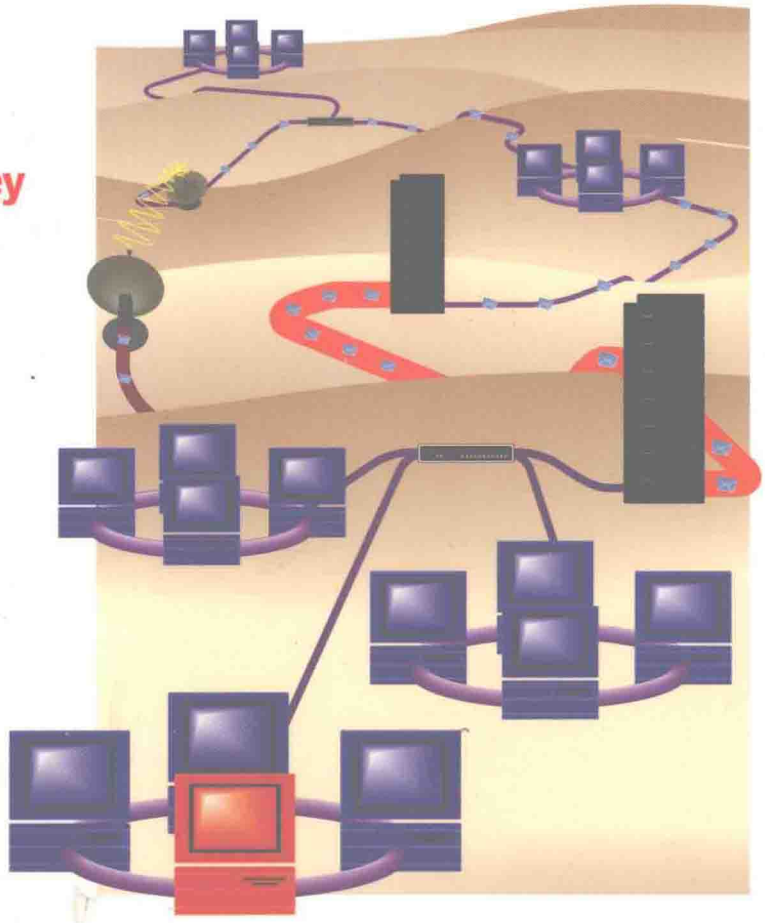
HOW THE INTERNET WORKS

ALL NEW EDITION

Take a visual journey through the inner workings of the Internet!

- Walk the path that data travels to connect you with people all around the world



- See how online services control traffic between your desktop and other subscribers
- Discover how e-mail finds its way from one network to another
- See how files are compressed and decompressed

PRESTON GRALLA

Illustrated by Sarah Ishida

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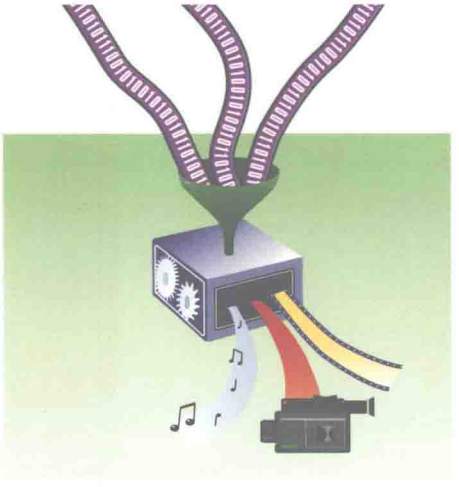

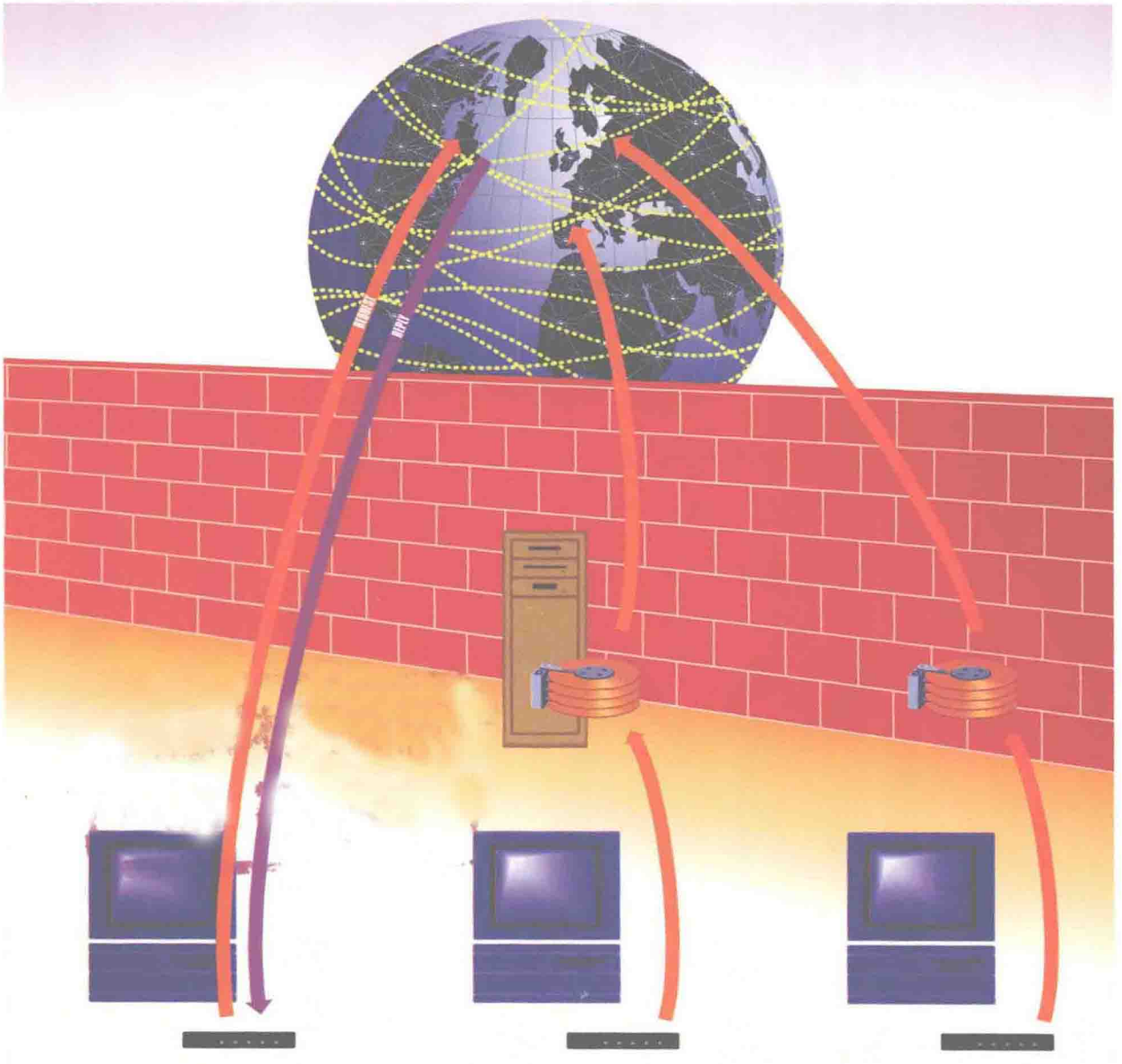

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THIS book, like the Internet itself, is a collaborative work. My name may be on the cover, but I am far from the only person involved in its creation.

Valerie Haynes Perry, senior development editor at Ziff-Davis Press, deserves much credit for her excellent eye and ear, and her firm yet gentle way of guiding me to use the right approach when explaining technical information.

Without Sarah Ishida and Karl Miyajima, the illustrators, there would be no book, since it is such a visual experience. And many thanks to the entire team at Ziff-Davis Press that produced the book: Margo R. Hill, copy editor, Madhu Prasher, project coordinator, Howard Blechman, word processor, M.D. Barrera, layout artist, and Carol Burbo, indexer.

Thanks also have to go to the many, many people I interviewed for this book. People from Quarterdeck Corporation, Chaco Communications, Progressive Networks, White Pine Software, SurfWatch Software, and VDONet Corp., are only a few of the people who gave their time to help me understand the nitty-gritty of how various Internet technologies work.

I gleaned much information from the many FAQs and similar documents widely available on the Internet. I'd like to thank the anonymous authors of those documents, wherever they are.

Much thanks goes to Mark Butler, the technical editor for the book, who did a superb job of ensuring that I always got the information right.

Finally, big thanks have to go to my wife Lydia, who put up with occasional glassy-eyed looks to simple questions (did you leave your keys in the refrigerator again?) and extreme absent-mindedness because I was figuring out how to explain how a firewall or ISDN or a Web robot works when I should have been concentrating on more immediate matters.

How many times have you wondered—when cruising the World Wide Web and clicking on a link, or transferring a file to your computer via FTP, or reading a newsgroup message, or when hearing about a technology such as firewalls—*How does that work?* How a message sent from your computer can travel through the vastness of cyberspace and end up in the right e-mail box halfway across the world. How you can use search tools to find the exact piece of information you want out of the millions of pieces of information on the whole Internet.

This book will answer all those questions, and many more. It will tell you how every aspect of the Internet works, and will show you how it works in vivid, beautifully detailed illustrations.

The book is designed for everyone interested in the Internet. Its guiding principle is this: No matter how much of a cyberpro you are—or how much of a novice—there's a lot you don't understand about the Internet. Just one small example: A friend of mine, who for several years has made his living with companies involved with the Internet—a complete cyberpro who lives and breathes the Internet—almost whispered to me the other day: "I don't like to admit this, but I don't know what a proxy server is. How *does* it work, anyway?"

If you're like just about everyone else involved in the Internet, you have similar questions. You'll find your answers here.

In Part 1, I explain the underlying basics of the Internet: Who runs it, how TCP/IP works, how to understand Internet addresses and domains, and similar topics.

Part 2 depicts the various ways that you can connect to the Internet. Whether you're interested in learning how ISDN works, how online services connect to the Internet, or a host of similar issues, you'll find out how it all works there.

Part 3 covers every aspect of Internet communications. It shows how e-mail and newsgroups work; how IRC chat works; and how you can use the Internet to make telephone calls anywhere in the world for the price of a local call.

In Part 4 I'll show how the common Internet tools and services work. Here's where you'll find out how the World Wide Web works; how gophers, Telnet, and WAIS work; and what happens when you download a file to your computer using FTP.

Part 5 shows how the cutting-edge and most exciting part of the Internet works: multimedia. Whether you want to know how Virtual Reality video works, how Netcams work, or how the Java programming language works, that's where you'll find it.

Part 6 details the various ways that the Internet is applied, and shows how it's used for business, medicine, and education. And it shows how robots, spiders, and search tools troll the Net for you, gathering information along the way.

Finally, Part 7 covers security concerns. It shows how firewalls work, how viruses can attack your computer, how cryptosystems allow confidential information to be sent across the Internet. And it covers the controversial issue of pornography on the Net—and shows how parental control software can prevent children from seeing objectionable material.

So come along and see how the vast Internet works. Even if you're a cyberpro, you'll find out a lot you never knew.

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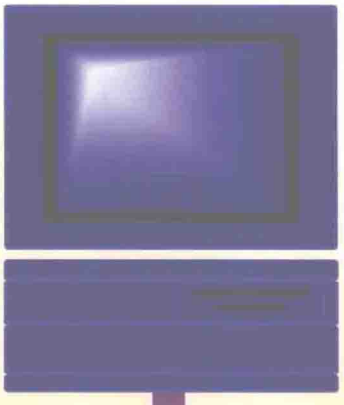

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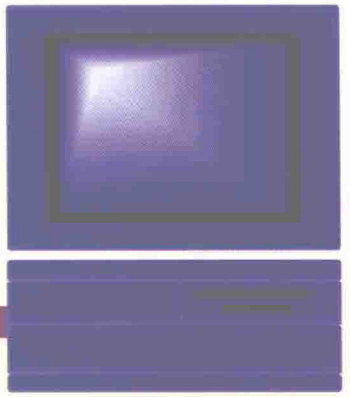

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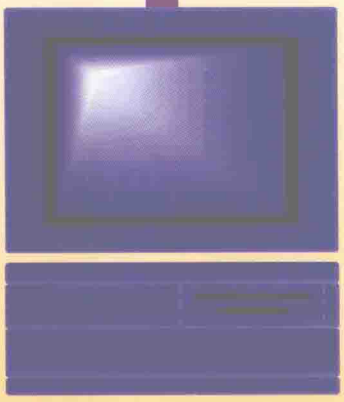

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FOR the first time ever, the world is truly at your fingertips. From your computer you can find information about anything you can name or even imagine. You can communicate with people on the other side of the world. You can set up a teleconference, tap into the resources of powerful computers anywhere in the globe, search through the world's best libraries, and visit the world's most amazing museums. You can watch videos and listen to music, and read special multimedia magazines.

You can do all this by tapping into the largest computer network in the world—the Internet.

The Internet isn't a single network; it is a vast, globe-spanning network of networks. No single person, group, or organization runs the Internet. Instead, it's the purest form of electronic democracy. The networks communicate with each other based on certain protocols, such as the Transmission Control Protocol (TCP) and the Internet Protocol (IP). More and more networks and computers are being hooked up to the Internet every day. There are tens of thousands of these networks, ranging from university networks to corporate local area networks to large online services such as America Online and CompuServe. Every time you tap into the Internet, your own computer becomes an extension of that network.

In the first section of this book we'll take a close look at what the Internet is. We'll also examine the architectures, protocols, and general concepts that make it all possible.

In Chapter 1 we will examine how the Internet runs. We'll look at who pays for the high-speed data backbones that carry much of the Internet's traffic, and at the organizations that make sure that there are standards for networks to follow so that the Internet can run smoothly. And we'll also look at the various kinds of networks that are connected to the Internet.

Chapter 2 explains how information travels across the Internet. It details how hardware such as routers, repeaters, and bridges sends information among networks. And it shows how smaller networks are grouped into larger regional networks—and how those large regional networks communicate among themselves.

In Chapter 3 we'll look at the Internet's basic protocols for communications, and learn a bit about basic Internet jargon: TCP/IP (short for Transmission Control Protocol and Internet Protocol). The chapter will explain how those protocols work, and how special software such as Winsock allows personal computers to get onto a network originally designed for larger computers.

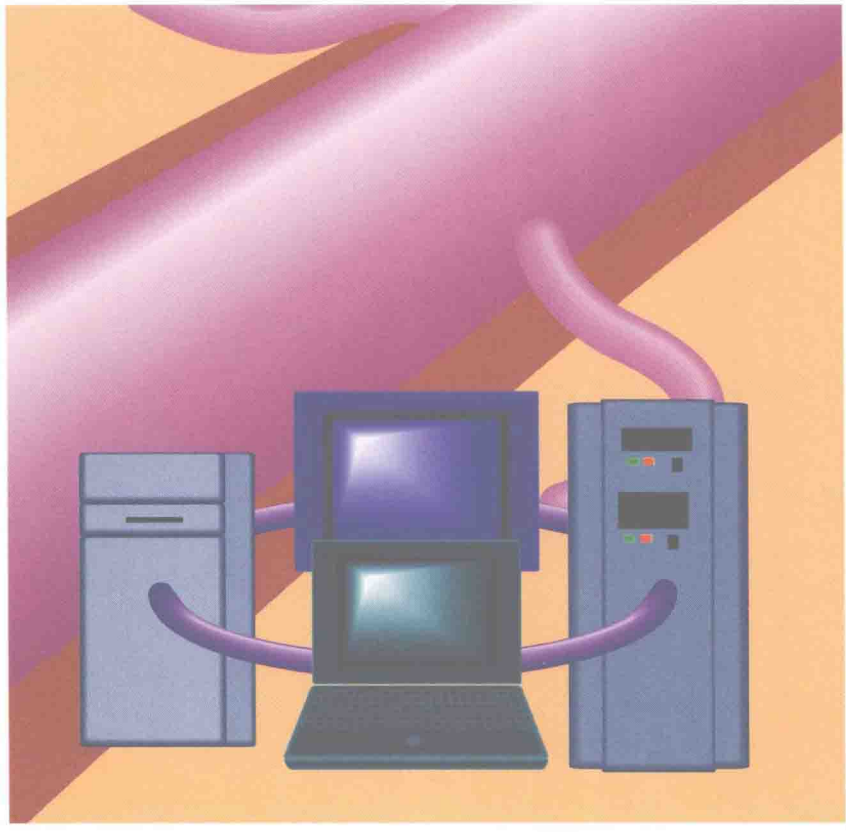
Chapter 4 takes the mystery out of the Internet's oft-times confusing addressing scheme. You'll learn about Internet domains and addresses, and will even be able to understand how to make sense of them.

Chapter 5 will give you an understanding of the most common types of files you'll come across when browsing the Net. Compressed files, video files, graphics files—you'll learn about just about any kind of file you might encounter.

Whether you're a newbie or cyberpro, this section will teach you the basics of the Internet.

CHAPTER 1

The Wired World of the Internet



ONE of the most frequently asked questions about the Internet is who runs it? It is inconceivable to most people that no one group or organization runs this vast global network. The truth is that there is no centralized management for the Internet. Instead, it is a collection of thousands of individual networks and organizations, each of which is run and paid for on its own. Each network cooperates with other networks to direct Internet traffic, so that information can pass among them. Together, all these networks and organizations make up the wired world of the Internet. In order for networks and computers to cooperate in this way, though, there needs to be general agreement about things such as Internet procedures and standards for protocols. These procedures and standards are laid out in RFCs (requests for comment) that Internet users and organizations have agreed upon.

A variety of groups guide the Internet's growth by helping to establish standards and educating people on the proper way to use the Internet. Perhaps the most important is the Internet Society, a private, nonprofit group. The Internet Society supports the work of the Internet Activities Board (IAB), which handles much of the Internet's behind-the-scenes and architectural issues. The IAB's Internet Engineering Task Force is responsible for overseeing how the Internet's TCP/IP protocols evolve. The IAB's Internet Research Task force works on network technology. The IAB also has responsibility for assigning network IP addresses through the Internet Assigned Numbers Authority. And it runs the Internet Registry, which runs the Domain Name System, and handles associating domain names with IP addresses.

The World Wide Web Consortium (W3 Consortium) develops standards for the evolution of the fastest growing part of the Internet, the World Wide Web. An industry consortium run by the Laboratory for Computer Science at the Massachusetts Institute of Technology, it collaborates with organizations all over the world, such as CERN, the originators of the Web. It serves as a repository of information about the Web for developers and users; it implements Web standards, and it makes prototypes and uses sample applications to demonstrate new technology.

While these organizations are important as a kind of glue for holding the Internet together, at the heart of the Internet are individual local networks. These networks can be found in private companies, universities, government agencies, and online services. They are funded separately from each other, in a variety of manners, such as fees from users, corporate support, taxes, and grants.

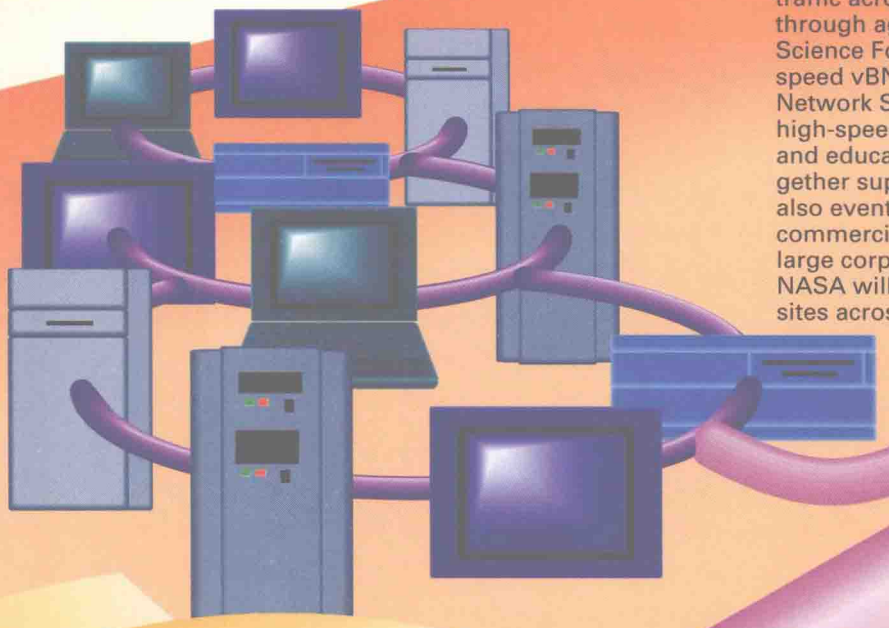
The networks are connected in a variety of ways. For efficiency's sake, local networks join together in consortiums known as regional networks. A variety of leased lines connect regional and local networks. The leased lines that connect networks can be as simple as a single telephone line, or as complex as a fiber optic cable with microwave links and satellite transmissions.

Backbones—very high-capacity lines—carry enormous amounts of Internet traffic. These backbones are paid for by government agencies such as NASA, and by large private corporations. Some backbones are paid for by the National Science Foundation.

How the Internet Runs

1 Since the Internet is a loose organization of networks, no one group runs it and pays for it. Instead, many private organizations, universities, and government agencies pay for and run parts of it. They all work together in a democratic, loosely organized alliance. Private organizations range from small, home-grown networks to commercial online services such as America Online and CompuServe, and private Internet providers who sell access to the Internet.

2 The federal government pays for some high-speed backbones that carry Internet traffic across the country and the world, through agencies such as the National Science Foundation. The extremely high-speed vBNS (very high-speed Backbone Network Services), for example, provides a high-speed infrastructure for the research and education community by linking together supercomputer centers, and will also eventually provide a backbone for commercial applications as well. Often a large corporation or organization such as NASA will also provide backbones to link sites across the country or world.

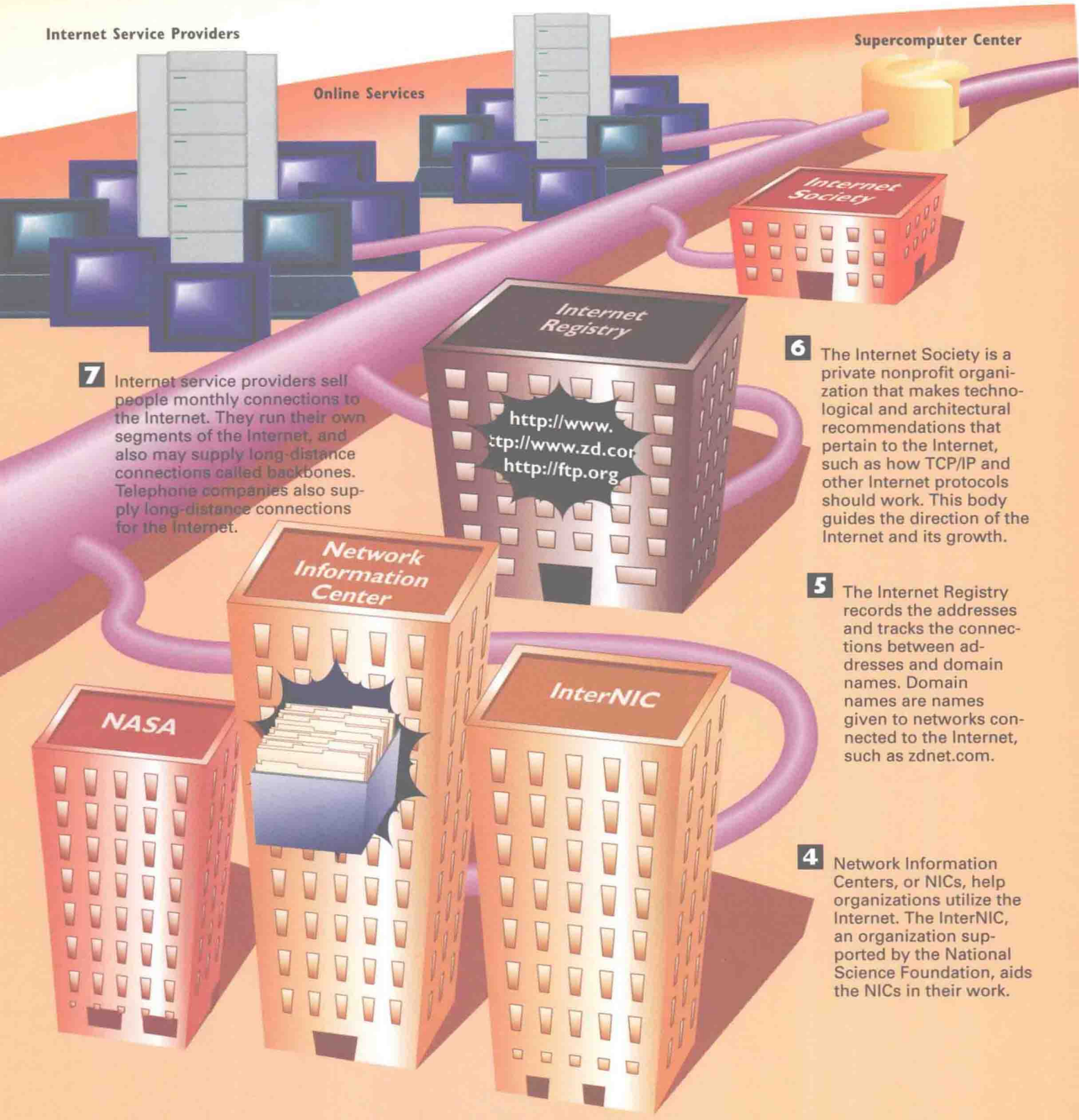


Regional Network

vBNS Backbone

3 Regional networks provide and maintain Internet access within a geographic area. Regional nets may consist of smaller networks and organizations within the area who have banded together to provide better service.

Supercomputer Center



7 Internet service providers sell people monthly connections to the Internet. They run their own segments of the Internet, and also may supply long-distance connections called backbones. Telephone companies also supply long-distance connections for the Internet.

6 The Internet Society is a private nonprofit organization that makes technological and architectural recommendations that pertain to the Internet, such as how TCP/IP and other Internet protocols should work. This body guides the direction of the Internet and its growth.

5 The Internet Registry records the addresses and tracks the connections between addresses and domain names. Domain names are names given to networks connected to the Internet, such as zdnet.com.

4 Network Information Centers, or NICs, help organizations utilize the Internet. The InterNIC, an organization supported by the National Science Foundation, aids the NICs in their work.

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