Germany | 9.0 | 4.1% |
| 6. United States | 9.0 | 4.1% |
| 7. Belgium | 9.0 | 4.1% |
| 8. Netherlands | 8.0 | 3.6% |
| 9. Saudi Arabia | 8.0 | 3.6% |
| 10. Canada | 4.0 | 1.8% |
| Other | 29.5 | 13.4% |
| **Total** | **219.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 364.0 | 460.0 | n.a. |
| Outgoing | 149.9 | 181.0 | 219.5 |
| Surplus (Deficit) | 214.1 | 279.0 | n.a. |
| Total Volume | 513.9 | 641.0 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Mozambique

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | South Africa | 9.7 | 47.8% |
| 2. | Portugal | 2.9 | 14.3% |
| 3. | Zimbabwe | 0.7 | 3.7% |
| 4. | United Kingdom | 0.4 | 2.0% |
| 5. | Swaziland | 0.4 | 1.8% |
| 6. | Italy | 0.3 | 1.3% |
| 7. | United States | 0.2 | 1.2% |
| 8. | Malawi | 0.2 | 1.0% |
| 9. | France | 0.2 | 1.0% |
| 10. | Tanzania | 0.2 | 0.9% |
| 11. | Germany | 0.2 | 0.8% |
| 12. | Spain | 0.1 | 0.7% |
| 13. | Brazil | 0.1 | 0.6% |
| 14. | Zambia | 0.1 | 0.6% |
| 15. | Pakistan | 0.1 | 0.6% |
| 16. | Netherlands | 0.1 | 0.5% |
| 17. | India | 0.1 | 0.4% |
| 18. | Angola | 0.1 | 0.4% |
| 19. | Sweden | 0.1 | 0.3% |
| 20. | Botswana | 0.1 | 0.3% |
| | Other | 4.0 | 19.8% |
| | **Total** | **20.3** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 29.1 | n.a. | 38.8 |
| Outgoing | 16.4 | 17.6 | 20.3 |
| Surplus (Deficit) | 12.7 | n.a. | 18.5 |
| Total Volume | 45.5 | n.a. | 59.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Myanmar

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Thailand | 3.4 | 19.7% |
| 2. Singapore | 3.2 | 18.6% |
| 3. Japan | 2.2 | 12.5% |
| 4. Malaysia | 1.4 | 8.0% |
| 5. United States | 1.2 | 6.9% |
| 6. China | 1.1 | 6.0% |
| 7. Taiwan | 1.0 | 5.7% |
| 8. India | 0.6 | 3.3% |
| 9. Australia | 0.4 | 2.2% |
| 10. Hong Kong | 0.4 | 2.1% |
| 11. United Kingdom | 0.3 | 1.9% |
| 12. Korea, Rep. | 0.3 | 1.8% |
| 13. Indonesia | 0.2 | 0.9% |
| 14. France | 0.1 | 0.7% |
| 15. Philippines | 0.1 | 0.7% |
| 16. Pakistan | 0.1 | 0.7% |
| 17. Bangladesh | 0.1 | 0.6% |
| 18. Germany | 0.1 | 0.5% |
| 19. Macau | 0.1 | 0.4% |
| 20. Vietnam | 0.1 | 0.4% |
| Other | 1.1 | 6.4% |
| **Total** | **17.4** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 35.0 | 36.3 | 29.8 |
| Outgoing | 16.3 | 19.1 | 17.4 |
| Surplus (Deficit) | 18.7 | 17.2 | 12.4 |
| Total Volume | 51.3 | 55.4 | 47.2 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Namibia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | South Africa | 51.2 | 83.6% |
| 2. | Germany | 2.3 | 3.8% |
| 3. | United Kingdom | 1.0 | 1.7% |
| 4. | United States | 0.7 | 1.1% |
| 5. | Zimbabwe | 0.7 | 1.1% |
| 6. | Angola | 0.4 | 0.7% |
| 7. | Spain | 0.4 | 0.7% |
| 8. | Zambia | 0.4 | 0.7% |
| 9. | France | 0.3 | 0.4% |
| 10. | Netherlands | 0.2 | 0.4% |
| 11. | China | 0.2 | 0.3% |
| 12. | Portugal | 0.2 | 0.3% |
| 13. | Switzerland | 0.2 | 0.3% |
| 14. | Italy | 0.2 | 0.3% |
| 15. | Russia | 0.2 | 0.3% |
| 16. | Australia | 0.1 | 0.2% |
| 17. | Austria | 0.1 | 0.2% |
| 18. | Belgium | 0.1 | 0.2% |
| | Other | 2.3 | 3.7% |
| | **Total** | **61.2** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 42.3 | 45.3 | 51.2 |
| Outgoing | 49.7 | 61.9 | 61.2 |
| Surplus (Deficit) | (7.4) | (16.6) | (10.0) |
| Total Volume | 92.0 | 107.2 | 112.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Netherlands

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 450.0 | 20.9% |
| 2. Belgium | 340.0 | 15.8% |
| 3. United Kingdom | 250.0 | 11.6% |
| 4. France | 165.0 | 7.7% |
| 5. United States | 135.0 | 6.3% |
| 6. Italy | 70.0 | 3.3% |
| 7. Spain | 60.0 | 2.8% |
| 8. Switzerland | 50.0 | 2.3% |
| 9. Turkey | 40.0 | 1.9% |
| 10. Canada | 40.0 | 1.9% |
| 11. Sweden | 32.0 | 1.5% |
| 12. Denmark | 27.0 | 1.3% |
| 13. Austria | 25.0 | 1.2% |
| 14. Poland | 24.0 | 1.1% |
| 15. Morocco | 17.0 | 0.8% |
| Other | 425.0 | 19.8% |
| **Total** | **2,150.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 1,615.0 | 1,885.0 | 2,150.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# New Caledonia

## Largest Telecommunications Routes, 1999

| Destination | | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 9,235.3 | 58.1% |
| 2. | Australia | 1,829.1 | 11.5% |
| 3. | French Polynesia | 1,009.8 | 6.3% |
| 4. | New Zealand | 451.9 | 2.8% |
| 5. | Vanuatu | 428.8 | 2.7% |
| 6. | Japan | 179.3 | 1.1% |
| 7. | United States | 143.8 | 0.9% |
| 8. | Indonesia | 129.5 | 0.8% |
| 9. | Vietnam | 120.1 | 0.8% |
| 10. | Fiji | 99.4 | 0.6% |
| 11. | Germany | 53.8 | 0.3% |
| 12. | Singapore | 51.7 | 0.3% |
| 13. | United Kingdom | 50.0 | 0.3% |
| 14. | Thailand | 32.6 | 0.2% |
| 15. | Hong Kong | 29.5 | 0.2% |
| 16. | Philippines | 23.9 | 0.2% |
| 17. | China | 21.4 | 0.1% |
| 18. | Solomon Islands | 14.7 | 0.1% |
| 19. | Papua New Guinea | 11.4 | 0.1% |
| 20. | Malaysia | 11.2 | 0.1% |
| | Other | 1,976.9 | 12.4% |
| | **Total** | **15,904.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | n.a. | 13.1 | 15.9 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# New Zealand

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Australia | 365.0 | 44.8% |
| 2. United States | 100.0 | 12.3% |
| 3. United Kingdom | 95.0 | 11.7% |
| 4. Canada | 40.0 | 4.9% |
| 5. Philippines | 21.0 | 2.6% |
| 6. Hong Kong | 14.0 | 1.7% |
| 7. Japan | 14.0 | 1.7% |
| 8. Fiji | 13.0 | 1.6% |
| 9. Malaysia | 10.0 | 1.2% |
| 10. Singapore | 10.0 | 1.2% |
| Other | 133.0 | 16.3% |
| **Total** | **815.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 430.0 | n.a. | n.a. |
| Outgoing | 407.0 | 610.0 | 815.0 |
| Surplus (Deficit) | 23.0 | n.a. | n.a. |
| Total Volume | 837.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Fiscal year ends 31 March.

# Nicaragua

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 23.8 | 45.7% |
| 2. | Costa Rica | 12.1 | 23.3% |
| 3. | Guatemala | 2.9 | 5.6% |
| 4. | Honduras | 2.2 | 4.3% |
| 5. | El Salvador | 2.0 | 3.9% |
| 6. | Mexico | 1.3 | 2.6% |
| 7. | Panama | 1.2 | 2.4% |
| 8. | Spain | 1.0 | 2.0% |
| 9. | Canada | 0.9 | 1.7% |
| 10. | Dominican Republic | 0.3 | 0.6% |
| 11. | Colombia | 0.3 | 0.5% |
| 12. | Cuba | 0.2 | 0.4% |
| 13. | Germany | 0.2 | 0.4% |
| 14. | Italy | 0.2 | 0.3% |
| 15. | Brazil | 0.2 | 0.3% |
| 16. | Netherlands | 0.1 | 0.3% |
| 17. | Peru | 0.1 | 0.2% |
| 18. | Chile | 0.1 | 0.2% |
| 19. | France | 0.1 | 0.2% |
| 20. | Venezuela | 0.1 | 0.2% |
| | Other | 2.6 | 5.0% |
| | **Total** | **52.0** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 52.5 | 59.7 | 72.7 |
| Outgoing | 40.4 | 46.5 | 52.0 |
| Surplus (Deficit) | 12.1 | 13.2 | 20.7 |
| Total Volume | 92.9 | 106.2 | 124.7 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Niger

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 2,955.2 | 48.4% |
| 2. Côte d'Ivoire | 539.1 | 8.8% |
| 3. Benin | 473.5 | 7.8% |
| 4. Burkina Faso | 432.2 | 7.1% |
| 5. Senegal | 184.5 | 3.0% |
| 6. United States | 173.3 | 2.8% |
| 7. Nigeria | 169.6 | 2.8% |
| 8. Belgium | 132.9 | 2.2% |
| 9. Saudi Arabia | 82.7 | 1.4% |
| 10. Germany | 80.5 | 1.3% |
| Other | 876.5 | 14.4% |
| **Total** | **6,100.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 5.3 | 5.8 | 6.1 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Norway

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Sweden | 153.2 | 27.0% |
| 2. Denmark | 81.5 | 14.4% |
| 3. United Kingdom | 72.7 | 12.8% |
| 4. United States | 44.7 | 7.9% |
| 5. Germany | 38.5 | 6.8% |
| 6. Netherlands | 17.6 | 3.1% |
| 7. France | 16.2 | 2.9% |
| 8. Spain | 14.4 | 2.5% |
| 9. Finland | 12.7 | 2.2% |
| 10. Italy | 8.1 | 1.4% |
| Other | 107.2 | 18.9% |
| **Total** | **567.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 515.0 | n.a. | 386.9 |
| Outgoing | 481.0 | 540.0 | 567.0 |
| Surplus (Deficit) | 34.0 | n.a. | (180.1) |
| Total Volume | 996.0 | n.a. | 953.9 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Oman

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | India | 30.3 | 29.9% |
| 2. | United Arab Emirates | 27.4 | 27.0% |
| 3. | Pakistan | 6.5 | 6.4% |
| 4. | United Kingdom | 5.8 | 5.7% |
| 5. | Egypt | 4.1 | 4.1% |
| 6. | Saudi Arabia | 2.8 | 2.8% |
| 7. | Bangladesh | 2.7 | 2.6% |
| 8. | Bahrain | 2.4 | 2.4% |
| 9. | United States | 2.3 | 2.2% |
| 10. | Jordan | 1.7 | 1.6% |
| 11. | Sri Lanka | 1.5 | 1.5% |
| 12. | Kuwait | 1.5 | 1.5% |
| 13. | Philippines | 1.4 | 1.4% |
| 14. | Qatar | 1.4 | 1.3% |
| 15. | Tanzania | 1.1 | 1.1% |
| 16. | South Africa | 1.0 | 1.0% |
| 17. | Sudan | 0.9 | 0.9% |
| 18. | Germany | 0.8 | 0.8% |
| 19. | France | 0.8 | 0.8% |
| 20. | Netherlands | 0.6 | 0.6% |
| | Other | 4.3 | 4.2% |
| | **Total** | **101.3** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 70.4 | 71.7 | 83.4 |
| Outgoing | 74.3 | 90.0 | 101.3 |
| Surplus (Deficit) | (3.9) | (18.3) | (17.9) |
| Total Volume | 144.7 | 161.8 | 184.7 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Data exclude some cross-border traffic to the United Arab Emirates

# Pakistan

## Largest Telecommunications Routes, FY 1999/00

| Destination | | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United Kingdom | 15.2 | 20.2% |
| 2. | United States | 9.7 | 12.9% |
| 3. | United Arab Emirates | 9.5 | 12.6% |
| 4. | Saudi Arabia | 7.6 | 10.2% |
| 5. | Canada | 6.1 | 8.1% |
| 6. | Italy | 3.2 | 4.3% |
| 7. | Germany | 2.2 | 2.9% |
| 8. | Iran | 2.1 | 2.8% |
| 9. | Japan | 1.9 | 2.6% |
| 10. | France | 1.6 | 2.1% |
| 11. | Qatar | 1.4 | 1.9% |
| 12. | Singapore | 1.3 | 1.7% |
| 13. | China | 1.1 | 1.5% |
| 14. | Bangladesh | 1.1 | 1.5% |
| 15. | Hong Kong | 1.0 | 1.3% |
| 16. | India | 1.0 | 1.3% |
| 17. | Oman | 0.8 | 1.1% |
| 18. | Netherlands | 0.8 | 1.0% |
| 19. | Kuwait | 0.8 | 1.0% |
| 20. | Australia | 0.7 | 1.0% |
| | Other | 6.0 | 8.0% |
| | **Total** | **75.1** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 557.8 | 640.4 | 644.9 |
| Outgoing | 84.1 | 87.5 | 75.1 |
| Surplus (Deficit) | 473.7 | 552.9 | 569.8 |
| Total Volume | 641.9 | 727.9 | 720.0 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Fiscal year ends 30 June. Data exclude some cross-border traffic to India.

# Palestinian Authority

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Jordan | 14.9 | 42.7% |
| 2. | United States | 4.7 | 13.5% |
| 3. | Egypt | 2.2 | 6.2% |
| 4. | Saudi Arabia | 1.7 | 5.0% |
| 5. | United Arab Emirates | 1.3 | 3.6% |
| 6. | Germany | 0.9 | 2.6% |
| 7. | United Kingdom | 0.8 | 2.2% |
| 8. | Italy | 0.6 | 1.8% |
| 9. | France | 0.5 | 1.4% |
| 10. | Turkey | 0.4 | 1.2% |
| 11. | Syria | 0.4 | 1.1% |
| 12. | Canada | 0.4 | 1.1% |
| 13. | Morocco | 0.3 | 0.8% |
| 14. | Kuwait | 0.3 | 0.8% |
| 15. | Qatar | 0.2 | 0.7% |
| 16. | Sweden | 0.2 | 0.5% |
| 17. | Tunisia | 0.2 | 0.5% |
| 18. | Iraq | 0.2 | 0.5% |
| 19. | Switzerland | 0.2 | 0.5% |
| 20. | China | 0.2 | 0.4% |
| | Other | 4.5 | 12.9% |
| | **Total** | **34.9** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 16.6 | n.a. |
| Outgoing | n.a. | 27.6 | 34.9 |
| Surplus (Deficit) | n.a. | (11.0) | n.a. |
| Total Volume | n.a. | 44.3 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data exclude traffic with Israel

# Panama

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 19.0 | 35.4% |
| 2. | Colombia | 5.6 | 10.5% |
| 3. | Costa Rica | 4.2 | 7.8% |
| 4. | Mexico | 2.3 | 4.4% |
| 5. | Guatemala | 1.4 | 2.6% |
| 6. | Dominican Republic | 1.3 | 2.4% |
| 7. | Venezuela | 1.3 | 2.4% |
| 8. | Nicaragua | 1.0 | 1.9% |
| 9. | Spain | 1.0 | 1.9% |
| 10. | El Salvador | 1.0 | 1.9% |
| 11. | Ecuador | 0.9 | 1.6% |
| 12. | Cuba | 0.9 | 1.6% |
| 13. | Honduras | 0.7 | 1.4% |
| 14. | Peru | 0.7 | 1.3% |
| 15. | Brazil | 0.7 | 1.3% |
| 16. | Canada | 0.7 | 1.3% |
| 17. | Argentina | 0.5 | 1.0% |
| 18. | Chile | 0.5 | 1.0% |
| 19. | United Kingdom | 0.5 | 1.0% |
| 20. | China | 0.4 | 0.8% |
| | Other | 8.8 | 16.4% |
| | **Total** | **53.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 95.1 | 95.5 | 95.8 |
| Outgoing | 41.4 | 50.0 | 53.6 |
| Surplus (Deficit) | 53.7 | 45.5 | 42.2 |
| Total Volume | 136.5 | 145.5 | 149.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data based on billing point of traffic.

# Paraguay

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Argentina | 11.8 | 34.1% |
| 2. Brazil | 8.5 | 24.6% |
| 3. United States | 3.6 | 10.2% |
| 4. Uruguay | 1.5 | 4.3% |
| 5. Lebanon | 1.3 | 3.8% |
| 6. Chile | 1.3 | 3.7% |
| 7. Germany | 0.6 | 1.7% |
| 8. Bolivia | 0.5 | 1.4% |
| 9. Spain | 0.5 | 1.4% |
| 10. Peru | 0.5 | 1.3% |
| 11. Taiwan | 0.4 | 1.2% |
| 12. China | 0.3 | 0.9% |
| 13. Italy | 0.3 | 0.8% |
| 14. Korea, Rep. | 0.3 | 0.8% |
| 15. France | 0.3 | 0.8% |
| 16. Mexico | 0.3 | 0.7% |
| 17. Japan | 0.2 | 0.7% |
| 18. Canada | 0.2 | 0.6% |
| 19. Switzerland | 0.2 | 0.5% |
| 20. United Kingdom | 0.2 | 0.4% |
| Other | 2.0 | 5.9% |
| **Total** | **34.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 57.4 | 54.8 |
| Outgoing | 26.1 | 37.8 | 34.7 |
| Surplus (Deficit) | n.a. | 19.6 | 20.1 |
| Total Volume | n.a. | 95.2 | 89.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Peru

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 33.5 | 37.7% |
| 2. Chile | 8.2 | 9.2% |
| 3. Argentina | 6.5 | 7.3% |
| 4. Spain | 6.0 | 6.8% |
| 5. Colombia | 3.4 | 3.8% |
| 6. Venezuela | 3.2 | 3.6% |
| 7. Bolivia | 3.0 | 3.4% |
| 8. Mexico | 3.0 | 3.4% |
| 9. Brazil | 2.8 | 3.2% |
| 10. Ecuador | 2.1 | 2.4% |
| 11. Japan | 2.1 | 2.4% |
| 12. Canada | 1.8 | 2.0% |
| 13. Germany | 1.5 | 1.6% |
| 14. United Kingdom | 1.2 | 1.3% |
| 15. France | 0.9 | 1.0% |
| 16. Switzerland | 0.8 | 0.9% |
| 17. Panama | 0.7 | 0.8% |
| 18. Costa Rica | 0.5 | 0.6% |
| 19. China | 0.5 | 0.5% |
| 20. Uruguay | 0.5 | 0.5% |
| Other | 6.9 | 7.8% |
| **Total** | **88.9** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | 1999 |
|---|---|---|---|
| Incoming | 256.9 | 272.6 | 302.6 |
| Outgoing | 79.4 | 90.4 | 88.9 |
| Surplus (Deficit) | 177.5 | 182.3 | 213.7 |
| Total Volume | 336.3 | 363.0 | 391.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic

# Philippines

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 55.0 | 25.2% |
| 2. Japan | 40.0 | 18.3% |
| 3. Hong Kong | 20.0 | 9.2% |
| 4. Singapore | 15.0 | 6.9% |
| 5. Taiwan | 15.0 | 6.9% |
| 6. Saudi Arabia | 15.0 | 6.9% |
| 7. Canada | 15.0 | 6.9% |
| 8. Australia | 10.0 | 4.6% |
| 9. Korea, Rep. | 5.0 | 2.3% |
| 10. Malaysia | 5.0 | 2.3% |
| Other | 23.0 | 10.6% |
| **Total** | **218.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 930.0 | n.a. | n.a. |
| Outgoing | 274.0 | 262.0 | 218.0 |
| Surplus (Deficit) | 656.0 | n.a. | n.a. |
| Total Volume | 1,204.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Fiscal year ends 31 March.

# Poland

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 240.0 | 38.5% |
| 2. United Kingdom | 45.0 | 7.2% |
| 3. Italy | 42.0 | 6.7% |
| 4. France | 34.0 | 5.4% |
| 5. United States | 27.0 | 4.3% |
| 6. Austria | 21.0 | 3.4% |
| 7. Netherlands | 21.0 | 3.4% |
| 8. Ukraine | 20.0 | 3.2% |
| 9. Sweden | 17.0 | 2.7% |
| 10. Czech Republic | 15.0 | 2.4% |
| Other | 142.0 | 22.8% |
| **Total** | **624.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 800.2 | 1,144.2 | n.a. |
| Outgoing | 529.0 | 602.4 | 624.0 |
| Surplus (Deficit) | 271.2 | 541.8 | n.a. |
| Total Volume | 1,329.2 | 1,746.6 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Portugal

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | France | 102.9 | 19.3% |
| 2. | Spain | 91.1 | 17.1% |
| 3. | United Kingdom | 54.9 | 10.3% |
| 4. | Germany | 51.3 | 9.6% |
| 5. | Brazil | 28.5 | 5.3% |
| 6. | Switzerland | 27.3 | 5.1% |
| 7. | United States | 23.9 | 4.5% |
| 8. | Italy | 18.1 | 3.4% |
| 9. | Netherlands | 16.4 | 3.1% |
| 10. | Belgium | 13.0 | 2.4% |
| 11. | Angola | 12.6 | 2.4% |
| 12. | Canada | 8.8 | 1.7% |
| 13. | Cape Verde | 8.4 | 1.6% |
| 14. | Luxembourg | 5.9 | 1.1% |
| 15. | Sweden | 4.8 | 0.9% |
| 16. | Venezuela | 4.2 | 0.8% |
| 17. | South Africa | 4.1 | 0.8% |
| 18. | Mozambique | 4.0 | 0.8% |
| 19. | Guinea-Bissau | 4.0 | 0.7% |
| 20. | Ireland | 2.9 | 0.6% |
| | Other | 45.7 | 8.6% |
| | **Total** | **532.8** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 628.8 | 713.8 | 753.3 |
| Outgoing | 393.3 | 462.8 | 532.8 |
| Surplus (Deficit) | 235.5 | 250.9 | 220.5 |
| Total Volume | 1,022.1 | 1,176.6 | 1,286.0 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data are for Portugal Telecom only and may exclude some cross-border traffic to Spain.

# Qatar

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | India | 24.0 | 18.7% |
| 2. | United Arab Emirates | 21.2 | 16.5% |
| 3. | Saudi Arabia | 10.0 | 7.8% |
| 4. | Egypt | 9.7 | 7.6% |
| 5. | Bahrain | 7.5 | 5.8% |
| 6. | Pakistan | 6.4 | 5.0% |
| 7. | United Kingdom | 5.9 | 4.6% |
| 8. | United States | 3.8 | 3.0% |
| 9. | Bangladesh | 3.7 | 2.9% |
| 10. | Jordan | 3.7 | 2.9% |
| 11. | Kuwait | 3.1 | 2.4% |
| 12. | Sudan | 3.1 | 2.4% |
| 13. | Sri Lanka | 2.7 | 2.1% |
| 14. | Philippines | 2.6 | 2.0% |
| 15. | Iran | 2.1 | 1.6% |
| 16. | Oman | 2.0 | 1.6% |
| 17. | Lebanon | 2.0 | 1.6% |
| 18. | Syria | 1.8 | 1.4% |
| 19. | France | 1.3 | 1.0% |
| 20. | Yemen | 1.1 | 0.8% |
| | Other | 10.7 | 8.3% |
| | **Total** | **128.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 59.5 | 70.0 | 84.0 |
| Outgoing | 99.9 | 112.5 | 128.5 |
| Surplus (Deficit) | (40.4) | (42.5) | (44.5) |
| Total Volume | 159.4 | 182.5 | 212.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Russia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Ukraine | 264.1 | 28.0% |
| 2. | Belarus | 100.9 | 10.1% |
| 3. | Kazakhstan | 59.0 | 7.4% |
| 4. | Germany | 47.2 | 5.0% |
| 5. | Azerbaijan | 42.1 | 4.9% |
| 6. | Georgia | 32.2 | 3.9% |
| 7. | Uzbekistan | 30.8 | 3.7% |
| 8. | Armenia | 24.7 | 3.2% |
| 9. | United States | 20.9 | 3.1% |
| 10. | Moldova | 18.1 | 2.0% |
| 11. | Latvia | 16.1 | 1.4% |
| 12. | United Kingdom | 13.9 | 1.4% |
| 13. | Turkey | 13.1 | 1.2% |
| 14. | Lithuania | 13.0 | 1.2% |
| 15. | Kyrgyzstan | 11.7 | 1.2% |
| 16. | China | 11.4 | 1.2% |
| 17. | Italy | 10.9 | 1.1% |
| 18. | France | 10.7 | 1.0% |
| 19. | Finland | 10.5 | 1.0% |
| 20. | Estonia | 8.7 | 0.8% |
| | Other | 168.2 | 16.9% |
| | **Total** | **928.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 1,035.6 | 1,029.8 | 929.3 |
| Outgoing | 969.6 | 1,038.3 | 928.2 |
| Surplus (Deficit) | 66.0 | (8.5) | 1.1 |
| Total Volume | 2,005.2 | 2,068.1 | 1,857.5 |

**Note:** *Data are in millions of minutes of outgoing public switched telecommunications traffic. Data are for Rostelecom only.* Other operators carried an estimated 200 million minutes of addition traffic in 1998 and 1999.

# Rwanda

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Belgium | 753.8 | 15.9% |
| 2. | United States | 565.4 | 11.9% |
| 3. | Kenya | 368.5 | 7.8% |
| 4. | France | 319.4 | 6.7% |
| 5. | South Africa | 314.1 | 6.6% |
| 6. | Uganda | 313.3 | 6.6% |
| 7. | Burundi | 193.5 | 4.1% |
| 8. | United Kingdom | 172.7 | 3.6% |
| 9. | Germany | 139.2 | 2.9% |
| 10. | Netherlands | 113.4 | 2.4% |
| 11. | Italy | 109.4 | 2.3% |
| 12. | India | 68.1 | 1.4% |
| 13. | Canada | 41.4 | 0.9% |
| 14. | United Arab Emirates | 39.3 | 0.8% |
| 15. | Côte d'Ivoire | 36.5 | 0.8% |
| 16. | Senegal | 34.9 | 0.7% |
| 17. | Ethiopia | 33.7 | 0.7% |
| 18. | Cameroon | 30.8 | 0.6% |
| 19. | Egypt | 28.2 | 0.6% |
| 20. | China | 22.0 | 0.5% |
| | Other | 1,242.8 | 26.2% |
| | **Total** | **4,742.8** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | n.a. | 4.6 | 4.7 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Saudi Arabia

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Egypt | 164.9 | 15.6% |
| 2. | India | 123.0 | 11.6% |
| 3. | Pakistan | 92.0 | 8.7% |
| 4. | United Arab Emirates | 49.0 | 4.6% |
| 5. | Syria | 48.6 | 4.6% |
| 6. | Philippines | 48.4 | 4.6% |
| 7. | Sudan | 46.0 | 4.3% |
| 8. | Yemen | 41.0 | 3.9% |
| 9. | Bahrain | 38.5 | 3.6% |
| 10. | United States | 33.0 | 3.1% |
| 11. | Kuwait | 27.0 | 2.5% |
| 12. | Jordan | 24.8 | 2.3% |
| 13. | Lebanon | 20.0 | 1.9% |
| 14. | Morocco | 18.8 | 1.8% |
| 15. | United Kingdom | 17.0 | 1.6% |
| 16. | Bangladesh | 15.0 | 1.4% |
| 17. | Canada | 14.0 | 1.3% |
| 18. | Qatar | 10.8 | 1.0% |
| 19. | Iran | 10.8 | 1.0% |
| 20. | France | 10.0 | 0.9% |
| | Other | 207.4 | 19.6% |
| | **Total** | **1,060.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 801.3 | 932.6 | 1,060.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Senegal

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 11.0 | 30.1% |
| 2. Côte d'Ivoire | 2.4 | 6.6% |
| 3. United States | 2.3 | 6.2% |
| 4. Italy | 1.5 | 4.1% |
| 5. Mali | 1.4 | 3.9% |
| 6. Gambia | 1.2 | 3.2% |
| 7. Guinea | 0.9 | 2.4% |
| 8. Mauritania | 0.9 | 2.4% |
| 9. Gabon | 0.7 | 2.0% |
| 10. Spain | 0.6 | 1.6% |
| 11. Morocco | 0.6 | 1.5% |
| 12. Canada | 0.5 | 1.4% |
| 13. Burkina Faso | 0.4 | 1.2% |
| 14. Germany | 0.4 | 1.1% |
| 15. Switzerland | 0.4 | 1.1% |
| 16. United Kingdom | 0.4 | 1.0% |
| 17. Cameroon | 0.3 | 0.9% |
| 18. Benin | 0.3 | 0.9% |
| 19. Portugal | 0.3 | 0.9% |
| 20. Togo | 0.3 | 0.9% |
| Other | 9.7 | 26.5% |
| **Total** | **36.5** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | 1999 |
|---|---|---|---|
| Incoming | 68.7 | 93.8 | 111.1 |
| Outgoing | 27.7 | 29.6 | 36.5 |
| Surplus (Deficit) | 41.0 | 64.2 | 74.7 |
| Total Volume | 96.4 | 123.4 | 147.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Singapore

## Largest Telecommunications Routes, FY 1999/00

| Destination | | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Malaysia | 465.0 | 34.4% |
| 2. | Hong Kong | 100.0 | 7.4% |
| 3. | Indonesia | 70.0 | 5.2% |
| 4. | United States | 70.0 | 5.2% |
| 5. | Australia | 65.0 | 4.8% |
| 6. | China | 65.0 | 4.8% |
| 7. | Japan | 55.0 | 4.1% |
| 8. | Thailand | 45.0 | 3.3% |
| 9. | Philippines | 38.0 | 2.8% |
| 10. | India | 33.0 | 2.4% |
| 11. | United Kingdom | 33.0 | 2.4% |
| | Other | 311.0 | 23.0% |
| | **Total** | **1,350.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 1,161.0 | 1,235.0 | 1,350.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Data based on billing point of traffic. Fiscal year ends 31 March

# Slovak Republic

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Czech Republic | 64.6 | 39.7% |
| 2. Germany | 19.7 | 12.1% |
| 3. Austria | 13.8 | 8.5% |
| 4. Hungary | 8.3 | 5.1% |
| 5. United Kingdom | 6.9 | 4.3% |
| 6. Italy | 6.7 | 4.1% |
| 7. Poland | 5.5 | 3.4% |
| 8. Ukraine | 4.6 | 2.8% |
| 9. United States | 3.6 | 2.2% |
| 10. France | 3.4 | 2.1% |
| 11. Switzerland | 3.1 | 1.9% |
| 12. Netherlands | 2.2 | 1.4% |
| 13. Russia | 2.1 | 1.3% |
| 14. Belgium | 1.5 | 0.9% |
| 15. Spain | 1.5 | 0.9% |
| 16. Croatia | 1.3 | 0.8% |
| 17. Yugoslavia | 1.3 | 0.8% |
| 18. Canada | 0.9 | 0.6% |
| 19. Greece | 0.9 | 0.5% |
| 20. Sweden | 0.8 | 0.5% |
| Other | 10.1 | 6.2% |
| **Total** | **162.8** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | 174.4 | 186.4 | 208.7 |
| Outgoing | 144.7 | 151.8 | 162.8 |
| Surplus (Deficit) | 29.7 | 34.6 | 45.9 |
| Total Volume | 319.1 | 338.1 | 371.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic

# Slovenia

## Largest Telecommunications Routes, 1998

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Croatia | 31.3 | 24.1% |
| 2. Germany | 15.7 | 12.1% |
| 3. Austria | 14.6 | 11.3% |
| 4. Italy | 14.4 | 11.1% |
| 5. Yugoslavia | 13.2 | 10.2% |
| 6. Bosnia-Herzegovina | 6.1 | 4.7% |
| 7. Macedonia | 3.4 | 2.6% |
| 8. Switzerland | 3.0 | 2.3% |
| 9. United Kingdom | 2.9 | 2.2% |
| 10. France | 2.8 | 2.1% |
| 11. Hungary | 2.3 | 1.8% |
| 12. United States | 2.1 | 1.6% |
| 13. Russia | 1.7 | 1.3% |
| 14. Netherlands | 1.6 | 1.2% |
| 15. Czech Republic | 1.4 | 1.1% |
| 16. Sweden | 1.2 | 0.9% |
| 17. Belgium | 1.1 | 0.9% |
| 18. Poland | 0.8 | 0.6% |
| 19. Canada | 0.8 | 0.6% |
| 20. Chile | 0.7 | 0.5% |
| Other | 8.5 | 6.6% |
| **Total** | **129.6** | |



## National Traffic Balance

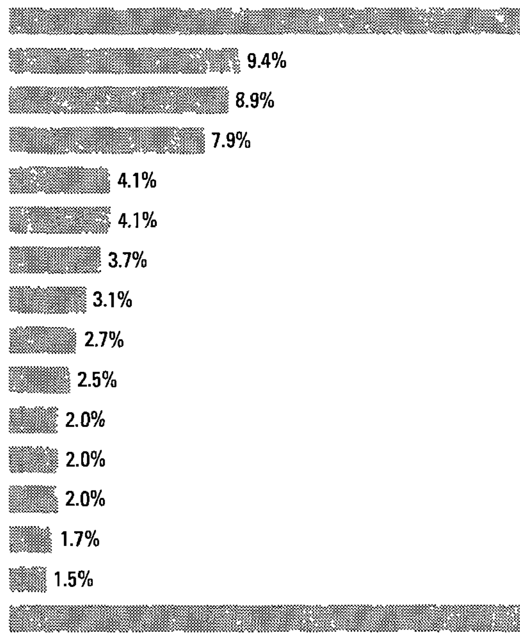
| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 118.9 | 137.0 | n.a. |
| Outgoing | 113.5 | 129.6 | n.a. |
| Surplus (Deficit) | 5.4 | 7.4 | n.a. |
| Total Volume | 232.4 | 266.6 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. 1999 traffic data are not available.

# South Africa

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United Kingdom | 96.9 | 21.0% |
| 2. United States | 43.3 | 9.4% |
| 3. Namibia | 41.0 | 8.9% |
| 4. Zimbabwe | 36.5 | 7.9% |
| 5. Botswana | 18.8 | 4.1% |
| 6. Mozambique | 18.8 | 4.1% |
| 7. Germany | 17.1 | 3.7% |
| 8. Swaziland | 14.2 | 3.1% |
| 9. Australia | 12.5 | 2.7% |
| 10. Lesotho | 11.4 | 2.5% |
| 11. Canada | 9.1 | 2.0% |
| 12. France | 9.1 | 2.0% |
| 13. Netherlands | 9.1 | 2.0% |
| 14. Italy | 8.0 | 1.7% |
| 15. Zambia | 6.8 | 1.5% |
| Other | 108.3 | 23.5% |
| **Total** | **461.1** | |





## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 343.2 | n.a. | n.a. |
| Outgoing | 368.8 | 405.0 | 461.1 |
| Surplus (Deficit) | (25.6) | n.a. | n.a. |
| Total Volume | 712.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Spain

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Germany | 320.0 | 16.5% |
| 2. | France | 300.0 | 15.5% |
| 3. | United Kingdom | 300.0 | 15.5% |
| 4. | Italy | 130.0 | 6.7% |
| 5. | Portugal | 90.0 | 4.7% |
| 6. | United States | 90.0 | 4.7% |
| 7. | Switzerland | 60.0 | 3.1% |
| 8. | Belgium | 55.0 | 2.8% |
| 9. | Netherlands | 55.0 | 2.8% |
| 10. | Cuba | 40.0 | 2.1% |
| 11. | Morocco | 35.0 | 1.8% |
| 12. | Argentina | 28.0 | 1.4% |
| 13. | Andorra | 27.0 | 1.4% |
| 14. | Sweden | 23.0 | 1.2% |
| 15. | Brazil | 20.0 | 1.0% |
| 16. | Chile | 20.0 | 1.0% |
| 17. | Mexico | 20.0 | 1.0% |
| 18. | Colombia | 17.0 | 0.9% |
| 19. | Denmark | 16.0 | 0.8% |
| 20. | Austria | 13.0 | 0.7% |
| | Other | 276.0 | 14.3% |
| | **Total** | **1,935.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 1,319.0 | 1,675.0 | 1,935.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Sri Lanka

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. India | 7.5 | 16.6% |
| 2. United Kingdom | 4.7 | 10.4% |
| 3. Singapore | 2.9 | 6.3% |
| 4. Japan | 2.6 | 5.7% |
| 5. United States | 2.6 | 5.6% |
| 6. Australia | 2.1 | 4.6% |
| 7. Germany | 1.8 | 4.0% |
| 8. United Arab Emirates | 1.8 | 3.9% |
| 9. Hong Kong | 1.7 | 3.6% |
| 10. Saudi Arabia | 1.4 | 3.2% |
| 11. Maldives | 1.2 | 2.6% |
| 12. Korea, Rep. | 1.2 | 2.6% |
| 13. Italy | 1.0 | 2.3% |
| 14. Canada | 0.9 | 1.9% |
| 15. France | 0.9 | 1.9% |
| 16. Pakistan | 0.8 | 1.8% |
| 17. Malaysia | 0.7 | 1.5% |
| 18. Thailand | 0.7 | 1.4% |
| 19. Switzerland | 0.6 | 1.4% |
| 20. Kuwait | 0.6 | 1.4% |
| Other | 7.8 | 17.2% |
| **Total** | **45.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 124.3 | 146.8 | n.a. |
| Outgoing | 33.2 | 39.3 | 45.5 |
| Surplus (Deficit) | 91.1 | 107.5 | n.a. |
| Total Volume | 157.5 | 186.1 | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Sudan

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Saudi Arabia | 6.9 | 31.3% |
| 2. | United Arab Emirates | 2.5 | 11.3% |
| 3. | Egypt | 1.6 | 7.4% |
| 4. | United Kingdom | 1.1 | 5.2% |
| 5. | Qatar | 0.6 | 2.9% |
| 6. | United States | 0.5 | 2.4% |
| 7. | China | 0.4 | 1.8% |
| 8. | Jordan | 0.4 | 1.7% |
| 9. | Syria | 0.4 | 1.6% |
| 10. | Germany | 0.3 | 1.3% |
| 11. | India | 0.3 | 1.2% |
| 12. | France | 0.2 | 1.1% |
| 13. | Netherlands | 0.2 | 1.1% |
| 14. | Italy | 0.2 | 1.1% |
| 15. | Canada | 0.2 | 1.0% |
| 16. | Libya | 0.2 | 0.9% |
| 17. | Yemen | 0.2 | 0.8% |
| 18. | Oman | 0.2 | 0.8% |
| 19. | Switzerland | 0.1 | 0.7% |
| 20. | Kenya | 0.1 | 0.6% |
| | Other | 5.3 | 23.9% |
| | **Total** | **21.9** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 43.2 | 88.0 | 105.3 |
| Outgoing | 14.8 | 18.4 | 21.9 |
| Surplus (Deficit) | 28.4 | 69.6 | 83.4 |
| Total Volume | 58.0 | 106.4 | 127.2 |

**Note:** *Data are in millions of minutes of outgoing public switched telecommunications traffic. Data exclude some cross-border traffic to Chad.*

# Suriname

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Netherlands | 6,348.5 | 51.3% |
| 2. | United States | 1,325.6 | 10.7% |
| 3. | Brazil | 898.3 | 7.3% |
| 4. | Taiwan | 524.4 | 4.2% |
| 5. | Guyana | 341.6 | 2.8% |
| 6. | Netherlands Antilles | 316.9 | 2.6% |
| 7. | French Guiana | 198.2 | 1.6% |
| 8. | Trinidad & Tobago | 188.7 | 1.5% |
| 9. | Canada | 156.2 | 1.3% |
| 10. | United Kingdom | 155.0 | 1.3% |
| 11. | Dominican Republic | 138.5 | 1.1% |
| 12. | Aruba | 108.6 | 0.9% |
| 13. | Venezuela | 75.7 | 0.6% |
| 14. | France | 59.7 | 0.5% |
| 15. | Japan | 37.3 | 0.3% |
| 16. | Jamaica | 32.6 | 0.3% |
| 17. | Germany | 29.0 | 0.2% |
| 18. | Colombia | 23.1 | 0.2% |
| 19. | Argentina | 21.5 | 0.2% |
| 20. | Panama | 17.8 | 0.1% |
| | Other | 1,380.2 | 11.2% |
| | **Total** | **12,377.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 31.0 | 34.4 | 27.9 |
| Outgoing | 4.6 | 5.0 | 12.4 |
| Surplus (Deficit) | 26.4 | 29.4 | 15.5 |
| Total Volume | 35.6 | 39.4 | 40.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Swaziland

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. South Africa | 25,693.6 | 87.6% |
| 2. Mozambique | 865.6 | 3.0% |
| 3. United Kingdom | 421.2 | 1.4% |
| 4. United States | 169.3 | 0.6% |
| 5. Lesotho | 162.2 | 0.6% |
| 6. Zimbabwe | 158.5 | 0.5% |
| 7. Zambia | 96.7 | 0.3% |
| 8. Kenya | 57.2 | 0.2% |
| 9. Germany | 56.1 | 0.2% |
| 10. Namibia | 54.4 | 0.2% |
| 11. Netherlands | 50.7 | 0.2% |
| 12. Tanzania | 47.3 | 0.2% |
| 13. Malawi | 43.7 | 0.1% |
| 14. Uganda | 41.7 | 0.1% |
| 15. Italy | 40.9 | 0.1% |
| 16. India | 37.9 | 0.1% |
| 17. Canada | 34.6 | 0.1% |
| 18. Ghana | 33.0 | 0.1% |
| 19. Australia | 32.4 | 0.1% |
| 20. Belgium | 30.9 | 0.1% |
| Other | 1,200.0 | 4.1% |
| **Total** | **29,340.2** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | n.a. | 28.4 | 29.3 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic Fiscal year ends 31 March.

# Sweden

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United Kingdom | 200.0 | 14.7% |
| 2. Finland | 180.0 | 13.2% |
| 3. Norway | 165.0 | 12.1% |
| 4. United States | 145.0 | 10.6% |
| 5. Denmark | 135.0 | 9.9% |
| 6. Germany | 120.0 | 8.8% |
| 7. Poland | 70.0 | 5.1% |
| 8. France | 60.0 | 4.4% |
| 9. Netherlands | 45.0 | 3.3% |
| 10. Switzerland | 35.0 | 2.6% |
| Other | 210.0 | 15.4% |
| **Total** | **1,365.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 1,140.0 | 1,230.0 | 1,365.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Switzerland

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 620.0 | 22.7% |
| 2. France | 420.0 | 15.4% |
| 3. Italy | 370.0 | 13.6% |
| 4. United Kingdom | 145.0 | 5.3% |
| 5. Austria | 135.0 | 4.9% |
| 6. United States | 115.0 | 4.2% |
| 7. Portugal | 80.0 | 2.9% |
| 8. Spain | 80.0 | 2.9% |
| 9. Netherlands | 65.0 | 2.4% |
| 10. Yugoslavia | 50.0 | 1.8% |
| Other | 650.0 | 23.8% |
| **Total** | **2,730.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 1,723.0 | n.a. | n.a. |
| Outgoing | 2,164.0 | 2,425.0 | 2,730.0 |
| Surplus (Deficit) | (441.0) | n.a. | n.a. |
| Total Volume | 3,887.0 | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Syria

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Lebanon | 36.0 | 28.7% |
| 2. | Saudi Arabia | 20.8 | 16.5% |
| 3. | United Arab Emirates | 8.1 | 6.4% |
| 4. | Jordan | 7.6 | 6.1% |
| 5. | Kuwait | 5.4 | 4.3% |
| 6. | United States | 5.2 | 4.1% |
| 7. | Egypt | 3.0 | 2.4% |
| 8. | France | 2.6 | 2.1% |
| 9. | United Kingdom | 2.2 | 1.8% |
| 10. | Turkey | 1.9 | 1.5% |
| 11. | Germany | 1.8 | 1.4% |
| 12. | Iraq | 1.7 | 1.4% |
| 13. | Canada | 1.4 | 1.1% |
| 14. | Italy | 1.4 | 1.1% |
| 15. | Russia | 1.0 | 0.8% |
| 16. | Greece | 0.9 | 0.7% |
| 17. | Qatar | 0.7 | 0.6% |
| 18. | Sudan | 0.7 | 0.5% |
| 19. | Sweden | 0.6 | 0.5% |
| 20. | Yemen | 0.6 | 0.4% |
| | Other | 22.2 | 17.7% |
| | **Total** | **125.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 173.2 | n.a. | 256.7 |
| Outgoing | 89.3 | 103.0 | 125.6 |
| Surplus (Deficit) | 83.9 | n.a. | 131.1 |
| Total Volume | 262.5 | n.a. | 382.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Taiwan

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | China | 286.9 | 30.2% |
| 2. | United States | 162.0 | 17.1% |
| 3. | Japan | 80.3 | 8.5% |
| 4. | Hong Kong | 73.7 | 7.8% |
| 5. | Philippines | 55.5 | 5.8% |
| 6. | Thailand | 45.0 | 4.7% |
| 7. | Canada | 29.6 | 3.1% |
| 8. | Singapore | 26.8 | 2.8% |
| 9. | Indonesia | 23.5 | 2.5% |
| 10. | Vietnam | 20.8 | 2.2% |
| 11. | Australia | 18.5 | 2.0% |
| 12. | Malaysia | 15.6 | 1.6% |
| 13. | Korea, Rep. | 13.0 | 1.4% |
| 14. | Russia | 11.6 | 1.2% |
| 15. | Germany | 10.4 | 1.1% |
| 16. | United Kingdom | 10.0 | 1.1% |
| 17. | New Zealand | 6.8 | 0.7% |
| 18. | France | 6.7 | 0.7% |
| 19. | Macau | 4.4 | 0.5% |
| 20. | Netherlands | 4.3 | 0.5% |
| | Other | 44.1 | 4.6% |
| | **Total** | **949.3** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 842.2 | 781.8 | 882.0 |
| Outgoing | 789.0 | 862.0 | 949.3 |
| Surplus (Deficit) | 53.2 | (80.2) | (67.3) |
| Total Volume | 1,631.2 | 1,643.9 | 1,831.3 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Tajikistan

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Russia | 5.4 | 60.0% |
| 2. Uzbekistan | 1.6 | 17.8% |
| 3. Kazakhstan | 0.6 | 6.7% |
| 4. Ukraine | 0.4 | 4.4% |
| 5. Kyrgyzstan | 0.3 | 3.3% |
| 6. Turkmenistan | 0.2 | 2.2% |
| 7. Belarus | 0.1 | 1.1% |
| Other | 0.4 | 4.4% |
| **Total** | **9.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 13.6 | 9.9 | 9.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. The "Other" category may include routes to non-members of the Commonwealth of Independent States that rank among the top destinations for outgoing traffic.

# Thailand

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Japan | 45.0 | 15.1% |
| 2. United States | 40.0 | 13.4% |
| 3. Singapore | 34.0 | 11.4% |
| 4. Hong Kong | 22.0 | 7.4% |
| 5. United Kingdom | 17.0 | 5.7% |
| 6. Taiwan | 16.0 | 5.4% |
| 7. Australia | 15.0 | 5.0% |
| 8. China | 13.0 | 4.4% |
| 9. Germany | 13.0 | 4.4% |
| 10. France | 7.0 | 2.3% |
| 11. India | 7.0 | 2.3% |
| 12. Korea, Rep. | 6.0 | 2.0% |
| 13. Philippines | 6.0 | 2.0% |
| 14. Indonesia | 5.0 | 1.7% |
| 15. Switzerland | 4.0 | 1.3% |
| Other | 49.0 | 16.4% |
| **Total** | **298.7** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 408.5 | 358.6 | 327.8 |
| Outgoing | 278.4 | 296.4 | 298.7 |
| Surplus (Deficit) | 130.1 | 62.2 | 29.1 |
| Total Volume | 686.9 | 655.0 | 626.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Data exclude some cross-border traffic with Laos, Malaysia, and Myanmar.

# Togo

## Largest Telecommunications Routes, 1999

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. France | 2,336.2 | 27.6% |
| 2. Benin | 1,009.4 | 11.9% |
| 3. Côte d'Ivoire | 923.2 | 10.9% |
| 4. Burkina Faso | 496.4 | 5.9% |
| 5. Ghana | 417.1 | 4.9% |
| 6. United States | 400.8 | 4.7% |
| 7. Germany | 375.5 | 4.4% |
| 8. Senegal | 260.0 | 3.1% |
| 9. Niger | 256.5 | 3.0% |
| 10. Nigeria | 224.6 | 2.6% |
| 11. Belgium | 155.7 | 1.8% |
| 12. Mali | 154.7 | 1.8% |
| 13. Gabon | 151.8 | 1.8% |
| 14. United Kingdom | 149.6 | 1.8% |
| 15. Switzerland | 107.6 | 1.3% |
| 16. Canada | 85.8 | 1.0% |
| 17. Italy | 75.0 | 0.9% |
| 18. Cameroon | 72.0 | 0.8% |
| 19. Netherlands | 68.5 | 0.8% |
| 20. China | 53.3 | 0.6% |
| Other | 705.0 | 8.3% |
| **Total** | **8,478.6** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 17.1 | 21.6 |
| Outgoing | 7.9 | 8.4 | 8.5 |
| Surplus (Deficit) | n.a. | 8.7 | 13.1 |
| Total Volume | n.a. | 25.5 | 30.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Trinidad & Tobago

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 30.7 | 45.6% |
| 2. Canada | 6.0 | 8.9% |
| 3. United Kingdom | 4.7 | 7.0% |
| 4. Barbados | 3.7 | 5.6% |
| 5. Grenada | 2.9 | 4.4% |
| 6. Guyana | 2.2 | 3.3% |
| 7. Jamaica | 2.1 | 3.1% |
| 8. Saint Vincent & the Grenadines | 2.0 | 2.9% |
| 9. Venezuela | 1.9 | 2.8% |
| 10. Saint Lucia | 1.7 | 2.5% |
| 11. Antigua & Barbuda | 1.0 | 1.5% |
| 12. Dominica | 0.5 | 0.7% |
| 13. Germany | 0.5 | 0.7% |
| 14. Netherlands Antilles | 0.5 | 0.7% |
| 15. Saint Kitts & Nevis | 0.5 | 0.7% |
| 16. British Virgin Islands | 0.4 | 0.6% |
| 17. Bahamas | 0.3 | 0.4% |
| 18. Cayman Islands | 0.3 | 0.4% |
| Other | 5.5 | 8.2% |
| **Total** | **67.2** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | 130.0 | 141.5 | 158.8 |
| Outgoing | 62.0 | 64.4 | 67.2 |
| Surplus (Deficit) | 68.0 | 77.1 | 91.6 |
| Total Volume | 192.0 | 206.0 | 226.0 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Fiscal year ends 31 March.

# Turkey

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Germany | 204.9 | 29.3% |
| 2. | United Kingdom | 48.6 | 7.0% |
| 3. | France | 35.4 | 5.1% |
| 4. | Netherlands | 30.4 | 4.4% |
| 5. | United States | 26.5 | 3.8% |
| 6. | Bulgaria | 20.0 | 2.9% |
| 7. | Romania | 18.4 | 2.6% |
| 8. | Switzerland | 17.0 | 2.4% |
| 9. | Austria | 16.6 | 2.4% |
| 10. | Italy | 15.3 | 2.2% |
| 11. | Belgium | 13.5 | 1.9% |
| 12. | Russia | 13.3 | 1.9% |
| 13. | Azerbaijan | 11.3 | 1.6% |
| 14. | Greece | 11.1 | 1.6% |
| 15. | Ukraine | 10.3 | 1.5% |
| 16. | Iran | 7.5 | 1.1% |
| 17. | Moldova | 7.1 | 1.0% |
| 18. | Israel | 6.6 | 0.9% |
| 19. | Saudi Arabia | 6.2 | 0.9% |
| 20. | Sweden | 6.0 | 0.9% |
| | Other | 172.4 | 24.7% |
| | **Total** | **698.4** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 836.0 | 955.9 | 1,122.7 |
| Outgoing | 557.5 | 644.1 | 698.4 |
| Surplus (Deficit) | 278.5 | 311.7 | 424.3 |
| Total Volume | 1,393.5 | 1,600.0 | 1,821.1 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data exclude some cross-border traffic to Iran

# Turkmenistan

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 5.5 | 33.3% |
| 2. | Uzbekistan | 1.1 | 6.7% |
| 3. | Ukraine | 1.0 | 6.1% |
| 4. | Azerbaijan | 0.9 | 5.5% |
| 5. | Kazakhstan | 0.7 | 4.2% |
| 6. | Armenia | 0.4 | 2.4% |
| 7. | Belarus | 0.3 | 1.8% |
| 8. | Tajikistan | 0.3 | 1.8% |
| 9. | Georgia | 0.2 | 1.2% |
| 10. | Kyrgyzstan | 0.2 | 1.2% |
| 11. | Moldova | 0.2 | 1.2% |
| | Other | 5.8 | 35.2% |
| | **Total** | **16.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 10.0 | 15.3 | 16.5 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. The "Other" category may include routes to non-members of the Commonwealth of Independent States that rank among the top destinations for outgoing traffic.

# Ukraine

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 215.4 | 60.0% |
| 2. | Belarus | 19.8 | 5.5% |
| 3. | Moldova | 15.0 | 4.2% |
| 4. | Germany | 13.9 | 3.9% |
| 5. | Poland | 10.3 | 2.9% |
| 6. | Czech Republic | 5.2 | 1.4% |
| 7. | Armenia | 5.0 | 1.4% |
| 8. | Italy | 4.3 | 1.2% |
| 9. | United States | 4.1 | 1.1% |
| 10. | Kazakhstan | 4.0 | 1.1% |
| 11. | United Kingdom | 3.6 | 1.0% |
| 12. | Georgia | 3.5 | 1.0% |
| 13. | Hungary | 3.4 | 0.9% |
| 14. | Azerbaijan | 3.3 | 0.9% |
| 15. | Turkey | 3.2 | 0.9% |
| 16. | Latvia | 3.2 | 0.9% |
| 17. | Israel | 3.1 | 0.9% |
| 18. | Uzbekistan | 3.1 | 0.9% |
| 19. | Lithuania | 2.6 | 0.7% |
| 20. | Bulgaria | 2.3 | 0.6% |
| | Other | 30.9 | 8.6% |
| | **Total** | **359.2** | |



## National Traffic Balance

| **Minutes** | **1997** | **1998** | **1999** |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 486.8 | 465.9 | 359.2 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# United Arab Emirates

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | India | 238.2 | 24.7% |
| 2. | Pakistan | 94.7 | 9.8% |
| 3. | Egypt | 56.0 | 5.8% |
| 4. | United Kingdom | 52.0 | 5.4% |
| 5. | Saudi Arabia | 50.4 | 5.2% |
| 6. | Syria | 37.6 | 3.9% |
| 7. | Oman | 36.0 | 3.7% |
| 8. | United States | 34.0 | 3.5% |
| 9. | Iran | 27.2 | 2.8% |
| 10. | Jordan | 25.2 | 2.6% |
| 11. | Philippines | 22.4 | 2.3% |
| 12. | Lebanon | 22.3 | 2.3% |
| 13. | Qatar | 21.6 | 2.2% |
| 14. | Bahrain | 19.5 | 2.0% |
| 15. | Sudan | 18.7 | 1.9% |
| 16. | Bangladesh | 18.5 | 1.9% |
| 17. | Kuwait | 16.7 | 1.7% |
| 18. | Sri Lanka | 12.7 | 1.3% |
| 19. | Canada | 11.4 | 1.2% |
| 20. | Germany | 11.1 | 1.2% |
| | Other | 136.8 | 14.2% |
| | **Total** | **963.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | n.a. | n.a. |
| Outgoing | 738.0 | 874.8 | 963.0 |
| Surplus (Deficit) | n.a. | n.a. | n.a. |
| Total Volume | n.a. | n.a. | n.a. |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# United Kingdom—Outgoing

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 1,610.9 | 15.9% |
| 2. Germany | 913.3 | 9.0% |
| 3. Ireland | 809.3 | 8.0% |
| 4. France | 655.8 | 6.5% |
| 5. Spain | 435.2 | 4.3% |
| 6. Italy | 396.6 | 3.9% |
| 7. Netherlands | 348.1 | 3.4% |
| 8. Australia | 325.6 | 3.2% |
| 9. Canada | 247.9 | 2.4% |
| 10. Belgium | 234.6 | 2.3% |
| 11. Switzerland | 201.1 | 2.0% |
| 12. Greece | 196.5 | 1.9% |
| 13. Sweden | 186.3 | 1.8% |
| 14. India | 181.3 | 1.8% |
| 15. Turkey | 153.2 | 1.5% |
| 16. South Africa | 150.3 | 1.5% |
| 17. Pakistan | 136.0 | 1.3% |
| 18. Portugal | 116.9 | 1.2% |
| 19. Poland | 116.6 | 1.1% |
| 20. Austria | 115.7 | 1.1% |
| Other | 2,609.8 | 25.7% |
| **Total** | **10,141.0** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | 6,400.0 | 6,853.4 |
| Outgoing | 6,800.0 | 8,225.0 | 10,141.0 |
| Surplus (Deficit) | n.a. | (1,825.0) | (3,287.6) |
| Total Volume | n.a. | 14,625.0 | 16,994.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Fiscal year ends 31 March. Data include include approximately two billion minutes of traffic refiled via the U.K , thus overstating U.K.-originated volumes.

# United Kingdom—Incoming

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. United States | 1,479.8 | 21.6% |
| 2. Ireland | 629.2 | 9.2% |
| 3. Germany | 603.0 | 8.8% |
| 4. France | 552.2 | 8.1% |
| 5. Spain | 299.1 | 4.4% |
| 6. Canada | 294.8 | 4.3% |
| 7. Australia | 289.4 | 4.2% |
| 8. Netherlands | 237.7 | 3.5% |
| 9. Italy | 228.0 | 3.3% |
| 10. Sweden | 155.0 | 2.3% |
| 11. Switzerland | 139.3 | 2.0% |
| 12. Belgium | 117.2 | 1.7% |
| 13. Greece | 106.2 | 1.5% |
| 14. South Africa | 91.5 | 1.3% |
| 15. New Zealand | 82.5 | 1.2% |
| 16. Singapore | 78.6 | 1.1% |
| 17. Hong Kong | 76.2 | 1.1% |
| 18. Norway | 70.2 | 1.0% |
| 19. Austria | 63.2 | 0.9% |
| 20. Denmark | 63.0 | 0.9% |
| Other | 1,197.3 | 17.5% |
| **Total** | **6,853.4** | |

# U.K. Top 100 Correspondents

| Country | Outgoing Q3 98/99 | Outgoing Q3 99/00 | Incoming Q3 98/99 | Incoming Q3 99/00 |
|---|---|---|---|---|
| Albania | 1.7 | 2.3 | 0.2 | 0.7 |
| Algeria | 3.5 | 3.2 | 2.1 | 2.7 |
| Argentina | 2.7 | 3.3 | 1.1 | 1.3 |
| Australia | 65.3 | 78.1 | 67.6 | 80.0 |
| Austria | 25.7 | 25.3 | 7.2 | 15.1 |
| Bahrain | 2.2 | 2.3 | 1.6 | 2.2 |
| Bangladesh | 5.8 | 7.7 | 2.3 | 2.7 |
| Barbados | 2.3 | 2.7 | 1.0 | 0.9 |
| Belgium | 37.2 | 63.2 | 33.3 | 29.0 |
| Brazil | 6.7 | 11.2 | 4.1 | 4.7 |
| Bulgaria | 3.8 | 4.1 | 0.9 | 0.9 |
| Cameroon | 1.5 | 3.1 | 0.3 | 0.3 |
| Canada | 48.8 | 63.9 | 53.8 | 72.4 |
| Chile | 3.6 | 4.8 | 0.9 | 1.6 |
| China | 6.7 | 11.7 | 3.6 | 5.0 |
| Colombia | 7.0 | 5.5 | 1.2 | 2.2 |
| Croatia | 3.3 | 4.8 | 1.7 | 1.7 |
| Cuba | 1.7 | 2.0 | 1.5 | 0.4 |
| Cyprus | 10.9 | 10.3 | 7.6 | 6.5 |
| Czech Republic | 11.3 | 8.9 | 4.5 | 4.5 |
| Denmark | 23.5 | 22.3 | 16.6 | 14.9 |
| Dominican Rep. | n.a. | 1.9 | n.a. | 0.4 |
| Ecuador | 1.7 | 4.8 | 0.2 | 0.8 |
| Egypt | 9.1 | 14.0 | 2.9 | 7.0 |
| Finland | 11.1 | 13.6 | 5.4 | 7.3 |
| France | 135.0 | 141.2 | 106.0 | 130.0 |
| Gambia | 1.7 | 4.3 | 0.3 | 0.9 |
| Georgia | n.a. | 2.6 | n.a. | 0.1 |
| Germany | 177.9 | 232.9 | 81.6 | 156.8 |
| Ghana | 9.2 | 12.1 | 2.7 | 3.4 |
| Gibraltar | 2.4 | 2.8 | 1.7 | 1.9 |
| Greece | 31.0 | 48.0 | 25.0 | 28.2 |
| Guyana | n.a. | 2.7 | n.a. | 0.6 |
| Honduras | n.a. | 2.2 | n.a. | 0.1 |
| Hong Kong | 22.4 | 21.4 | 7.6 | 19.6 |
| Hungary | 13.2 | 16.2 | 4.0 | 3.9 |
| Iceland | 1.7 | 3.2 | 1.4 | 1.5 |
| India | 33.0 | 39.7 | 9.4 | 15.2 |
| Indonesia | 2.0 | 3.4 | 2.0 | 2.2 |
| Iran | 5.2 | 5.4 | 3.1 | 3.0 |
| Iraq | n.a. | 2.1 | n.a. | 0.2 |
| Ireland | 197.4 | 213.5 | 149.2 | 149.9 |
| Israel | 10.7 | 14.2 | 6.4 | 7.2 |
| Italy | 90.7 | 94.0 | 43.8 | 53.5 |
| Jamaica | 6.5 | 10.8 | 1.3 | 2.5 |
| Japan | 20.4 | 27.1 | 11.5 | 14.5 |
| Jordan | 3.9 | 3.6 | 1.5 | 2.2 |
| Kazakhstan | 1.8 | 3.2 | 0.6 | 0.4 |
| Kenya | 4.4 | 4.1 | 1.8 | 0.4 |
| Korea, Rep. | 2.5 | 4.4 | 2.7 | 2.8 |
| Kuwait | 4.4 | 3.0 | 2.1 | 1.0 |
| Latvia | 4.0 | 4.0 | 0.5 | 0.6 |
| Lebanon | 4.4 | 8.5 | 1.6 | 4.7 |
| Lithuania | 1.8 | 5.0 | 0.3 | 0.3 |
| Luxembourg | 6.5 | 7.0 | 3.9 | 4.5 |
| Macedonia | 1.6 | 3.4 | 0.4 | 1.1 |
| Malaysia | 5.8 | 7.4 | 3.7 | 7.4 |
| Mali | 2.6 | 2.2 | 0.7 | 0.1 |
| Malta | 4.0 | 3.5 | 3.1 | 2.9 |
| Mauritius | 3.2 | 3.4 | 2.1 | 3.5 |
| Mexico | 2.8 | 3.7 | 1.3 | 1.7 |
| Morocco | 7.3 | 9.0 | 2.7 | 3.8 |
| Netherlands | 63.2 | 86.3 | 55.7 | 57.4 |
| New Zealand | 15.0 | 13.9 | 14.2 | 24.6 |
| Nigeria | 16.4 | 14.3 | 4.9 | 5.6 |
| Norway | 21.6 | 20.1 | 21.1 | 17.9 |
| Oman | 1.9 | 2.2 | 1.5 | 1.5 |
| Pakistan | 23.5 | 33.2 | 4.0 | 4.4 |
| Peru | 1.5 | 5.2 | 0.4 | 0.4 |
| Philippines | 5.3 | 8.9 | 1.3 | 3.8 |
| Poland | 28.0 | 37.1 | 9.4 | 11.5 |
| Portugal | 19.8 | 26.6 | 13.1 | 15.0 |
| Romania | 5.8 | 6.0 | 1.8 | 1.9 |
| Russia | 14.7 | 16.6 | 3.5 | 5.3 |
| Saudi Arabia | 7.7 | 9.8 | 6.9 | 7.5 |
| Senegal | 1.3 | 3.9 | 0.2 | 0.4 |
| Singapore | 8.8 | 10.3 | 5.2 | 19.7 |
| Slovak Republic | 4.9 | 5.1 | 2.0 | 1.5 |
| Slovenia | 1.6 | 8.1 | 0.9 | 1.1 |
| South Africa | 25.5 | 43.7 | 21.0 | 22.3 |
| Spain | 83.1 | 104.4 | 59.0 | 69.3 |
| Sri Lanka | 6.5 | 5.0 | 1.2 | 1.9 |
| Sweden | 37.2 | 49.2 | 38.3 | 37.9 |
| Switzerland | 35.7 | 46.8 | 23.7 | 21.6 |
| Syria | 4.3 | 4.9 | 0.6 | 1.4 |
| Taiwan | 3.7 | 4.1 | 2.3 | 2.9 |
| Tanzania | 2.2 | 4.5 | 0.6 | 0.7 |
| Thailand | 5.2 | 6.4 | 3.6 | 5.0 |
| Trinidad & Tobago | 2.0 | 2.4 | 1.2 | 1.3 |
| Tunisia | 3.9 | 6.4 | 0.9 | 1.1 |
| Turkey | 30.0 | 44.5 | 12.6 | 13.5 |
| U.A.E. | 11.1 | 14.0 | 9.4 | 13.3 |
| Uganda | 1.8 | 2.1 | 0.6 | 0.7 |
| Ukraine | 8.6 | 3.4 | 1.3 | 1.3 |
| United States | 323.0 | 390.8 | 344.0 | 387.3 |
| Venezuela | n.a. | 2.1 | n.a. | 0.7 |
| Vietnam | 5.0 | 6.7 | 4.3 | 3.7 |
| Yugoslavia | 4.9 | 10.6 | 1.3 | 2.6 |
| Zaire | n.a. | 2.1 | n.a. | 1.2 |
| Zimbabwe | 1.9 | 2.4 | 2.6 | 3.3 |

Note: Data are millions of minutes of public switched traffic for the largest U.K international carriers during the third quarters (October-December) of FY 1998/1999 and FY 1999/2000. *Route data may include some calls refiled via the U.K., thus overstating actual U.K.-originated traffic.*

Source: Office of Telecommunications (OFTEL)

# United States—Outgoing

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Canada | 4,491.3 | 15.2% |
| 2. | Mexico | 4,084.3 | 13.8% |
| 3. | United Kingdom | 1,909.6 | 6.4% |
| 4. | Germany | 1,525.3 | 5.2% |
| 5. | India | 996.4 | 3.4% |
| 6. | Japan | 874.2 | 3.0% |
| 7. | Philippines | 773.4 | 2.6% |
| 8. | Italy | 772.0 | 2.6% |
| 9. | Dominican Republic | 626.8 | 2.1% |
| 10. | France | 626.3 | 2.1% |
| 11. | Brazil | 623.5 | 2.1% |
| 12. | Australia | 420.5 | 1.4% |
| 13. | China | 416.0 | 1.4% |
| 14. | Jamaica | 364.3 | 1.2% |
| 15. | Israel | 362.6 | 1.2% |
| 16. | Korea, Rep. | 351.4 | 1.2% |
| 17. | Taiwan | 333.4 | 1.1% |
| 18. | Spain | 325.2 | 1.1% |
| 19. | Colombia | 318.8 | 1.1% |
| 20. | Pakistan | 300.7 | 1.0% |
| | Other | 9,112.7 | 30.8% |
| | **Total** | **29,608.8** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 9,213.3 | 10,395.3 | 10,640.8 |
| Outgoing | 23,001.7 | 25,163.8 | 29,608.8 |
| Surplus (Deficit) | (13,788.4) | (14,768.5) | (18,968.0) |
| Total Volume | 32,215.0 | 35,559.2 | 40,249.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic. Data include include at least two billion minutes of traffic refiled via the U.S., thus overstating traffic originating from the U.S. Carriers and traffic from points beyond the United States, Puerto Rico, and the U.S. Virgin Islands are excluded.

# United States—Incoming

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Canada | 3,920.9 | 36.8% |
| 2. United Kingdom | 1,126.4 | 10.6% |
| 3. Mexico | 1,124.1 | 10.6% |
| 4. Australia | 437.7 | 4.1% |
| 5. Germany | 327.2 | 3.1% |
| 6. Japan | 305.7 | 2.9% |
| 7. Israel | 237.4 | 2.2% |
| 8. France | 224.7 | 2.1% |
| 9. Italy | 201.1 | 1.9% |
| 10. Korea, Rep. | 199.5 | 1.9% |
| 11. Brazil | 185.9 | 1.7% |
| 12. Sweden | 144.0 | 1.4% |
| 13. Netherlands | 136.2 | 1.3% |
| 14. Dominican Republic | 122.0 | 1.1% |
| 15. Taiwan | 121.2 | 1.1% |
| 16. Hong Kong | 103.6 | 1.0% |
| 17. Switzerland | 81.7 | 0.8% |
| 18. Spain | 74.0 | 0.7% |
| 19. Colombia | 57.1 | 0.5% |
| 20. Jamaica | 54.2 | 0.5% |
| Other | 1,456.2 | 13.7% |
| **Total** | **10,640.8** | |

# U.S. Top 100 Correspondents

| Country | Outgoing Minutes 1998 | Outgoing Minutes 1999 | Incoming Minutes 1998 | Incoming Minutes 1999 |
|---|---|---|---|---|
| Antigua & Barbuda | 66.7 | 62.3 | 7.1 | 6.3 |
| Argentina | 234.0 | 114.2 | 46.1 | 32.4 |
| Aruba | 25.8 | 26.2 | 5.7 | 6.6 |
| Australia | 459.2 | 420.5 | 261.3 | 437.7 |
| Austria | 76.0 | 108.0 | 26.1 | 22.6 |
| Bahamas | 82.7 | 94.4 | 49.7 | 42.2 |
| Bangladesh | 52.7 | 65.9 | 4.7 | 3.7 |
| Barbados | 47.7 | 52.6 | 12.6 | 9.4 |
| Belarus | 12.6 | 15.1 | 1.1 | 0.8 |
| Belgium | 116.7 | 135.1 | 39.7 | 34.6 |
| Belize | 15.1 | 17.8 | 5.0 | 3.9 |
| Bermuda | 42.8 | 49.3 | 30.0 | 19.6 |
| Bolivia | 52.8 | 42.9 | 5.5 | 6.5 |
| Brazil | 609.5 | 623.5 | 180.2 | 185.9 |
| Bulgaria | 14.6 | 29.4 | 1.6 | 3.3 |
| Canada | 4,024.6 | 4,491.3 | 3,359.0 | 3,920.9 |
| Cayman Islands | 25.8 | 25.7 | 14.2 | 10.0 |
| Chile | 128.2 | 93.0 | 81.1 | 52.7 |
| China | 446.6 | 416.0 | 79.4 | 46.9 |
| Colombia | 224.3 | 318.8 | 51.2 | 57.1 |
| Costa Rica | 74.1 | 82.4 | 26.6 | 24.0 |
| Croatia | 24.0 | 43.6 | 5.1 | 4.3 |
| Cuba | 141.8 | 77.5 | 1.2 | 7.4 |
| Cyprus | 11.1 | 17.6 | 4.6 | 5.4 |
| Czech Republic | 30.3 | 54.7 | 9.9 | 9.1 |
| Denmark | 75.8 | 72.2 | 26.5 | 19.7 |
| Dominica | 29.3 | 20.6 | 2.1 | 2.0 |
| Dominican Rep. | 453.2 | 626.8 | 111.4 | 122.0 |
| Ecuador | 113.5 | 192.8 | 13.6 | 14.3 |
| Egypt | 113.8 | 168.0 | 11.7 | 11.2 |
| El Salvador | 198.9 | 235.3 | 16.0 | 24.7 |
| Ethiopia | 22.0 | 23.2 | 1.8 | 1.9 |
| Finland | 32.1 | 35.6 | 14.1 | 13.3 |
| France | 593.8 | 626.3 | 270.8 | 224.7 |
| Germany | 1,175.8 | 1,525.3 | 365.9 | 327.2 |
| Ghana | 44.8 | 47.6 | 7.8 | 5.8 |
| Greece | 116.3 | 182.4 | 42.8 | 38.6 |
| Grenada | 63.8 | 67.4 | 2.3 | 3.0 |
| Guatemala | 145.6 | 178.5 | 17.9 | 18.7 |
| Haiti | 100.0 | 134.2 | 7.2 | 6.8 |
| Honduras | 150.0 | 167.6 | 15.1 | 14.6 |
| Hong Kong | 623.0 | 242.1 | 214.7 | 103.6 |
| Hungary | 39.4 | 83.0 | 12.7 | 11.9 |
| Iceland | 14.1 | 20.0 | 8.9 | 8.3 |
| India | 776.9 | 996.4 | 58.5 | 44.1 |
| Indonesia | 103.4 | 96.0 | 28.6 | 20.5 |
| Iran | 61.1 | 111.9 | 17.7 | 20.0 |
| Ireland | 161.0 | 193.5 | 69.0 | 50.1 |
| Israel | 221.9 | 362.6 | 171.4 | 237.4 |
| Italy | 546.9 | 772.0 | 134.0 | 201.1 |
| Jamaica | 291.5 | 364.3 | 51.9 | 54.2 |
| Japan | 839.5 | 874.2 | 336.4 | 305.7 |
| Jordan | 51.6 | 46.8 | 6.8 | 6.9 |
| Kenya | 26.5 | 35.4 | 4.1 | 3.8 |
| Korea, Rep. | 399.9 | 351.4 | 219.7 | 199.5 |
| Kuwait | 50.7 | 52.7 | 8.8 | 5.5 |
| Lebanon | 57.7 | 74.1 | 11.2 | 6.1 |
| Lithuania | 7.0 | 16.4 | 1.1 | 0.9 |
| Luxembourg | 16.0 | 17.4 | 6.9 | 6.7 |
| Malaysia | 103.7 | 72.8 | 25.2 | 19.6 |
| Mauritius | 14.0 | 15.5 | 0.6 | 0.2 |
| Mexico | 3,121.1 | 4,084.3 | 1,086.3 | 1,124.1 |
| Morocco | 74.9 | 63.4 | 6.4 | 6.0 |
| Netherlands | 280.8 | 284.3 | 122.2 | 136.2 |
| New Zealand | 75.6 | 90.3 | 54.7 | 42.4 |
| Nicaragua | 62.3 | 112.3 | 8.2 | 13.7 |
| Nigeria | 163.9 | 132.4 | 17.4 | 9.2 |
| Norway | 90.6 | 80.0 | 51.8 | 41.0 |
| Pakistan | 213.5 | 300.7 | 15.6 | 8.8 |
| Panama | 69.6 | 68.7 | 18.9 | 16.9 |
| Paraguay | 16.2 | 17.8 | 3.7 | 2.9 |
| Peru | 185.5 | 232.4 | 31.4 | 27.5 |
| Philippines | 589.5 | 773.4 | 50.7 | 37.9 |
| Poland | 189.5 | 254.8 | 27.9 | 24.8 |
| Portugal | 72.0 | 93.1 | 23.1 | 13.2 |
| Romania | 76.1 | 61.6 | 31.5 | 7.5 |
| Russia | 176.3 | 173.1 | 22.0 | 16.6 |
| Saint Lucia | 20.1 | 21.4 | 3.5 | 4.2 |
| Saudi Arabia | 120.7 | 111.0 | 35.8 | 32.0 |
| Senegal | 19.9 | 32.5 | 2.0 | 1.5 |
| Singapore | 175.7 | 116.1 | 65.6 | 26.3 |
| Slovak Republic | 11.2 | 29.5 | 3.3 | 2.5 |
| South Africa | 130.8 | 163.4 | 36.5 | 38.9 |
| Spain | 254.0 | 325.2 | 69.5 | 74.0 |
| Sri Lanka | 21.2 | 28.6 | 3.1 | 7.9 |
| Sweden | 151.0 | 173.9 | 113.8 | 144.0 |
| Switzerland | 199.9 | 238.8 | 102.1 | 81.7 |
| Syria | 16.2 | 24.3 | 4.1 | 2.6 |
| Taiwan | 334.4 | 333.4 | 153.0 | 121.2 |
| Thailand | 130.3 | 118.5 | 32.2 | 23.5 |
| Trinidad & Tobago | 105.9 | 132.1 | 31.5 | 27.9 |
| Turkey | 113.7 | 231.5 | 28.4 | 27.0 |
| Ukraine | 46.1 | 70.8 | 6.3 | 3.8 |
| U.A.E. | 60.4 | 90.7 | 32.3 | 32.0 |
| United Kingdom | 1,524.7 | 1,909.6 | 1,193.5 | 1,126.4 |
| Uruguay | 36.5 | 35.5 | 8.2 | 7.0 |
| Venezuela | 233.3 | 230.4 | 60.2 | 49.2 |
| Vietnam | 201.9 | 246.8 | 4.5 | 7.4 |
| Yemen | 29.8 | 20.7 | 1.3 | 1.2 |
| Yugoslavia | 33.9 | 27.7 | 8.4 | 3.2 |

Note: All data are millions of minutes of public switched and International Simple Resale (ISR) traffic Because data are based on the billing point of the traffic, route data may not exactly correspond with traffic volumes as measured by the originating point of traffic (see Methodology on page 285) Carriers and traffic from outside the U.S. states, Puerto Rico, and the U.S. Virgin Islands (e.g., Guam) are excluded

# Uruguay

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Argentina | 41.3 | 51.6% |
| 2. Brazil | 10.7 | 13.4% |
| 3. United States | 9.1 | 11.3% |
| 4. Spain | 3.3 | 4.1% |
| 5. Chile | 2.0 | 2.5% |
| 6. Paraguay | 1.8 | 2.2% |
| 7. Italy | 1.4 | 1.8% |
| 8. Mexico | 1.0 | 1.2% |
| 9. France | 0.9 | 1.1% |
| 10. Peru | 0.8 | 0.9% |
| 11. Canada | 0.6 | 0.8% |
| 12. Germany | 0.6 | 0.7% |
| 13. Venezuela | 0.5 | 0.6% |
| 14. Switzerland | 0.5 | 0.6% |
| 15. Australia | 0.4 | 0.5% |
| 16. Colombia | 0.4 | 0.4% |
| 17. United Kingdom | 0.4 | 0.4% |
| 18. Cuba | 0.3 | 0.3% |
| 19. Ecuador | 0.2 | 0.3% |
| 20. Bolivia | 0.2 | 0.2% |
| Other | 3.9 | 4.9% |
| **Total** | **80.1** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 93.7 | 97.0 | 98.3 |
| Outgoing | 68.4 | 78.3 | 80.1 |
| Surplus (Deficit) | 25.3 | 18.7 | 18.2 |
| Total Volume | 162.1 | 175.3 | 178.4 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Uzbekistan

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | Russia | 29.0 | 42.3% |
| 2. | Kazakhstan | 10.3 | 15.0% |
| 3. | Ukraine | 3.6 | 5.3% |
| 4. | Kyrgyzstan | 3.3 | 4.8% |
| 5. | Tajikistan | 2.7 | 3.9% |
| 6. | Turkmenistan | 1.9 | 2.7% |
| 7. | Turkey | 1.9 | 2.7% |
| 8. | Germany | 1.6 | 2.4% |
| 9. | United States | 1.5 | 2.2% |
| 10. | United Kingdom | 1.0 | 1.5% |
| 11. | Belarus | 0.9 | 1.4% |
| 12. | Korea, Rep. | 0.9 | 1.3% |
| 13. | China | 0.8 | 1.1% |
| 14. | Azerbaijan | 0.7 | 1.0% |
| 15. | Pakistan | 0.6 | 0.9% |
| 16. | France | 0.4 | 0.6% |
| 17. | India | 0.4 | 0.5% |
| 18. | Japan | 0.4 | 0.5% |
| 19. | Italy | 0.4 | 0.5% |
| 20. | Greece | 0.2 | 0.3% |
| | Other | 6.0 | 8.8% |
| | **Total** | **68.5** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | n.a. | 74.7 | 75.0 |
| Outgoing | 63.1 | 91.7 | 68.5 |
| Surplus (Deficit) | n.a. | (17.0) | 6.6 |
| Total Volume | n.a. | 166.5 | 143.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Venezuela

## Largest Telecommunications Routes, 1999

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | United States | 65.6 | 40.9% |
| 2. | Colombia | 24.9 | 15.5% |
| 3. | Italy | 11.3 | 7.1% |
| 4. | Spain | 10.0 | 6.3% |
| 5. | Canada | 9.8 | 6.1% |
| 6. | United Kingdom | 4.2 | 2.6% |
| 7. | Peru | 3.9 | 2.4% |
| 8. | Mexico | 3.0 | 1.8% |
| 9. | Portugal | 2.5 | 1.5% |
| 10. | Argentina | 2.5 | 1.5% |
| 11. | Brazil | 2.1 | 1.3% |
| 12. | Dominican Republic | 2.0 | 1.3% |
| 13. | France | 2.0 | 1.3% |
| 14. | Chile | 1.9 | 1.2% |
| 15. | Ecuador | 1.3 | 0.8% |
| 16. | Trinidad & Tobago | 1.3 | 0.8% |
| 17. | Germany | 1.2 | 0.8% |
| 18. | Panama | 1.0 | 0.6% |
| 19. | Honduras | 0.9 | 0.6% |
| 20. | Netherlands Antilles | 0.8 | 0.5% |
| | Other | 8.6 | 5.3% |
| | **Total** | **160.2** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 286.9 | 298.1 | 315.3 |
| Outgoing | 159.2 | 164.5 | 160.2 |
| Surplus (Deficit) | 127.7 | 133.6 | 155.2 |
| Total Volume | 446.1 | 462.6 | 475.5 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Yugoslavia

## Largest Telecommunications Routes, 1999

| Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. Germany | 38.0 | 16.8% |
| 2. Austria | 20.6 | 9.1% |
| 3. Croatia | 17.9 | 7.9% |
| 4. Switzerland | 16.8 | 7.4% |
| 5. Macedonia | 14.4 | 6.3% |
| 6. Italy | 14.2 | 6.3% |
| 7. Hungary | 11.7 | 5.2% |
| 8. Bosnia-Herzegovina | 11.2 | 4.9% |
| 9. Slovenia | 8.9 | 3.9% |
| 10. United States | 8.8 | 3.9% |
| 11. France | 8.7 | 3.8% |
| 12. Greece | 7.9 | 3.5% |
| 13. United Kingdom | 7.8 | 3.4% |
| 14. Bulgaria | 4.4 | 1.9% |
| 15. Sweden | 4.4 | 1.9% |
| 16. Russia | 4.1 | 1.8% |
| 17. Netherlands | 3.3 | 1.4% |
| 18. Romania | 2.8 | 1.2% |
| 19. Canada | 2.4 | 1.1% |
| 20. Czech Republic | 1.7 | 0.8% |
| Other | 17.0 | 7.5% |
| **Total** | **227.0** | |



## National Traffic Balance

| Minutes | 1997 | 1998 | 1999 |
|---|---|---|---|
| Incoming | 332.0 | 423.3 | 498.8 |
| Outgoing | 217.0 | 219.5 | 227.0 |
| Surplus (Deficit) | 115.0 | 203.8 | 271.7 |
| Total Volume | 549.0 | 642.9 | 725.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic. Data based on billing point of traffic.

# Zambia

## Largest Telecommunications Routes, FY 1999/00

| Destination | Minutes (thousands) | Percentage of Outgoing Traffic |
|---|---|---|
| 1. South Africa | 4,554.1 | 30.0% |
| 2. United Kingdom | 2,244.2 | 14.8% |
| 3. United States | 1,734.6 | 11.4% |
| 4. Zimbabwe | 1,469.8 | 9.7% |
| 5. Japan | 1,221.4 | 8.1% |
| 6. India | 514.7 | 3.4% |
| 7. Botswana | 314.9 | 2.1% |
| 8. Kenya | 314.1 | 2.1% |
| 9. Italy | 308.6 | 2.0% |
| 10. Tanzania | 277.7 | 1.8% |
| 11. Germany | 272.2 | 1.8% |
| 12. Netherlands | 257.4 | 1.7% |
| 13. Malawi | 254.1 | 1.7% |
| 14. France | 208.9 | 1.4% |
| 15. Canada | 166.2 | 1.1% |
| 16. Belgium | 107.9 | 0.7% |
| 17. Namibia | 96.7 | 0.6% |
| 18. Denmark | 84.9 | 0.6% |
| 19. Sweden | 77.7 | 0.5% |
| 20. Norway | 76.0 | 0.5% |
| Other | 800.0 | 4.0% |
| **Total** | **15,874.2** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | 20.3 | 15.9 |
| Outgoing | n.a. | 13.5 | 15.9 |
| Surplus (Deficit) | n.a. | 6.8 | 0.0 |
| Total Volume | n.a. | 33.8 | 31.8 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Zimbabwe

## Largest Telecommunications Routes, FY 1999/00

| | Destination | Minutes (millions) | Percentage of Outgoing Traffic |
|---|---|---|---|
| 1. | South Africa | 29.7 | 45.3% |
| 2. | United Kingdom | 11.8 | 18.0% |
| 3. | United States | 3.7 | 5.6% |
| 4. | Botswana | 3.0 | 4.6% |
| 5. | Zambia | 2.5 | 3.8% |
| 6. | Malawi | 1.3 | 2.1% |
| 7. | Mozambique | 1.1 | 1.7% |
| 8. | Germany | 0.8 | 1.3% |
| 9. | Kenya | 0.8 | 1.2% |
| 10. | France | 0.6 | 1.0% |
| 11. | Netherlands | 0.6 | 0.9% |
| 12. | India | 0.5 | 0.8% |
| 13. | Canada | 0.5 | 0.7% |
| 14. | Switzerland | 0.5 | 0.7% |
| 15. | Namibia | 0.4 | 0.7% |
| 16. | China | 0.4 | 0.6% |
| 17. | Japan | 0.4 | 0.5% |
| 18. | Belgium | 0.4 | 0.5% |
| 19. | Angola | 0.3 | 0.5% |
| 20. | Australia | 0.3 | 0.5% |
| | Other | 5.9 | 9.0% |
| | **Total** | **65.6** | |



## National Traffic Balance

| Minutes | FY 1997/98 | FY 1998/99 | FY 1999/00 |
|---|---|---|---|
| Incoming | n.a. | 53.2 | 59.0 |
| Outgoing | n.a. | 52.8 | 65.6 |
| Surplus (Deficit) | n.a. | 0.4 | (6.6) |
| Total Volume | n.a. | 106.0 | 124.6 |

**Note:** Data are in millions of minutes of outgoing public switched telecommunications traffic.

# Methodology

The traffic statistics in *TeleGeography 2001* 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.

To enable comparisons of countries' international traffic statistics, TeleGeography has endeavored to apply a consistent methodology. When reviewing the traffic statistics in *TeleGeography 2001*, however, readers should keep in mind the following issues.

**Public Switched Network vs. Private Line Traffic**

Traffic volumes in *TeleGeography 2001* are generally reported in minutes. In most cases, the statistics refer to paid minutes on public switched circuits and thus include voice as well as fax traffic.

Traffic volumes include traffic carried by wholesale carriers that is resold by "pure" resellers. These resellers do not own or lease their own international transmission facilities. Instead, they resell the traffic of other carriers; thus, pure resale traffic is counted as part of the minutes for the facilities-based carrier whose services are resold.

Traffic carried by International Simple Resale (ISR) carriers is also included. ISR carriers resell the capacity of international private lines (IPLs) for switched services by interconnecting their IPLs to the public switched network at one or both ends.

**Illicit Bypass**

While traffic volumes include ISR, they generally do not include illicit bypass traffic that bypasses the international settlement rate regime. One form of illicit bypass is Voice-over-Internet-Protocol (VoIP). For an overview of Voice-over-IP traffic volumes, see "VoIP Routes and Traffic."

**Cross-Border Traffic**

Neighboring countries may not classify local cross-border traffic in the same way. That is, one country may treat some cross-border traffic as domestic, while its neighbor counts all such traffic as international.

**Billing Point vs. Originating Point of Traffic**

Unless otherwise stated in the notes to a table, the outbound minutes reported for countries in *TeleGeography 2001* refer to outbound traffic originated in the reporting country even if it is billed in another country.

In the past, 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 calling card and call-back services has shifted the billing point for many international calls. For example, calls from Italy to the United States (or a third country, such as Argentina) may now be set up and billed in the U.S.

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 can include traffic actually originating in another. Thus, incoming minutes reported for one country may not match the outgoing traffic on the same route by the correspondent country. Some double counting may also occur. For example, a call from Thailand to the U.S. which is billed to a U.S. calling card is reported by the U.S. carrier as outbound U.S. traffic; the same call also may be reported as outbound minutes by Thailand.

Accordingly, in countries where calling card and call-back services are widely used, a year-to-year comparison of national traffic also requires examining the statistics of countries, such as the U.S. and the U.K., where the calls are hubbed.

**Transit Traffic**

Unless otherwise stated, *TeleGeography 2001* excludes refile traffic from the totals of countries acting as transit hubs. Notable exceptions include the U.K. and U.S. statistics, which do include some traffic reoriginated from other countries.

**Fixed vs. Mobile Traffic**

Traffic volumes include international calls originated and terminated on both fixed and mobile networks.

**Rounding**

Rounding may cause the figures on total national incoming and outgoing traffic to appear inconsistent with other national data.

**Revised Data**

Some differences exist between the historical statistics (1998 or earlier) reported in *TeleGeography 2001* and data published in prior TeleGeography reports or *Direction of Traffic*. The variations reflect corrections and/or revised data subsequently provided to TeleGeography.

# Global Reference: Blue Pages

# National Telecommunications Indicators (A-K)

| Countries | GDP 1999 (US$ billions) | Population 1999 (millions) | Main Lines 1999 (thous.) | Lines Per 100 people | Cellular Users 1999 (thous.) | International Carriers 1999 | Internet Hosts 1999 (thous.) |
|---|---|---|---|---|---|---|---|
| Albania (a) | 3.1 | 3.9 | 140 | 3.6 | 11 | 1 | n.a. |
| Algeria | 47.0 | 30.8 | 1,600 | 5.2 | 72 | 1 | n.a. |
| Andorra | n.a. | 0.1 | 35 | 46.7 | 18 | 1 | 1 |
| Angola | 5.9 | 12.5 | 96 | 0.8 | 17 | 1 | n.a. |
| Argentina | 281.9 | 36.6 | 7,357 | 20.1 | 4,434 | 2 | 142 |
| Armenia | 1.9 | 3.5 | 547 | 15.5 | 9 | 1 | 2 |
| Australia (b) | 389.7 | 18.9 | 9,857 | 52.1 | 6,501 | 28 | 1,090 |
| Austria (c) | 208.9 | 8.2 | 3,939 | 48.2 | 4,242 | 17 | 263 |
| Azerbaijan (a) | 4.5 | 7.7 | 730 | 9.5 | 180 | 1 | 1 |
| Bahamas | n.a. | 0.3 | 111 | 36.9 | 16 | 1 | n.a. |
| Bahrain (a) | n.a. | 0.7 | 165 | 24.9 | 134 | 1 | 1 |
| Bangladesh | 45.8 | 126.9 | 433 | 0.3 | 149 | 1 | n.a. |
| Belarus (a, c) | n.a. | 10.3 | 2,683 | 26.1 | 22 | 1 | 1 |
| Belgium (a) | 245.7 | 10.2 | 5,100 | 50.2 | 3,193 | 18 | 339 |
| Bolivia | 8.5 | 8.1 | 502 | 6.2 | 420 | 1 | 1 |
| Bosnia-Herzegovina (c, d) | n.a. | 3.8 | 368 | 9.6 | 53 | 3 | 2 |
| Brazil (a) | 760.3 | 168.0 | 24,985 | 14.9 | 15,033 | 2 | 446 |
| Brunei (c) | n.a. | 0.3 | 82 | 25.6 | 64 | 2 | 1 |
| Bulgaria | 12.1 | 8.3 | 2,833 | 34.2 | 350 | 1 | 17 |
| Canada (a) | 612.0 | 30.5 | 19,957 | 65.5 | 7,000 | 49 | 1,670 |
| Chile | 71.1 | 15.0 | 3,109 | 20.7 | 2,261 | 10 | 40 |
| China | 991.2 | 1266.8 | 108,716 | 8.6 | 43,296 | 2 | 72 |
| Costa Rica (a) | 11.1 | 3.9 | 803 | 20.4 | 143 | 1 | 7 |
| Côte d'Ivoire | 11.2 | 14.5 | 219 | 1.5 | 257 | 1 | 1 |
| Cuba | n.a. | 11.2 | 434 | 3.9 | 5 | 1 | n.a. |
| Cyprus (a, c) | 9.0 | 0.8 | 424 | 54.5 | 148 | 1 | 6 |
| Czech Republic (a) | n.a. | 10.3 | 3,806 | 37.1 | 1,945 | 1 | 122 |
| Denmark (a) | 174.4 | 5.3 | 3,638 | 68.5 | 2,629 | 18 | 338 |
| Dominican Republic | 17.1 | 8.4 | 810 | 9.7 | 256 | 3 | 7 |
| Egypt | 92.4 | 67.2 | 4,686 | 7.0 | 481 | 1 | 2 |
| El Salvador (c) | 12.2 | 6.2 | 468 | 7.6 | 383 | 10 | 1 |
| Estonia (a) | 5.1 | 1.4 | 510 | 35.3 | 387 | 1 | 30 |
| Finland (c) | 126.1 | 5.2 | 2,850 | 55.2 | 3,364 | 8 | 462 |
| France | 1,410.3 | 58.9 | 34,100 | 57.9 | 21,434 | 50 | 1,233 |
| Georgia (c) | 4.2 | 5.5 | 672 | 12.3 | 78 | 2 | 1 |
| Germany (a) | 2,081.2 | 82.2 | 48,300 | 58.8 | 23,470 | 40 | 1,635 |
| Ghana | 7.6 | 19.7 | 159 | 0.8 | 70 | 1 | n.a. |
| Greece (c) | 123.9 | 10.6 | 5,611 | 52.8 | 3,300 | 1 | 75 |
| Guatemala | 18.0 | 11.1 | 605 | 5.5 | 351 | 2 | 2 |
| Guyana | n.a. | 0.9 | 64 | 7.5 | 2 | 1 | n.a. |
| Hong Kong (a, b) | 158.6 | 6.9 | 3,869 | 56.2 | 3,973 | 80 | 115 |
| Hungary (a) | 48.4 | 10.2 | 4,109 | 40.2 | 1,628 | 1 | 120 |
| India (a, b, c) | 459.8 | 998.1 | 26,511 | 2.7 | 1,195 | 1 | 23 |
| Indonesia (a, c) | 141.0 | 209.3 | 6,080 | 2.9 | 2,221 | 2 | 21 |
| Iran | 101.1 | 66.8 | 8,371 | 12.5 | 491 | 1 | 1 |
| Ireland (b) | 84.9 | 3.7 | 1,770 | 47.8 | 1,400 | 25 | 64 |
| Israel (a) | 99.1 | 6.1 | 2,800 | 45.9 | 2,800 | 3 | 149 |
| Italy | 1,150.0 | 57.3 | 26,502 | 46.2 | 30,296 | 15 | 302 |
| Jamaica (a) | 6.1 | 2.6 | 510 | 19.9 | 144 | 2 | n.a. |
| Japan (b) | 4,395.1 | 126.5 | 62,490 | 49.4 | 56,849 | 50 | 2,637 |
| Jordan (a) | 7.6 | 6.5 | 542 | 8.4 | 92 | 1 | 1 |
| Kazakhstan (c) | 15.6 | 16.3 | 1,760 | 10.8 | 50 | 3 | 4 |
| Korea, Rep. (c, d) | 406.9 | 46.5 | 20,518 | 44.1 | 23,443 | 24 | 283 |
| Kuwait | 29.6 | 1.9 | 456 | 24.0 | 300 | 1 | 4 |
| Kyrgyzstan (c) | n.a. | 4.7 | 356 | 7.6 | 3 | 1 | 4 |

Source: TeleGeography research, ITU, and *World Development Report 2000/2001*, World Bank, September 2000

# International Telephone Traffic (A-K)

| Outgoing MiTT (millions) | | | Incoming MiTT (millions) | | | Traffic Balance | | |
|---|---|---|---|---|---|---|---|---|
| 1998 | 1999 | % Change | 1998 | 1999 | % Change | 1998 | 1999 | Countries |
| 49.2 | 74.6 | 51.7% | 93.6 | 121.7 | 30.0% | 44.4 | 47.1 | Albania (a) |
| 121.3 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. | Algeria |
| 47.4 | 53.2 | 12.2% | 32.2 | n.a. | n.a. | -15.2 | n.a. | Andorra |
| 27.3 | 35.0 | 28.0% | 22.3 | 33.1 | 48.4% | -5.0 | -1.9 | Angola |
| 358.7 | 377.6 | 5.3% | n.a. | n.a. | n.a. | n.a. | n.a. | Argentina |
| 56.6 | 33.7 | -40.4% | 94.0 | 89.8 | -4.5% | 37.4 | 56.0 | Armenia |
| 1,690.0 | 2,115.0 | 25.1% | n.a. | n.a. | n.a. | n.a. | n.a. | Australia (b) |
| 1,160.0 | 1,350.0 | 16.4% | n.a. | n.a. | n.a. | n.a. | n.a. | Austria (c) |
| 42.9 | 32.2 | -24.9% | 46.0 | 68.6 | 49.0% | 3.2 | 36.4 | Azerbaijan (a) |
| 63.5 | n.a. | n.a. | 90.0 | n.a. | n.a. | 26.5 | n.a. | Bahamas |
| 124.4 | 134.1 | 7.8% | 102.1 | 106.5 | 4.3% | -22.3 | -27.5 | Bahrain (a) |
| 41.8 | n.a. | n.a. | 196.2 | n.a. | n.a. | 154.4 | n.a. | Bangladesh |
| 176.1 | 161.2 | -8.5% | 193.5 | 195.6 | 1.1% | 17.3 | 34.4 | Belarus (a, c) |
| 1,460.0 | 1,590.0 | 8.9% | n.a. | n.a. | n.a. | n.a. | n.a. | Belgium (a) |
| 31.6 | 29.7 | -6.1% | 76.4 | 82.2 | 7.6% | 44.8 | 52.5 | Bolivia |
| 94.9 | 97.2 | n.a. | 159.2 | 200.5 | n.a. | 64.3 | 103.3 | Bosnia-Herzegovina (c, d) |
| 545.8 | 574.8 | 5.3% | 806.9 | 838.5 | 3.9% | 261.1 | 263.7 | Brazil (a) |
| 23.4 | 18.8 | -19.7% | 25.5 | 21.7 | -15.1% | 2.1 | 2.9 | Brunei (c) |
| 96.0 | 98.9 | 3.0% | 201.0 | n.a. | n.a. | 105.0 | n.a. | Bulgaria |
| 4,805.0 | 5,680.0 | 18.2% | n.a. | n.a. | n.a. | n.a. | n.a. | Canada (a) |
| 259.4 | 270.0 | 4.1% | n.a. | n.a. | n.a. | n.a. | n.a. | Chile |
| 1,711.5 | 1,950.0 | 13.9% | n.a. | n.a. | n.a. | n.a. | n.a. | China |
| 82.7 | 94.1 | 13.8% | 112.9 | 109.0 | -3.4% | 30.2 | 14.9 | Costa Rica (a) |
| 57.3 | n.a. | n.a. | 46.6 | n.a. | n.a. | -10.7 | n.a. | Côte d'Ivoire |
| 29.0 | 32.6 | 12.2% | 203.0 | 225.3 | 10.9% | 174.0 | 192.7 | Cuba |
| 182.0 | 168.2 | -7.6% | 120.6 | 134.1 | 11.2% | -61.4 | -34.0 | Cyprus (a, c) |
| 317.4 | 364.0 | 14.7% | 406.9 | 452.2 | 11.1% | 89.5 | 88.2 | Czech Republic (a) |
| 710.0 | 800.0 | 12.7% | n.a. | n.a. | n.a. | n.a. | n.a. | Denmark (a) |
| 157.5 | 185.7 | 17.9% | 730.5 | 920.0 | 25.9% | 573.0 | 734.3 | Dominican Republic |
| 127.3 | 171.0 | 34.3% | 475.3 | 554.6 | 16.7% | 348.0 | 383.6 | Egypt |
| 43.1 | 47.0 | 9.1% | 149.2 | n.a. | n.a. | 106.1 | n.a. | El Salvador (c) |
| 75.1 | 74.6 | -0.7% | 79.2 | 84.8 | 7.1% | 4.1 | 10.2 | Estonia (a) |
| 410.8 | 423.9 | 3.2% | n.a. | n.a. | n.a. | n.a. | n.a. | Finland (c) |
| 4,115.0 | 4,950.0 | 20.3% | n.a. | n.a. | n.a. | n.a. | n.a. | France |
| n.a. | 46.7 | n.a. | n.a. | 65.7 | n.a. | n.a. | 19.0 | Georgia (c) |
| 5,870.0 | 6,965.0 | 18.7% | n.a. | n.a. | n.a. | n.a. | n.a. | Germany (a) |
| 28.9 | 30.1 | 4.3% | 100.8 | 118.4 | 17.4% | 72.0 | 88.2 | Ghana |
| 681.3 | 725.7 | 6.5% | 710.1 | 794.2 | 11.8% | 28.8 | 68.5 | Greece (c) |
| 60.0 | 83.3 | 38.9% | n.a. | 208.6 | n.a. | n.a. | 125.3 | Guatemala |
| 14.3 | 16.1 | 12.3% | 93.8 | 101.0 | 7.7% | 79.5 | 84.9 | Guyana |
| 1,879.8 | 2,720.3 | 44.7% | 1,833.0 | 1,747.2 | -4.7% | -46.8 | -973.1 | Hong Kong (a, b) |
| 296.3 | 343.9 | 16.1% | 374.5 | n.a. | n.a. | 78.2 | n.a. | Hungary (a) |
| 436.2 | 473.3 | 8.5% | 1,498.8 | 1,772.5 | 18.3% | 1,062.6 | 1,299.2 | India (a, b, c) |
| 324.5 | 269.6 | -16.9% | 434.2 | n.a. | n.a. | 109.7 | n.a. | Indonesia (a, c) |
| 177.0 | 200.4 | 13.2% | 185.7 | 216.3 | 16.5% | 8.8 | 15.9 | Iran |
| 885.0 | 1,015.0 | 14.7% | n.a. | n.a. | n.a. | n.a. | n.a. | Ireland (b) |
| 661.0 | 804.0 | 21.6% | 424.0 | n.a. | n.a. | -237.0 | n.a. | Israel (a) |
| 2,640.0 | 3,100.0 | 17.4% | n.a. | n.a. | n.a. | n.a. | n.a. | Italy |
| 60.1 | 66.4 | 10.5% | 349.8 | 335.9 | -4.0% | 289.7 | 269.5 | Jamaica (a) |
| 1,895.0 | 1,956.6 | 3.3% | 1,575.0 | 1,929.6 | 22.5% | -320.0 | -27.0 | Japan (b) |
| 122.6 | 132.5 | 8.1% | 176.9 | n.a. | n.a. | 54.4 | n.a. | Jordan (a) |
| 118.9 | 104.5 | -12.1% | 137.5 | 149.8 | 9.0% | 18.6 | 45.3 | Kazakhstan (c) |
| 907.7 | 898.0 | n.a. | 719.4 | n.a. | n.a. | -188.3 | n.a. | Korea, Rep. (c, d) |
| 173.1 | 170.0 | -1.8% | 135.0 | 120.0 | -11.1% | -38.1 | -50.0 | Kuwait |
| 30.4 | 23.5 | -22.8% | 30.1 | n.a. | n.a. | -0.3 | n.a. | Kyrgyzstan (c) |

Notes: Data are in millions of minutes of public switched traffic.
a. International minutes based on billing point of traffic.
b. International traffic for year ending 31 March. Australia, Mauritius, and Pakistan ends 30 June.
c. Traffic data exclude some carriers or routes. (See country table for details)
d. 1998 and 1999 traffic data not directly comparable. (See country table for details)

# National Telecommunications Indicators (L-Z)

| Countries | GDP 1999 (US$ billions) | Population 1999 (millions) | Main Lines 1999 (thous.) | Lines Per 100 people | Cellular Users 1999 (thous.) | International Carriers 1999 | Internet Hosts 1999 (thous.) |
|---|---|---|---|---|---|---|---|
| Latvia (a) | 6.7 | 2.4 | 732 | 30.0 | 274 | 1 | 19 |
| Luxembourg | n.a. | 0.4 | 311 | 72.4 | 209 | 3 | 10 |
| Macau (a) | n.a. | 0.4 | 178 | 40.8 | 89 | 1 | n.a. |
| Macedonia (c, d) | 3.4 | 2.0 | 471 | 23.4 | 50 | 1 | 1 |
| Malaysia (a, b) | 74.6 | 21.8 | 4,431 | 20.3 | 2,860 | 5 | 59 |
| Malta | n.a. | 0.4 | 198 | 51.2 | 38 | 1 | 6 |
| Mauritius (b) | n.a. | 1.1 | 257 | 22.4 | 102 | 1 | 1 |
| Mexico (a) | 475.0 | 97.4 | 10,927 | 11.2 | 7,622 | 16 | 405 |
| Moldova (a) | 1.1 | 4.4 | 555 | 12.7 | 17 | 1 | 1 |
| Morocco | 35.2 | 27.9 | 1,467 | 5.3 | 374 | 1 | 2 |
| Mozambique | 4.2 | 19.3 | 78 | 0.4 | 12 | 1 | n.a. |
| Myanmar | n.a. | 45.1 | 249 | 0.6 | 11 | 1 | n.a. |
| Namibia | 3.1 | 1.7 | 108 | 6.4 | 30 | 1 | 2 |
| Netherlands | 384.8 | 15.8 | 9,610 | 60.6 | 6,900 | 30 | 959 |
| New Zealand (b) | 53.6 | 3.8 | 1,877 | 49.0 | 881 | 19 | 271 |
| Nicaragua (a) | 2.3 | 4.9 | 147 | 3.0 | 69 | 1 | 1 |
| Norway (a) | 145.4 | 4.4 | 3,165 | 71.2 | 2,745 | 14 | 439 |
| Oman (a, c) | n.a. | 2.5 | 220 | 9.0 | 121 | 1 | 1 |
| Pakistan (b, c) | 59.9 | 134.5 | 2,986 | 2.2 | 266 | 1 | 5 |
| Palestinian Authority (c) | 3.6 | 3.1 | n.a. | n.a. | n.a. | 1 | n.a. |
| Panama (a) | 9.6 | 2.8 | 462 | 16.4 | 242 | 1 | 1 |
| Paraguay | 8.1 | 5.4 | 297 | 5.5 | 436 | 1 | 2 |
| Peru (a) | 57.3 | 25.2 | 1,689 | 6.7 | 1,013 | 18 | 9 |
| Philippines (a, b) | 75.4 | 74.5 | 2,940 | 3.9 | 1,734 | 12 | 12 |
| Poland (a) | 154.1 | 38.7 | 10,068 | 26.0 | 3,956 | 1 | 171 |
| Portugal (c) | 107.7 | 10.0 | 4,230 | 42.4 | 4,672 | 1 | 78 |
| Qatar | n.a. | 0.6 | 155 | 26.3 | 84 | 1 | n.a. |
| Russia (c) | 375.3 | 147.2 | 30,388 | 20.6 | 1,360 | 35 | 91 |
| Saudi Arabia | n.a. | 20.9 | 3,051 | 14.6 | 627 | 1 | 3 |
| Senegal | 4.8 | 9.2 | 166 | 1.8 | 74 | 1 | n.a. |
| Singapore (a, b) | 84.9 | 3.2 | 1,861 | 57.7 | 1,532 | 1 | 148 |
| Slovak Republic (a) | 19.3 | 5.4 | 1,655 | 30.8 | 918 | 1 | 28 |
| Slovenia | 20.7 | 2.0 | 802 | 40.3 | 210 | 1 | 24 |
| South Africa | 131.1 | 39.9 | 5,493 | 13.8 | 5,269 | 1 | 168 |
| Spain (a) | 562.2 | 39.4 | 16,480 | 41.8 | 12,300 | 16 | 470 |
| Sri Lanka | 0.0 | 18.6 | 679 | 3.6 | 227 | 1 | 1 |
| Sudan (c) | 0.0 | 28.9 | 251 | 0.9 | 13 | 1 | n.a. |
| Swaziland (b) | 0.0 | 1.0 | 31 | 3.1 | 11 | 1 | 1 |
| Sweden (a) | 226.4 | 8.9 | 5,889 | 66.5 | 5,125 | 16 | 523 |
| Switzerland | 260.3 | 7.1 | 4,992 | 69.9 | 2,935 | 40 | 270 |
| Syria (a) | 19.4 | 15.7 | 1,600 | 10.2 | 4 | 1 | n.a. |
| Taiwan (a) | 0.0 | 22.1 | 12,044 | 54.4 | 11,541 | 1 | 597 |
| Thailand (a, c) | 123.9 | 60.9 | 5,216 | 8.6 | 1,957 | 2 | 40 |
| Trinidad & Tobago (a, b) | 0.0 | 1.3 | 276 | 21.4 | 39 | 1 | 5 |
| Turkey (c) | 188.4 | 68.2 | 18,054 | 26.5 | 8,000 | 1 | 79 |
| Turkmenistan (c) | 0.0 | 4.4 | 359 | 8.2 | 4 | 1 | n.a. |
| Ukraine | 0.0 | 50.7 | 10,074 | 19.9 | 116 | 1 | 29 |
| United Arab Emirates | 0.0 | 2.4 | 975 | 40.7 | 832 | 1 | 20 |
| United Kingdom (a, b) | 1,373.6 | 58.7 | 33,750 | 57.5 | 27,185 | 215 | 1,739 |
| United States (a) | 8,708.9 | 276.2 | 188,331 | 68.2 | 86,047 | 679 | 53,176 |
| Uruguay | n.a. | 3.3 | 897 | 27.1 | 316 | 1 | 25 |
| Uzbekistan (a) | 0.0 | 23.9 | 1,599 | 6.7 | 40 | 1 | n.a. |
| Venezuela (a) | 103.9 | 23.7 | 2,586 | 10.9 | 3,400 | 1 | 14 |
| Yugoslavia (a) | n.a. | 10.6 | 2,281 | 21.4 | 606 | 2 | 11 |
| Zimbabwe (b) | 5.7 | 11.5 | 239 | 2.1 | 174 | 1 | 2 |

Source: TeleGeography research, ITU, and the World Bank

# International Telephone Traffic (L-Z)

| Outgoing MiTT (millions) | | | Incoming MiTT (millions) | | | Traffic Balance | | |
|---|---|---|---|---|---|---|---|---|
| 1998 | 1999 | % Change | 1998 | 1999 | % Change | 1998 | 1999 | Countries |
| 55.4 | 55.6 | 0.4% | 87.2 | 90.0 | 3.3% | 31.8 | 34.4 | Latvia (a) |
| 293.8 | 319.1 | 8.6% | 242.6 | 277.5 | 14.4% | -51.2 | -41.5 | Luxembourg |
| 125.2 | 132.8 | 6.1% | 95.1 | 97.7 | 2.7% | -30.2 | -35.1 | Macau (a) |
| 37.1 | 82.3 | n.a. | 91.7 | 152.5 | n.a. | 54.6 | 70.3 | Macedonia (c, d) |
| 685.0 | 690.0 | 0.7% | n.a. | n.a. | n.a. | n.a. | n.a. | Malaysia (a, b) |
| 37.3 | 39.0 | 4.7% | 43.4 | 50.2 | 15.7% | 6.1 | 11.2 | Malta |
| 29.7 | 31.4 | 5.7% | 39.5 | 43.3 | 9.6% | 9.8 | 11.9 | Mauritius (b) |
| 1,310.0 | 1,563.0 | 19.3% | 3,060.0 | 4,007.5 | 31.0% | 1,750.0 | 2,444.5 | Mexico (a) |
| 55.8 | 49.0 | -12.3% | 90.3 | 101.1 | 11.9% | 34.4 | 52.1 | Moldova (a) |
| 181.0 | 219.5 | 21.3% | 460.0 | n.a. | n.a. | 279.0 | n.a. | Morocco |
| 17.6 | 20.3 | 15.8% | n.a. | 38.8 | n.a. | n.a. | 18.5 | Mozambique |
| 19.1 | 17.4 | -8.8% | 36.3 | 29.8 | -17.9% | 17.2 | 12.4 | Myanmar |
| 61.9 | 61.2 | -1.1% | 45.3 | 51.2 | 13.0% | -16.6 | -10.0 | Namibia |
| 1,885.0 | 2,150.0 | 14.1% | n.a. | n.a. | n.a. | n.a. | n.a. | Netherlands |
| 610.0 | 815.0 | 33.6% | n.a. | n.a. | n.a. | n.a. | n.a. | New Zealand (b) |
| 46.5 | 52.0 | 11.8% | 59.7 | 72.7 | 21.8% | 13.2 | 20.7 | Nicaragua (a) |
| 540.0 | 567.0 | 5.0% | n.a. | 386.9 | n.a. | n.a. | -180.1 | Norway (a) |
| 90.0 | 101.3 | 12.5% | 71.7 | 83.4 | 16.3% | -18.3 | -17.9 | Oman (a, c) |
| 87.5 | 75.1 | -14.1% | 640.4 | 644.9 | 0.7% | 552.9 | 569.8 | Pakistan (b, c) |
| 27.6 | 34.9 | 26.2% | 16.6 | n.a. | n.a. | -11.0 | n.a. | Palestinian Authority (c) |
| 50.0 | 53.6 | 7.2% | 95.5 | 95.8 | 0.3% | 45.5 | 42.2 | Panama (a) |
| 37.8 | 34.7 | -8.2% | 57.4 | 54.8 | -4.5% | 19.6 | 20.1 | Paraguay |
| 90.4 | 88.9 | -1.6% | 272.6 | 302.6 | 11.0% | 182.3 | 213.7 | Peru (a) |
| 262.0 | 218.0 | -16.8% | n.a. | n.a. | n.a. | n.a. | n.a. | Philippines (a, b) |
| 602.4 | 624.0 | 3.6% | 1,144.2 | n.a. | n.a. | 541.8 | n.a. | Poland (a) |
| 462.8 | 532.8 | 15.1% | 713.8 | 753.3 | 5.5% | 250.9 | 220.5 | Portugal (c) |
| 112.5 | 128.5 | 14.2% | 70.0 | 84.0 | 19.9% | -42.5 | -44.5 | Qatar |
| 1,038.3 | 928.2 | -10.6% | 1,029.8 | 929.3 | -9.8% | -8.5 | 1.1 | Russia (c) |
| 932.6 | 1,060.0 | 13.7% | n.a. | n.a. | n.a. | n.a. | n.a. | Saudi Arabia |
| 29.6 | 36.5 | 23.1% | 93.8 | 111.1 | 18.5% | 64.2 | 74.7 | Senegal |
| 1,235.0 | 1,350.0 | 9.3% | n.a. | n.a. | n.a. | n.a. | n.a. | Singapore (a, b) |
| 151.8 | 162.8 | 7.3% | 186.4 | 208.7 | 12.0% | 34.6 | 45.9 | Slovak Republic (a) |
| 129.6 | n.a. | n.a. | 137.0 | n.a. | n.a. | 7.4 | n.a. | Slovenia |
| 405.0 | 461.1 | 13.9% | n.a. | n.a. | n.a. | n.a. | n.a. | South Africa |
| 1,675.0 | 1,935.0 | 15.5% | n.a. | n.a. | n.a. | n.a. | n.a. | Spain (a) |
| 39.3 | 45.5 | 15.7% | 146.8 | n.a. | n.a. | 107.5 | n.a. | Sri Lanka |
| 18.4 | 21.9 | 19.1% | 88.0 | 105.3 | 19.7% | 69.6 | 83.3 | Sudan (c) |
| 28.4 | 29.3 | 3.3% | n.a. | n.a. | n.a. | n.a. | n.a. | Swaziland (b) |
| 1,230.0 | 1,365.0 | 11.0% | n.a. | n.a. | n.a. | n.a. | n.a. | Sweden (a) |
| 2,425.0 | 2,730.0 | 12.6% | n.a. | n.a. | n.a. | n.a. | n.a. | Switzerland |
| 103.0 | 125.6 | 21.9% | n.a. | 256.7 | n.a. | n.a. | 131.1 | Syria (a) |
| 862.0 | 949.3 | 10.1% | 781.8 | 882.0 | 12.8% | -80.2 | -67.3 | Taiwan (a) |
| 296.4 | 298.7 | 0.8% | 358.6 | 327.8 | -8.6% | 62.2 | 29.1 | Thailand (a, c) |
| 64.4 | 67.2 | 4.3% | 141.5 | 158.8 | 12.2% | 77.1 | 91.6 | Trinidad & Tobago (a, b) |
| 644.1 | 698.4 | 8.4% | 955.9 | 1,122.7 | 17.5% | 311.7 | 424.3 | Turkey (c) |
| 15.3 | 16.5 | 8.0% | n.a. | n.a. | n.a. | n.a. | n.a. | Turkmenistan (c) |
| 465.9 | 359.2 | -22.9% | n.a. | n.a. | n.a. | n.a. | n.a. | Ukraine |
| 874.8 | 963.0 | 10.1% | n.a. | n.a. | n.a. | n.a. | n.a. | United Arab Emirates |
| 8,225.0 | 10,141.0 | 23.3% | 6,400.0 | 6,853.4 | 7.1% | -1,825.0 | -3,287.6 | United Kingdom (a, b) |
| 25,163.8 | 29,608.8 | 17.7% | 10,395.3 | 10,640.8 | 2.4% | -14,768.5 | -18,968.0 | United States (a) |
| 78.3 | 80.1 | 2.3% | 97.0 | 98.3 | 1.3% | 18.7 | 18.2 | Uruguay |
| 91.7 | 68.5 | -25.4% | 74.7 | 75.0 | 0.4% | -17.0 | 6.6 | Uzbekistan (a) |
| 164.5 | 160.2 | -2.6% | 298.1 | 315.3 | 5.8% | 133.6 | 155.2 | Venezuela (a) |
| 219.5 | 227.0 | 3.4% | 423.3 | 498.8 | 17.8% | 203.8 | 271.7 | Yugoslavia (a) |
| 52.8 | 65.6 | 24.3% | 53.2 | 59.0 | 10.9% | 0.4 | -6.6 | Zimbabwe (b) |

Notes: Data are in millions of minutes of public switched traffic.

a. International minutes based on billing point of traffic.

b. International traffic for year ending 31 March. Australia, Mauritius, and Pakistan ends 30 June.

c. Traffic data exclude some carriers or routes. (See country table for details)

d. 1998 and 1999 traffic data not directly comparable. (See country table for details)

# International Dialing Codes, by Country

- **Afghanistan** .93
- **Albania** .355
  - Tirana .42
- **Algeria** .213
  - Algiers .2
- **American Samoa** .684
- **Andorra** .376
- **Angola** .244
  - Luanda .2
- **Anguilla** .1-264
- **Antigua & Barbuda** .1-268
- **Argentina** .54
  - Buenos Aires .1
- **Armenia** .374
  - Yerevan .1
- **Aruba** .297
- **Ascension Island** .247
- **Australia** .61
  - Melbourne .3
  - Sydney .2
- **Australian Territories** .672
- **Austria** .43
  - Vienna .1
- **Azerbaijan** .994
  - Baku .12
- **Bahamas** .1-242
- **Bahrain** .973
- **Bangladesh** .880
  - Dhaka .2
- **Barbados** .1-246
- **Belarus** .375
  - Minsk .172
- **Belgium** .32
  - Brussels .2
- **Belize** .501
  - Belmopan .8
- **Benin** .229
- **Bermuda** .1-441
- **Bhutan** .975
- **Bolivia** .591
  - La Paz .2
- **Bosnia-Herzegovina** .387
  - Sarajevo .71
- **Botswana** .267
- **Brazil** .55
  - Brasilia .61
  - Rio de Janeiro .21
  - São Paulo .11
- **British Indian Ocean Terr.** .246
- **British Virgin Islands** .1-284
- **Brunei** .673
  - Bandar Seri Begawan .2
- **Bulgaria** .359
  - Sofia .2
- **Burkina Faso** .226
- **Burundi** .257
- **Cambodia** .855
- **Cameroon** .237
- **Canada** .1
  - Montreal .514/450
  - Ottawa .613
  - Toronto .416/647
  - Vancouver .604
- **Cape Verde** .238
- **Cayman Islands** .1-345
- **Central African Republic** .236
  - Bangui .61
- **Chad** .235
- **Chile** .56
  - Santiago .2
- **China, People's Republic of** .86
  - Beijing .10
  - Guangzhou .20
  - Shanghai .21
- **Colombia** .57
  - Bogota .1
- **Cocos Islands; Norfolk & Christmas Islands** .672
- **Comoros** .269
- **Congo, Dem. Rep. of** .243
  - Kinshasa .12
- **Congo, Republic of** .242
  - Brazzaville .81/82/83
- **Cook Islands** .682
- **Costa Rica** .506
- **Côte d'Ivoire** .225
- **Croatia** .385
  - Zagreb .1
- **Cuba** .53
  - Havana .7
- **Cyprus** .357
  - Nicosia .2
- **Czech Republic** .420
  - Prague .2
- **Denmark** .45
- **Djibouti** .253
- **Dominica** .1-767
- **Dominican Republic** .1-809
- **East Timor** .672-9
- **Ecuador** .593
  - Quito .2
- **Egypt** .20
  - Cairo .2
- **El Salvador** .503
- **Equatorial Guinea** .240
- **Eritrea** .291
- **Estonia** .372
  - Tallinn .2
- **Ethiopia** .251
  - Addis Ababa .1
- **Falkland Islands** .500
- **Faroe Islands** .298
- **Fiji** .679
- **Finland** .358
  - Helsinki .9
- **France** .33
  - Paris .1
  - Marseille .491
- **French Antilles** .596
- **French Guiana** .594
- **French Polynesia** .689
- **Gabon** .241
- **Gambia** .220
- **Georgia** .995
  - Tbilisi .32
- **Germany** .49
  - Berlin .30
  - Bonn .228
  - Frankfurt .69
  - Munich .89
- **Ghana** .233
  - Accra .21
- **Gibraltar** .350
- **Greece** .30
  - Athens .1
- **Greenland** .299
- **Grenada** .1-473
- **Guadeloupe** .590
- **Guam** .1-671
- **Guatemala** .502
- **Guinea** .224
- **Guinea-Bissau** .245
- **Guyana** .592
  - Georgetown .2
- **Haiti** .509
- **Honduras** .504
- **Hong Kong** .852
- **Hungary** .36
  - Budapest .1
- **Iceland** .354
- **India** .91
  - Mumbai .22
  - Calcutta .33
  - New Delhi .11
- **Indonesia** .62
  - Jakarta .21
- **Inmarsat**
  - Special .870
  - East Atlantic .871
  - Pacific .872
  - Indian .873
  - West Atlantic .874
- **International Freephone** .800
- **Iran** .98
  - Tehran .21
- **Iraq** .964
  - Baghdad .1
- **Ireland** .353
  - Dublin .1
- **Israel** .972
  - Jerusalem .2
  - Tel Aviv .3
- **Italy** .39
  - Rome .06
  - Milan .02
- **Jamaica** .1-876
- **Japan** .81
  - Osaka .6
  - Tokyo .3
- **Jordan** .962
  - Amman .6
- **Kazakhstan** .7
  - Almaty .3272
- **Kenya** .254
  - Nairobi .2
- **Kiribati** .686
- **Korea, Dem. Rep. of** .850
  - Pyongyang .2
- **Korea, Republic of** .82
  - Seoul .2
- **Kuwait** .965
- **Kyrgyzstan** .996
  - Bishkek .312
- **Laos** .856
- **Latvia** .371
  - Riga .2

**Lebanon** 961
Beirut 1
**Lesotho** 266
**Liberia** 231
**Libya** 218
Tripoli 21
**Liechtenstein** 423
**Lithuania** 370
Vilnius 2
**Luxembourg** 352
**Macau** 853
**Macedonia** 389
Skopje 91
**Madagascar** 261
**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 3
Mexico City 5
Monterrey 8
**Micronesia** 691
**Moldova** 373
Chisinau 41
**Monaco** 377
**Mongolia** 976
Ulaanbaatar 1
**Montserrat** 1-664
**Morocco** 212
Casablanca 2
Rabat 7
**Mozambique** 258
Maputo 1
**Myanmar** 95
**Namibia** 264
Windhoek 61
**Nauru** 674
**Nepal** 977
Kathmandu 1
**Netherlands** 31
Amsterdam 20
**Netherlands Antilles** 599
**New Caledonia** 687
**New Zealand** 64
Auckland 9
Wellington 4
**Nicaragua** 505
Managua 2
**Niger** 227
**Nigeria** 234
Lagos 1
**Niue** 683
**Northern Marianas** 1-670
Saipan 322
**Norway** 47
Oslo 22/23
**Oman** 968
**Pakistan** 92
Islamabad 51
**Palestinian Authority** 970
**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 21
**Puerto Rico** 1-787
**Qatar** 974
**Réunion Island** 262
**Romania** 40
Bucharest 1
**Russia** 7
Moscow 095
St. Petersburg 812
**Rwanda** 250
**St. Helena** 290
**St. Kitts & Nevis** 1-869
**St. Lucia** 1-758
**St. Pierre & Miquelon** 508
**St. Vincent & the Grenadines** 1-784
**San Marino** 378
**Sao Tome and Principe** 239
**Saudi Arabia** 966
Riyadh 1
**Senegal** 221
**Seychelles** 248
**Sierra Leone** 232
Freetown 22
**Singapore** 65
**Slovak Republic** 421
Bratislava 7
**Slovenia** 386
Ljubljana 61
**Solomon Islands** 677
**Somalia** 252
Mogadishu 1
**South Africa** 27
Johannesburg 11
Pretoria 12
**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** 992
Dushanbe 37
**Tanzania** 255
Dar Es Salaam 22
**Thailand** 66
Bangkok 2
**Togo** 228
**Tokelau** 690
**Tonga** 676
**Trinidad & Tobago** 1-868
**Tunisia** 216
Tunis 1
**Turkey** 90
Ankara 312
Istanbul 212
**Turkmenistan** 993
Ashkhabad 12
**Turks & Caicos** 1-649
**Tuvalu** 688
**Uganda** 256
Kampala 41
**Ukraine** 380
Kiev 44
**United Arab Emirates** 971
Abu Dhabi 2
Dubai 4
**United Kingdom** 44
Cardiff 2920
Glasgow 141
London 207/208
Manchester 161
**United States** 1
Chicago 312/773/872
Houston 713/281/832
Los Angeles 213/323
Miami 305/786
New York 212/646/917
Washington 202
**U.S. Virgin Islands** 1-340
**Uruguay** 598
Montevideo 2
**Uzbekistan** 998
Tashkent 71
**Vanuatu** 678
**Vatican City** 379
**Venezuela** 58
Caracas 2
**Vietnam** 84
**Wallis & Futuna** 681
**Western Samoa** 685
**Yemen** 967
Sanaa 2
**Yugoslavia** 381
Belgrade 11
**Zambia** 260
Lusaka 1
**Zanzibar (Tanzania)** 255
**Zimbabwe** 263
Harare 4

# World Dialing Codes


GREENLAND
299
ICELAND
354
RUSSIA
7
SEE INSET
UKRAINE
380
KAZAKHSTAN
7
MONGOLIA
976
GEORGIA
995
ARMENIA
374
AZERBAIJAN
994
UZBEKISTAN
998
KYRGYZSTAN 996
TURKMENISTAN
993
TAJIKISTAN 992
KOREA, DEM.
850
KOREA, REP.
82
TURKEY
90
SYRIA
963
IRAQ
964
IRAN
98
AFGHANISTAN
93
CHINA
86
CYPRUS 357
LEBANON 961
ISRAEL 972
PAL. AUTH. 970
JORDAN
962
MOROCCO
212
TUNISIA
216
ALGERIA
213
LIBYA
218
EGYPT
20
KUWAIT
965
BAHRAIN
973
QATAR
974
PAKISTAN
92
NEPAL
977
BHUTAN
975
TAIWAN
886
W. Sahara
SAUDI
ARABIA
966
U.A.E.
971
OMAN
968
INDIA
91
BANGLADESH
880
MACAU
853
HONG KONG
852
MAURITANIA
222
MALI
223
NIGER
227
CHAD
235
SUDAN
249
ERITREA
291
YEMEN
967
MYANMAR
95
LAOS
856
VIETNAM
84
THAILAND
66
CAMBODIA
855
PHILIPPINES
63
CAPE VERDE
238
SENEGAL 221
GAMBIA 220
GUINEA-BISSAU 245
GUINEA 224
SIERRA LEONE 232
LIBERIA 231
BURKINA FASO
226
CÔTE D'IVOIRE
225
GHANA
233
TOGO
228
BENIN
229
NIGERIA
234
CAMEROON
237
CENTRAL AFRICAN
REPUBLIC
236
ETHIOPIA
251
DJIBOUTI
253
SRI LANKA
94
MALAYSIA
60
BRUNEI
673
EQUATORIAL GUINEA
240
SAO TOME
& PRINCIPE 239
GABON
241
REP OF
CONGO
242
UGANDA
256
KENYA
254
RWANDA
250
BURUNDI
257
DEM REP OF
CONGO
243
SOMALIA
252
MALDIVES
960
SINGAPORE 65
ASCENSION (UK)
247
TANZANIA
255
SEYCHELLES
248
BRITISH INDIAN
OCEAN TERRITORY
246
INDONESIA
62
COMOROS
269
East Timor
672-8
ANGOLA
244
ZAMBIA
260
MALAWI
265
ST. HELENA (UK)
290
MOZAMBIQUE
258
MAURITIUS
230
ZIMBABWE
263
MADAGASCAR
261
REUNION (FR.)
262
NAMIBIA
264
BOTSWANA
267
SWAZILAND
268
SOUTH
AFRICA
27
LESOTHO
266
FINLAND
358
NORWAY
47
SWEDEN
46
ESTONIA 372
RUSSIA
7
DENMARK
45
LATVIA 371
LITHUANIA
370
UNITED KINGDOM
44
IRELAND
353
NETHERLANDS
31
BELARUS
375
POLAND
48
GERMANY
49
UKRAINE
380
BELGIUM 32
LUXEMBOURG 352
CZECH REP. 420
SLOVAK REP. 421
MOLDOVA
373
LIECHTENSTEIN 423
AUSTRIA
43
HUNGARY
36
SWITZERLAND
41
ROMANIA
40
FRANCE
33
SLOVENIA 386
YUGO.
381
CROATIA 385
BOS.
387
BULGARIA
359
ANDORRA
376
MONACO
377
ITALY
39
MACEDONIA
389
ALBANIA
355
PORTUGAL
351
SPAIN
34
GREECE
30
GIBRALTAR
350
MALTA
356

# International Dialing Codes, by Number

| | |
|---|---|
| 1 | Canada |
| | Guam |
| | Northern Marianas |
| | United States |
| | Caribbean |
| 20 | Egypt |
| 212 | Morocco |
| 213 | Algeria |
| 216 | Tunisia |
| 218 | Libya |
| 220 | Gambia |
| 221 | Senegal |
| 222 | Mauritania |
| 223 | Mali |
| 224 | Guinea |
| 225 | Côte d'Ivoire |
| 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 |
| 239 | Sao Tome & Principe |
| 240 | Equatorial Guinea |
| 241 | Gabon |
| 242 | Congo, Republic of |
| 243 | Congo, Dem. Rep. of |
| 244 | Angola |
| 245 | Guinea-Bissau |
| 246 | British Indian Ocean Terr. |
| 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 |
| 260 | Zambia |
| 261 | Madagascar |
| 262 | Réunion |
| 263 | Zimbabwe |
| 264 | Namibia |
| 265 | Malawi |
| 266 | Lesotho |
| 267 | Botswana |
| 268 | Swaziland |
| 269 | Comoros & Mayotte |
| 27 | South Africa |
| 290 | St. Helena |
| 291 | Eritrea |
| 297 | Aruba |
| 298 | Faroe Islands |
| 299 | Greenland |
| 30 | Greece |
| 31 | Netherlands |
| 32 | Belgium |
| 33 | France |
| 34 | Spain |
| 350 | Gibraltar |
| 351 | Portugal |
| 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 |
| 374 | Armenia |
| 375 | Belarus |
| 376 | Andorra |
| 377 | Monaco |
| 378 | San Marino |
| 379 | Vatican City |
| 380 | Ukraine |
| 381 | Yugoslavia |
| 385 | Croatia |
| 386 | Slovenia |
| 387 | Bosnia-Herzegovina |
| 389 | Macedonia |
| 39 | Italy |
| 40 | Romania |
| 41 | Switzerland |
| 420 | Czech Republic |
| 421 | Slovak Republic |
| 423 | Liechtenstein |
| 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 |
| 672 | Australian Territories |
| 673 | Brunei |
| 674 | Nauru |
| 675 | Papua New Guinea |
| 676 | Tonga |
| 677 | Solomon Islands |
| 678 | Vanuatu |
| 679 | Fiji Islands |
| 680 | Palau |
| 681 | Wallis & Futuna |
| 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 | Kazakhstan |
| | Russia |
| 800 | International Freephone |
| 81 | Japan |
| 82 | Korea, Republic of |
| 84 | Vietnam |
| 850 | Korea, Dem. Rep. of |
| 852 | Hong Kong |
| 853 | Macau |
| 855 | Cambodia |
| 856 | Laos |
| 86 | China |
| 870 | Inmarsat Special |
| 871 | Inmarsat East Atlantic |
| 872 | Inmarsat Pacific |
| 873 | Inmarsat Indian |
| 874 | Inmarsat West Atlantic |
| 880 | Bangladesh |
| 886 | Taiwan |
| 90 | Turkey |
| 91 | India |
| 92 | Pakistan |
| 93 | Afghanistan |
| 94 | Sri Lanka |
| 95 | Myanmar |
| 960 | Maldives |
| 961 | Lebanon |
| 962 | Jordan |
| 963 | Syria |
| 964 | Iraq |
| 965 | Kuwait |
| 966 | Saudi Arabia |
| 967 | Yemen |
| 968 | Oman |
| 970 | Palestinian Authority |
| 971 | United Arab Emirates |
| 972 | Israel |
| 973 | Bahrain |
| 974 | Qatar |
| 975 | Bhutan |
| 976 | Mongolia |
| 977 | Nepal |
| 98 | Iran |
| 992 | Tajikistan |
| 993 | Turkmenistan |
| 994 | Azerbaijan |
| 995 | Georgia |
| 996 | Kyrgyzstan |
| 998 | Uzbekistan |

# North American Area Codes, by Number

| | |
|---|---|
| **201** | New Jersey |
| **202** | Dist. of Columbia |
| **203** | Connecticut |
| **204** | Manitoba |
| **205** | Alabama |
| **206** | Washington |
| **207** | Maine |
| **208** | Idaho |
| **209** | California |
| **210** | Texas |
| **212** | New York |
| **213** | California |
| **214** | Texas |
| **215** | Pennsylvania |
| **216** | Ohio |
| **217** | Illinois |
| **218** | Minnesota |
| **219** | Indiana |
| **224** | Illinois |
| **225** | Louisiana |
| **228** | Mississippi |
| **229** | Georgia |
| **231** | Michigan |
| **234** | Ohio |
| **240** | Maryland |
| **242** | Bahamas |
| **246** | Barbados |
| **248** | Michigan |
| **250** | British Columbia |
| **252** | North Carolina |
| **253** | Washington |
| **254** | Texas |
| **256** | Alabama |
| **262** | Wisconsin |
| **264** | Anguilla |
| **267** | Pennsylvania |
| **268** | Antigua |
| **270** | Kentucky |
| **278** | Michigan |
| **281** | Texas |
| **284** | British Virgin Is. |
| **289** | Ontario |
| **301** | Maryland |
| **302** | Delaware |
| **303** | Colorado |
| **304** | West Virginia |
| **305** | Florida |
| **306** | Saskatchewan |
| **307** | Wyoming |
| **308** | Nebraska |
| **309** | Illinois |
| **310** | California |
| **312** | Illinois |
| **313** | Michigan |
| **314** | Missouri |
| **315** | New York |
| **316** | Kansas |
| **317** | Indiana |
| **318** | Louisiana |
| **319** | Iowa |
| **320** | Minnesota |
| **321** | Florida |
| **323** | California |
| **330** | Ohio |
| **331** | Illinois |
| **334** | Alabama |
| **336** | North Carolina |
| **337** | Louisiana |
| **339** | Massachusetts |
| **340** | U.S. Virgin Is. |
| **341** | California |
| **345** | Cayman Islands |
| **347** | New York |
| **351** | Massachusetts |
| **352** | Florida |
| **360** | Washington |
| **361** | Texas |
| **369** | California |
| **401** | Rhode Island |
| **402** | Nebraska |
| **403** | Alberta |
| **404** | Georgia |
| **405** | Oklahoma |
| **406** | Montana |
| **407** | Florida |
| **408** | California |
| **409** | Texas |
| **410** | Maryland |
| **411** | Directory Assist. |
| **412** | Pennsylvania |
| **413** | Massachusetts |
| **414** | Wisconsin |
| **415** | California |
| **416** | Ontario |
| **417** | Missouri |
| **418** | Quebec |
| **419** | Ohio |
| **420** | Wisconsin |
| **423** | Tennessee |
| **424** | California |
| **425** | Washington |
| **435** | Utah |
| **440** | Ohio |
| **441** | Bermuda |
| **442** | California |
| **443** | Maryland |
| **445** | Pennsylvania |
| **450** | Quebec |
| **464** | Illinois |
| **469** | Texas |
| **473** | Grenada |
| **475** | Connecticut |
| **478** | Georgia |
| **480** | Arizona |
| **484** | Pennsylvania |
| **500** | Pers. Comm. Serv. (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 |
| **525** | Mexico City |
| **530** | California |
| **540** | Virginia |
| **541** | Oregon |
| **558** | St. Lucia |
| **559** | California |
| **561** | Florida |
| **562** | California |
| **564** | Washington |
| **570** | Pennsylvania |
| **571** | Virginia |
| **573** | Missouri |
| **580** | Oklahoma |
| **586** | Michigan |
| **601** | Mississippi |
| **602** | Arizona |
| **603** | New Hampshire |
| **604** | British Columbia |
| **605** | South Dakota |
| **606** | Kentucky |
| **607** | New York |
| **608** | Wisconsin |
| **609** | New Jersey |
| **610** | Pennsylvania |
| **611** | Repair Service |
| **612** | Minnesota |
| **613** | Ontario |
| **614** | Ohio |
| **615** | Tennessee |
| **616** | Michigan |
| **617** | Massachusetts |
| **618** | Illinois |
| **619** | California |
| **623** | Arizona |
| **626** | California |
| **627** | California |
| **628** | California |
| **630** | Illinois |
| **631** | New York |
| **636** | Missouri |
| **641** | Iowa |
| **646** | New York |
| **647** | Ontario |
| **649** | Turks & Caicos Is. |
| **650** | California |
| **651** | Minnesota |
| **657** | California |
| **660** | Missouri |
| **661** | California |
| **662** | Mississippi |
| **664** | Montserrat |
| **669** | California |
| **670** | Northern Marianas |
| **671** | Guam |
| **678** | Georgia |
| **679** | Michigan |
| **682** | Texas |
| **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 |
| **712** | Iowa |
| **713** | Texas |
| **714** | California |
| **715** | Wisconsin |
| **716** | New York |
| **717** | Pennsylvania |
| **718** | New York |
| **719** | Colorado |
| **720** | Colorado |
| **724** | Pennsylvania |
| **727** | Florida |
| **732** | New Jersey |
| **734** | Michigan |
| **737** | Texas |
| **740** | Ohio |
| **747** | California |
| **752** | California |
| **757** | Virginia |
| **758** | St. Lucia |
| **760** | California |
| **763** | Minnesota |
| **764** | California |
| **765** | Indiana |
| **767** | Dominica |
| **770** | Georgia |
| **773** | Illinois |
| **774** | Massachusetts |
| **775** | Nevada |
| **778** | British Colombia |
| **780** | Alberta |
| **781** | Massachusetts |
| **784** | St. Vincent & Grenadines |
| **785** | Kansas |
| **786** | Florida |
| **787** | Puerto Rico |
| **800** | Toll-free serv. |
| **801** | Utah |
| **802** | Vermont |
| **803** | South Carolina |
| **804** | Virginia |
| **805** | California |
| **806** | Texas |
| **807** | Ontario |
| **808** | Hawaii |
| **809** | Dominican Rep. |
| **810** | Michigan |
| **812** | Indiana |
| **813** | Florida |
| **814** | Pennsylvania |
| **815** | Illinois |
| **816** | Missouri |
| **817** | Texas |
| **818** | California |
| **819** | Quebec |
| **828** | North Carolina |
| **830** | Texas |
| **831** | California |
| **832** | Texas |
| **835** | Pennsylvania |
| **843** | South Carolina |
| **845** | New York |
| **847** | Illinois |
| **850** | Florida |
| **856** | New Jersey |
| **857** | Massachusetts |
| **858** | California |
| **859** | Kentucky |
| **860** | Connecticut |
| **863** | Florida |
| **864** | South Carolina |
| **865** | Tennessee |
| **867** | NW Territories/Yukon |
| **868** | Trinidad & Tobago |
| **869** | St. Kitts & Nevis |
| **870** | Arkansas |
| **872** | Illinois |
| **876** | Jamaica |
| **877** | Toll-free serv. |
| **878** | Pennsylvania |
| **880** | Toll-free serv. |
| **881** | Toll-free serv. |
| **882** | Toll-free serv. |
| **888** | Toll-free serv. |
| **900** | Info. Servs. |
| **901** | Tennessee |
| **902** | Nova Scotia & Prince Edward Is. |
| **903** | Texas |
| **904** | Florida |
| **905** | Ontario |
| **906** | Michigan |
| **907** | Alaska |
| **908** | New Jersey |
| **909** | California |
| **910** | North Carolina |
| **911** | Emergency Servs. |
| **912** | Georgia |
| **913** | Kansas |
| **914** | New York |
| **915** | Texas |
| **916** | California |
| **917** | New York |
| **918** | Oklahoma |
| **919** | North Carolina |
| **920** | Wisconsin |
| **925** | California |
| **931** | Tennessee |
| **935** | California |
| **936** | Texas |
| **937** | Ohio |
| **940** | Texas |
| **941** | Florida |
| **947** | Michigan |
| **949** | California |
| **951** | California |
| **952** | Minnesota |
| **954** | Florida |
| **956** | Texas |
| **959** | Connecticut |
| **970** | Colorado |
| **971** | Oregon |
| **972** | Texas |
| **973** | New Jersey |
| **978** | Massachusetts |
| **979** | Texas |
| **980** | North Carolina |
| **989** | Michigan |

# North American Area Codes, by Jurisdiction

**Alabama**
- Birmingham and northern Alabama .......205
- Huntsville and northern Alabama ........256
- Mobile, Montgomery, and southern Alabama .....334

**Alaska** .....907

**Alberta**
- Calgary, Banff, and southern Alberta .....403
- Edmonton, Jasper, and northern Alberta ..780

**Anguilla** .....264

**Antigua** .....268

**Arizona**
- Eastern Phoenix area .....480
- Arizona except Phoenix area .....520
- Central Phoenix area .....602
- Western Phoenix area .....623

**Arkansas**
- Little Rock, Fayetteville, and northwestern Arkansas .....501
- Jonesboro and southern Arkansas .......870

**Bahamas** .....242

**Barbados** .....246

**Bermuda** .....441

**British Columbia**
- British Columbia except Vancouver area ..250
- Vancouver area .....604/778

**British Virgin Islands** .....284

**California**
- Stockton, Fresno, Modesto, and central California .....209
- Los Angeles .....213/323
- Malibu, Beverly Hills, and west Los Angeles suburbs .....310/424
- Oakland, Berkeley, and Fremont areas .....341/510
- Solano County .....369
- San Jose, Sunnyvale, and Cupertino areas .....408/669
- San Francisco .....415/628
- Encitas, San Marcos, and southeastern California .....442
- Chico, Redding, and northeastern California .....530
- Fresno and central California .....559
- Long Beach .....562
- San Diego .....619
- Pasadena .....626
- Santa Rose, Sonoma, Napa, and north central California .....627
- San Mateo, Palo Alto, and south San Francisco suburbs .....650/764
- Northern Orange County .....657/714
- Bakersfield and south central California .....661
- Fort Bragg, Eureka, Ukiah, and northwestern California .....707
- Ontario, Pomona, and San Bernadino .....752/909
- Barstow, El Centro, Palm Springs, and southeast California .....760
- Santa Barbara, Bakersfield, and central western California .....805
- Burbank and Glendale areas .....818
- Monterey, Santa Cruz, and central western California .....831
- Northern San Diego and Del Mar .......858
- Sacramento .....916
- Concord, Livermore, Walnut Creek .......925
- Eastern San Diego and southwestern California .....935
- Anaheim, Irvine, and southern Orange County .....949
- Riverside, Hemet, San Jacinto .....951

**Cayman Islands** .....345

**Colorado**
- Denver area .....303/720
- Colorado Springs, Pueblo and southeastern Colorado .....719
- Aspen, Durango, and northwestern Colorado .....970

**Connecticut**
- Bridgeport, New Haven, and southwestern Connecticut .....203/475
- Hartford, Bristol, and northeastern Connecticut .....860/959

**Delaware** .....302

**District of Columbia** .....202

**Dominica** .....767

**Dominican Republic** .....809

**Florida**
- Miami, Key West and southeastern Florida .....305/786
- Orlando and central eastern Florida .....321/407
- Gainesville and central Florida .....352
- West Palm Beach, Boca Raton, and east central Florida .....561
- Tampa, St. Petersburg, and Clearwater area .....727/813
- Pensacola, Tallahassee, and northwestern Florida .....850
- South central Florida .....863
- Jacksonville, Daytona, and northeastern Florida .....904
- Bradenton, Sarasota, and southwestern Florida .....941
- Fort Lauderdale .....954

**Georgia**
- Albany, Valdosta, and south central Georgia .....229
- Atlanta, Marietta, Norcross ......404/678/770
- Macon, Swainsboro, and south central Georgia .....478
- Augusta and northern Georgia .....706
- Savannah, Vidalia, and southeastern Georgia .....912

**Grenada** .....473

**Guam** .....671

**Hawaii** .....808

**Idaho** .....208

**Illinois**
- Champaign, Urbana, Springfield, and central Illinois .....217
- Northeastern Illinois and northwest Chicago suburbs .....224/847
- Peoria, Rock Island, and west central Illinois .....309
- Chicago .....312/773/872
- Central Chicago suburbs .....331/630
- Southern Chicago suburbs .....464/708
- Alton, Mount Vernon, and southern Illinois .....618
- La Salle, Rockford, and northern Illinois .....815

**Indiana**
- Gary, South Bend, and northern Indiana ...219
- Indianapolis .....317
- Central Indiana excluding Indianapolis ....765
- Evansville and southern Indiana .....812

**Iowa**
- Davenport, Dubuque, and eastern Iowa ...319
- Des Moines, Ames, and central Iowa .....515
- Mason City, Pella, and central Iowa ......641
- Council Bluffs, Sioux City, and western Iowa .....712

**Jamaica** .....876

**Kansas**
- Dodge City, Wichita, and southern Kansas .....316
- Topeka, Lawrence, and northern Kansas ..785
- Kansas City and eastern Kansas .....913

**Kentucky**
- Paducah, Bowling Green, and western Kentucky .....270
- Louisville, Shelbyville, and north central Kentucky .....502
- Eastern Kentucky .....606
- Richmond, Danville, and northeastern Kentucky .....859

**Louisiana**
- Baton Rouge and central eastern Louisiana .....225
- Shreveport, Monroe, and northern Louisiana .....318
- Lake Charles, Lafayette, and southwestern Louisiana .....337
- New Orleans and southeastern Louisiana .....504

**Maine** .....207

**Manitoba** .....204

**Maryland**
- Rockville, Hagerstown, and western Maryland .....240/301
- Baltimore, Annapolis, and eastern Maryland .....410/443

**Massachusetts**
- Waltham, Lexington, and Boston suburbs .....339/781
- Lowell, Salem, and northern Massachusetts .....351/978
- Pittsfield, Springfield, and western Massachusetts .....413
- Framingham, Cape Cod, and southern Massachusetts .....508/774
- Boston .....617/857

**Michigan**
- Traverse City, Muskegon, and northwestern Michigan .....231
- Pontiac, Southfield, and Oakland County .....248/947
- Ann Arbor, Wayne, and Detroit suburbs .....278/734
- Detroit .....313/679
- Lansing and central Michigan .....517
- Flint, Flushing, and southeastern Michigan .....586/810
- Grand Rapids, Kalamazoo, and southwestern Michigan .....616
- Marquette, Sault Ste. Marie, and northern Michigan .....906
- Alpena, Bay City, and central Michigan ...989

Note: Two or more codes separated by a slash (e.g., in Houston, Texas) indicate an overlay; multiple codes are used for the same geographic area.

**Minnesota**
- Duluth and northern Minnesota .......... 218
- St. Cloud and central Minnesota .......... 320
- Rochester and southern Minnesota .......... 507
- Minneapolis .......... 612
- St. Paul .......... 651
- Fridley, Blaine, and northwest Minneapolis suburbs .......... 763
- Bloomington, Minnetonka, and southwest Minneapolis suburbs .......... 952

**Mississippi**
- Gulfport, Biloxi, and southern Mississippi .......... 228
- Jackson and central Mississippi .......... 601
- Greenville, Tupelo, and northern Mississippi .......... 662

**Missouri**
- St. Louis .......... 314
- Joplin, Springfield, and southwestern Missouri .......... 417
- Jefferson City, Columbia, and eastern Missouri .......... 573
- Franklin and Jefferson counties .......... 636
- Marshall and northern Missouri .......... 660
- Kansas City .......... 816

**Montana** .......... 406

**Montserrat** .......... 664

**Nebraska**
- North Platte and western Nebraska .......... 308
- Omaha, Lincoln, and eastern Nebraska .......... 402

**Nevada**
- Las Vegas and southern Nevada .......... 702
- Northern Nevada .......... 775

**New Brunswick** .......... 506

**New Hampshire** .......... 603

**New Jersey**
- Hackensack, Jersey City, and northeastern New Jersey .......... 201
- Atlantic City, Trenton, and southeastern New Jersey .......... 609
- Middlesex, Monmouth, and Ocean counties .......... 732
- Camden, Millville, and southwestern New Jersey .......... 856
- Elizabeth, Warren, and northwestern New Jersey .......... 908
- Newark, Patterson, and Morristown .......... 973

**New Mexico** .......... 505

**New York**
- Manhattan .......... 212/646/917
- Syracuse and northwestern New York .......... 315
- Brooklyn, State Island, Bronx, and Queens .......... 347/718
- Nassau County and western Long Island .......... 516
- Northeastern New York .......... 518
- Binghamton and south central New York .......... 607
- Lindenhurst, Islip, and eastern Long Island .......... 631
- Buffalo and western New York .......... 716
- Albany, Poughkeepsie, and southeastern New York .......... 845
- Westchester, White Plains, and southeastern New York .......... 914

**Newfoundland** .......... 709

**North Carolina**
- Northeastern North Carolina .......... 252
- Winston-Salem, Greensboro, and northwestern North Carolina .......... 336
- Charlotte and south central North Carolina .......... 704/980
- Asheville and western North Carolina .......... 828
- Fayetteville and southeastern North Carolina .......... 910
- Raleigh and northeastern North Carolina .......... 919

**North Dakota** .......... 701

**Northern Marianas** .......... 670

**Northwest Territories/Yukon** .......... 867

**Nova Scotia and Prince Edward Island** .......... 902

**Ohio**
- Cleveland .......... 216
- Youngstown, Akron, Canton, and northeastern Ohio .......... 234/330
- Toledo and northwestern Ohio .......... 419
- Northeastern Ohio excluding Cleveland .......... 440
- Cincinnati .......... 513
- Columbus .......... 614
- Southeastern Ohio excluding Columbus .......... 740
- Southwestern Ohio excluding Cincinnati .......... 937

**Oklahoma**
- Oklahoma City and central Oklahoma .......... 405
- Southern and western Oklahoma .......... 580
- Tulsa and northeastern Oklahoma .......... 918

**Ontario**
- Toronto .......... 416/647
- London and southwestern Ontario .......... 519
- Ottawa and southeastern Ontario .......... 613
- North Bay and northeastern Ontario .......... 705
- Thunder Bay and western Ontario .......... 807
- Hamilton and southeastern Ontario .......... 289/905

**Oregon**
- Portland, Salem, and northwestern Oregon .......... 503/971
- Oregon except Portland and Salem areas .......... 541

**Pennsylvania**
- Philadelphia .......... 215/267/445
- Pittsburgh and western Pennsylvania .......... 412/724/878
- Allentown, Reading, and southeastern Pennsylvania .......... 484/610/835
- Scranton and northeastern Pennsylvania .......... 570
- Harrisburg and south central Pennsylvania .......... 717
- Erie and northwestern Pennsylvania .......... 814

**Puerto Rico** .......... 787

**Quebec**
- Quebec City and eastern Quebec .......... 418
- Southern Quebec excluding Montreal .......... 450
- Montreal .......... 514
- Western Quebec .......... 819

**Rhode Island** .......... 401

**St. Kitts & Nevis** .......... 869

**St. Lucia** .......... 558

**St. Vincent & Grenadines** .......... 784

**Saskatchewan** .......... 306

**South Carolina**
- Columbia and central South Carolina .......... 803
- Charleston and eastern South Carolina .......... 843
- Greenville and western South Carolina .......... 864

**South Dakota** .......... 605

**Tennessee**
- Chattanooga, Johnson City, and southeastern Tennessee .......... 423
- Nashville .......... 615
- Knoxville, Jefferson City, and east central Tennessee .......... 865
- Memphis and western Tennessee .......... 901
- Central Tennessee excluding Nashville .......... 931

**Texas**
- San Antonio .......... 210
- Dallas .......... 214/469/972
- Waco and central Texas .......... 254
- Houston .......... 281/713/832
- Corpus Christi and southeastern Texas .......... 361
- Beaumont, Galveston, Port Arthur, and southeastern Texas .......... 409
- Austin and San Marcos .......... 512/737
- Fort Worth, Arlington, and Weatherford .......... 682/817
- Amarillo and northern Texas .......... 806
- Uvalde, Kerrville, and southwest Texas .......... 830
- Tyler and northeastern Texas .......... 903
- El Paso, Odessa, Midland, and western Texas .......... 915
- Conroe, Nacogdoches, Lufkin, and southeastern Texas .......... 936
- Wichita Falls, Denton, and northern Texas .......... 940
- Laredo, Brownsville, and southern Texas .......... 956
- Bryan, College Station, and southeastern Texas .......... 979

**Trinidad & Tobago** .......... 868

**Turks & Caicos Islands** .......... 649

**U.S. Virgin Islands** .......... 340

**Utah**
- Utah excluding Salt Lake City .......... 435
- Salt Lake City .......... 801

**Vermont** .......... 802

**Virginia**
- Roanoke and northwestern Virginia .......... 540
- Alexandria, Arlington, and McLean .......... 571/703
- Hampton, Norfolk, and southeastern Virginia .......... 757
- Richmond and central Virginia .......... 804

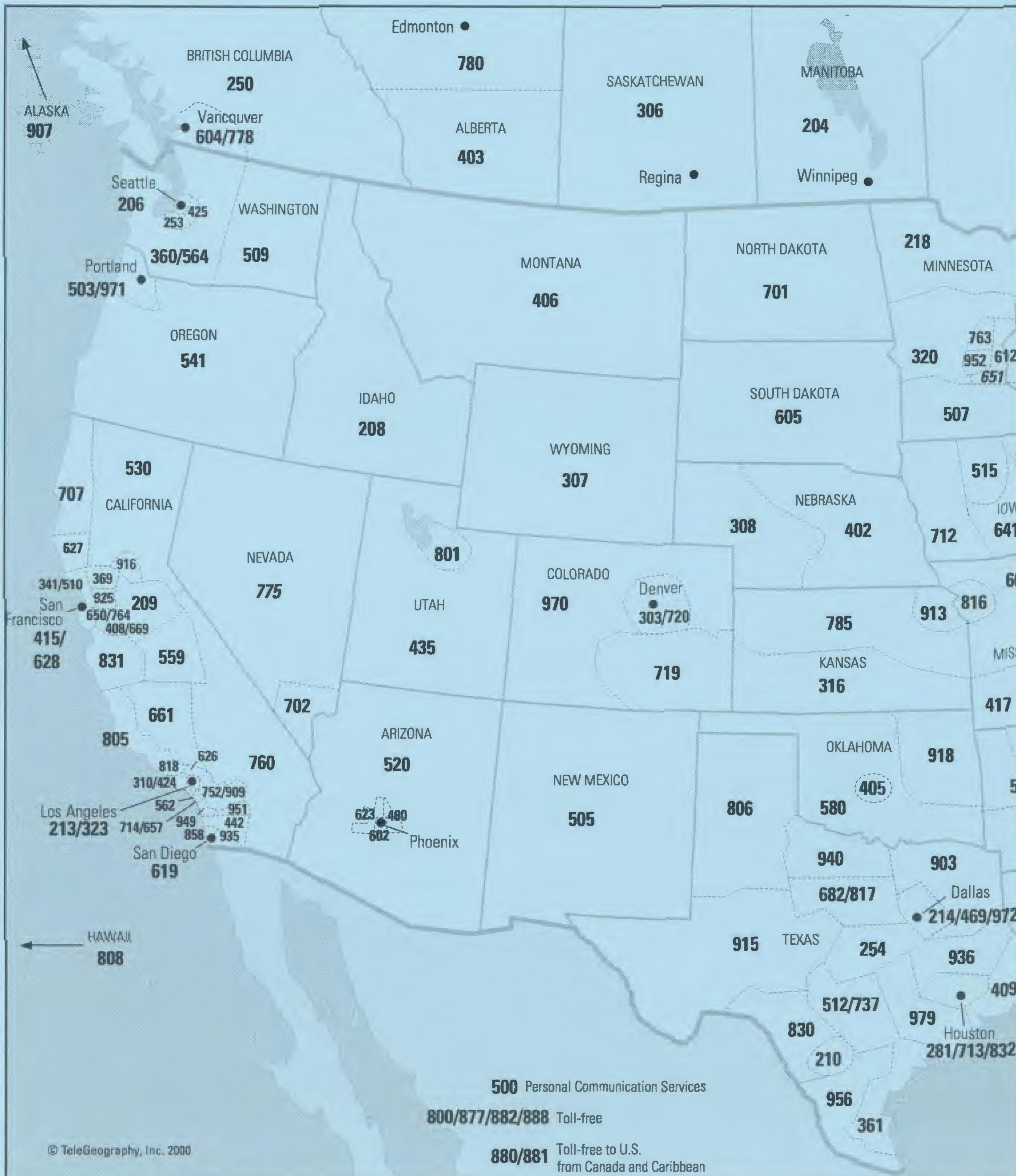
**Washington**
- Seattle .......... 206
- Tacoma and south Seattle suburbs .......... 253
- Western Washington excluding Seattle .......... 360/564
- North Seattle suburbs .......... 425
- Spokane and eastern Washington .......... 509

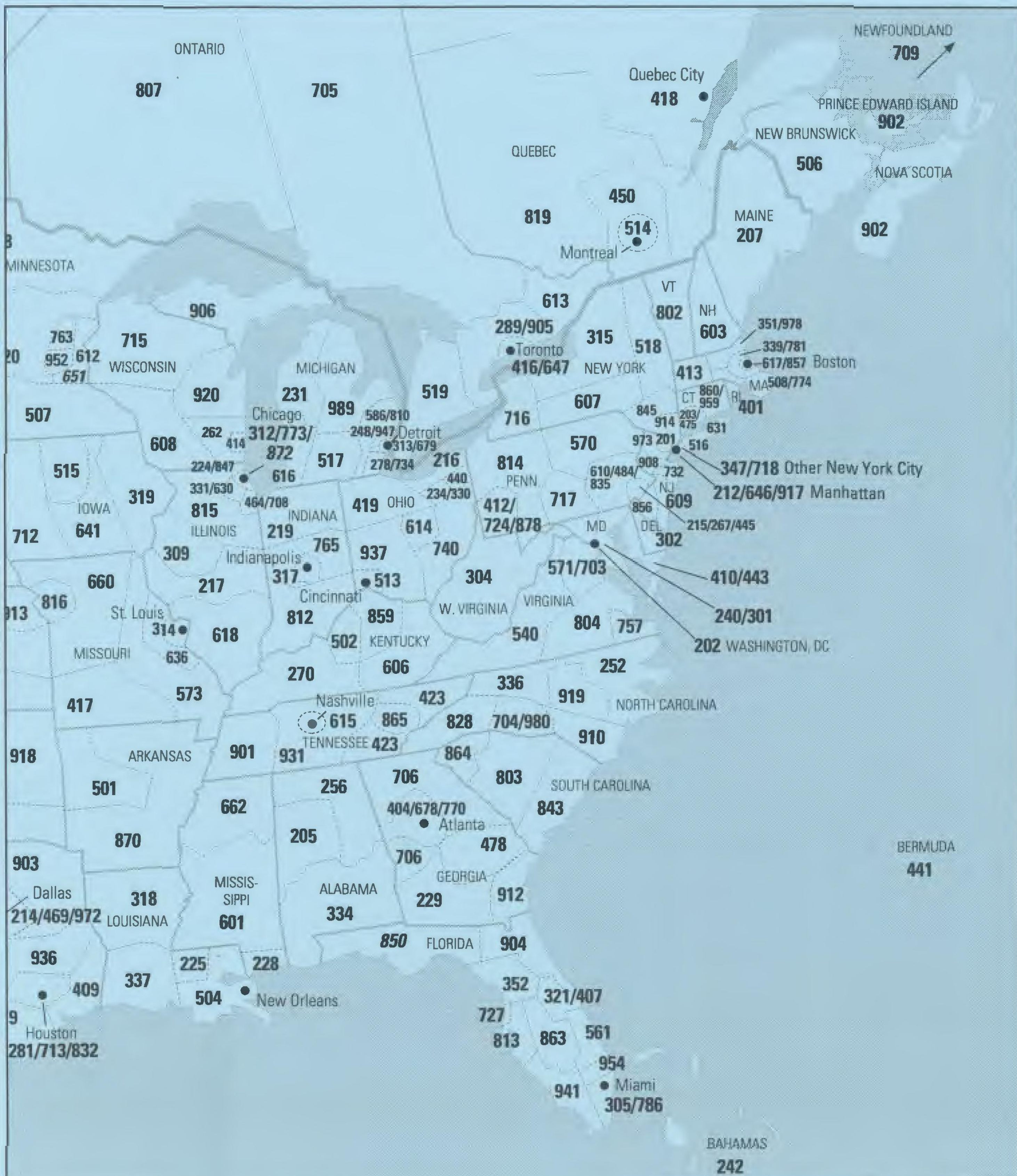
**West Virginia** .......... 304

**Wisconsin**
- Racine and southeastern Wisconsin .......... 262
- Milwaukee, Greenfield, and Oak Creek .......... 414
- Madison and southwestern Wisconsin .......... 608
- Eau Claire and northern Wisconsin .......... 715
- Southeastern Wisconsin excluding Milwaukee .......... 920

**Wyoming** .......... 307

# North American Area Codes




ONTARIO
807
705
Quebec City
418
QUEBEC
NEWFOUNDLAND
709
PRINCE EDWARD ISLAND
902
NEW BRUNSWICK
506
NOVA SCOTIA
902
450
819
514
Montreal
MAINE
207
MINNESOTA
VT
802
NH
603
613
289/905
Toronto
416/647
315
518
NEW YORK
413
351/978
339/781
617/857 Boston
MA 508/774
CT
860/959
RI
401
906
763
715
952
612
651
WISCONSIN
MICHIGAN
920
231
989
519
586/810
507
Chicago
312/773/872
262
414
248/947 Detroit
313/679
716
607
845
914
203/475
631
608
224/847
616
517
278/734
216
814
PENN
570
973
201
516
515
331/630
464/708
440
234/330
610/484/835
908
732
347/718 Other New York City
212/646/917 Manhattan
NJ
609
856
215/267/445
IOWA
319
815
INDIANA
419
OHIO
412/724/878
717
DEL
302
712
641
ILLINOIS
219
614
MD
309
Indianapolis
765
937
740
317
571/703
410/443
660
217
Cincinnati
513
304
VIRGINIA
816
St. Louis
314
812
859
W. VIRGINIA
804
757
240/301
MISSOURI
636
618
502
KENTUCKY
540
202 WASHINGTON, DC
270
606
252
336
573
Nashville
423
919
NORTH CAROLINA
417
615
865
828
704/980
TENNESSEE
423
910
918
ARKANSAS
901
931
864
501
256
706
803
SOUTH CAROLINA
662
404/678/770
Atlanta
843
870
205
478
706
GEORGIA
903
BERMUDA
441
Dallas
214/469/972
318
LOUISIANA
MISSISSIPPI
601
ALABAMA
334
229
912
850
FLORIDA
904
936
225
228
409
337
504
New Orleans
352
321/407
727
813
863
561
Houston
281/713/832
954
941
Miami
305/786
BAHAMAS
242

# A Primer on Bits

## Measuring Bytes Bit by Bit

Below are the standard metric prefixes used in the SI (Système International) conventions for scientific measurement. With units of time (e.g., gigabits per second) or things that come in powers of 10, they retain their usual meanings of multiplication by powers of $1{,}000 = 10^3$. When used with bytes (e.g., gigabytes of data storage) or other things that naturally come in powers of 2, they usually denote multiplication by powers of $1{,}024 = 2^{10}$.

| | Base 10 | | | | Base 2 | | |
|---|---|---|---|---|---|---|---|
| 1 Kilobit/s | $= 1{,}000^1 = 10^3$ | = | 1,000 | 1 Kilobyte | $= 1{,}024^1 = 2^{10}$ | = | 1,024 |
| 1 Megabit/s | $= 1{,}000^2 = 10^6$ | = | 1,000,000 | 1 Megabyte | $= 1{,}024^2 = 2^{20}$ | = | 1,048,576 |
| 1 Gigabit/s | $= 1{,}000^3 = 10^9$ | = | 1,000,000,000 | 1 Gigabyte | $= 1{,}024^3 = 2^{30}$ | = | 1,073,741,824 |
| 1 Terabit/s | $= 1{,}000^4 = 10^{12}$ | = | 1,000,000,000,000 | 1 Terabyte | $= 1{,}024^4 = 2^{40}$ | = | 1,099,511,627,776 |
| 1 Petabit/s | $= 1{,}000^5 = 10^{15}$ | = | 1,000,000,000,000,000 | 1 Petabyte | $= 1{,}024^5 = 2^{50}$ | = | 1,125,899,906,842,624 |
| 1 Exabit/s | $= 1{,}000^6 = 10^{18}$ | = | 1,000,000,000,000,000,000 | 1 Exabyte | $= 1{,}024^6 = 2^{60}$ | = | 1,152,921,504,606,846,976 |
| 1 Zettabit/s | $= 1{,}000^7 = 10^{21}$ | = | 1,000,000,000,000,000,000,000 | 1 Zettabyte | $= 1{,}024^7 = 2^{70}$ | = | 1,180,591,620,717,411,303,424 |
| 1 Yottabit/s | $= 1{,}000^8 = 10^{24}$ | = | 1,000,000,000,000,000,000,000,000 | 1 Yottabyte | $= 1{,}024^8 = 2^{80}$ | = | 1,208,925,819,614,629,174,706,176 |



## Measuring Telecommunications Bandwidth—DS-0 to OC-192

| Carrier Technology | Data Rate(Mbps) | Description | 64 Kbps Circuits* |
|---|---|---|---|
| DS-0 | 0.064 | Base rate in the Digital Signal (DS) level hierarchy | 1 |
| T-1 (DS-1) | 1.544 | Primary level of the American T-carrier multiplexing system; capacity is the same as a DS 1 carrier | 24 |
| T-2 (DS-2) | 6.312 | Four times the capacity of T-1 | 96 |
| T-3 (DS-3) | 44.736 | 28 times the capacity of T-1 | 672 |
| T-4 (DS-4) | 274.176 | 168 times the capacity of T-1 | 4,032 |
| E-1 | 2.048 | Primary level of the European E-carrier multiplexing system | 30 |
| E-2 | 8.448 | Carries four multiplexed E-1 signals | 120 |
| E-3 | 34.368 | Carries four E-2 signals | 480 |
| E-4 | 139.264 | Carries four E-3 signals | 1,920 |
| E-5 | 565.148 | Carries four E-4 signals | 7,680 |
| OC-1/STS-1 | 51.840 | Basic signaling rate of SONET hierarchy | 810 |
| OC-3/STM-1 | 155.520 | Exactly three times the capacity of OC-1** | 2,430 |
| OC-12/STM-4 | 622.080 | 12 times the capacity of OC-1 | 9,720 |
| OC-24 | 1,244.160 | 24 times the capacity of OC-1 | 19,440 |
| OC-48/STM-16 | 2,488.320 | 48 times the capacity of OC-1 | 38,880 |
| OC-192/STM-64 | 9,953.280 | 192 times the capacity of OC-1 | 155,520 |

**Key**

"T" T-carrier system in U.S., Canada, and Japan with 1.544 Mbps as the primary level (24 voice channels x 64 Kbps per channel).

"DS" Digital Signal that travels on the T-carrier or E-carrier.

"E" Used in countries other than U.S., Canada, and Japan. The hierarchy was established by the CEPT (Conférence Européenne des Postes et Télécommunications) with 2.048 Mbps as the primary level ([30 voice channels + 2 channels for overhead] x 64 Kbps per channel).

"OC" Optical Carrier interface designed to work with STS-*n* (Synchronous Transport Signal) signaling rate in a SONET (Synchronous Optical Network).

"STM" Synchronous Transport Module refers to a large carrier (base signal 155.52 Mbps) in a SONET.

"STS" Synchronous Transport Signal is the electrical counterpart to the Optical Carrier (OC).

* The number of 64 Kbps is presented for comparative purposes only. The actual number of simultaneous conversations possible over a given carrier may vary depending on the encoding scheme used.

** In the "E" and "T" hierarchies, each higher level is set to be "almost but not exactly" a multiple of the bit rate for the previous order (plesiochronous). To eliminate problems associated with plesiochronous multiplexing, SONET, a synchronous hierarchy, was defined in the United States in 1986. As a result, the "OC" and "STM" carriers are exact bit-rate multiples of their primary levels, OC-1 and STM-1, respectively.

Source: TeleGeography research, Alcatel, *Newton's Telecom Dictionary*

# About TeleGeography, Inc.

**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 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-à-vis another (cf. geopolitics, *archaic*).

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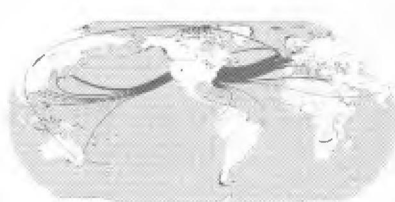

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