KEY CONCEPT The architecture of the TCP/IP protocol suite is often described in terms of a layered reference model called the *TCP/IP model*, *DARPA model*, or *DoD model*. The TCP/IP model includes four layers: the *network interface layer* (responsible for interfacing the suite to the physical hardware on which it runs), the *Internet layer* (where device addressing, basic datagram communication, and routing take place), the *host-to-host transport layer* (where connections are managed and reliable communication is ensured), and the *application layer* (where end-user applications and services reside). The first three layers correspond to layers 2 through 4 of the OSI Reference Model respectively; the application layer is equivalent to OSI layers 5 to 7.

TCP/IP Protocols

Since TCP/IP is a protocol suite, it is most often discussed in terms of the protocols that compose it. Each protocol resides in a particular layer of the TCP/IP architectural model that I just discussed and is charged with performing a certain subset of the total functionality required to implement a TCP/IP network or application. The protocols work together to allow TCP/IP as a whole to operate.

NOTE *You will sometimes hear TCP/IP called just a protocol instead of a protocol suite. This is a simplification that, while technically incorrect, is widely used. I believe it arises in large part due to Microsoft referring to protocol suites as protocols in its operating systems. I discuss this issue in more detail in Chapter 1.*

As mentioned earlier, a few TCP/IP protocols are usually called the core of the suite, because they are responsible for its basic operation. In this core, most people would include the main protocols at the Internet and transport layers: IP, TCP, and UDP. These core protocols support many other protocols in order to perform a variety of functions at each of the TCP/IP model layers.

NOTE *On the whole, there are many hundreds of TCP/IP protocols and applications, and I could not begin to cover each and every one in this book. I do include chapters in which I discuss several dozen of the protocols that I consider important for one reason or another. Full coverage of each of these protocols (to varying levels of detail) can be found in Section II and Section III of this book.*

Table 8-1 contains a summary of each of the TCP/IP protocols discussed in this book. I have organized them by layer, and I have provided cross-references to the chapters where each is discussed. The organization of protocols in the TCP/IP protocol suite can also be seen at a glance in Figure 8-3. I have also shown in the network interface layer where TCP/IP hardware drivers conceptually reside; these are used at layer 2 when TCP/IP is implemented on a LAN or WAN technology, rather than using SLIP or PPP.

Table 8-1: TCP/IP Protocols

TCP/IP Layer	Protocol Name	Protocol Abbr.	Description
Network Interface (Layer 2)	Serial Line Internet Protocol	SLIP	Provides basic TCP/IP functionality by creating a layer 2 connection between two devices over a serial line. See Chapter 9.
	Point-to-Point Protocol	PPP	Provides layer 2 connectivity like SLIP, but is much more sophisticated and capable. PPP is itself a suite of protocols (subprotocols, if you will) that allow for functions such as authentication, data encapsulation, encryption, and aggregation, thereby facilitating TCP/IP operation over WAN links. See Chapters 9-12.
Network Interface/ Internet (Layer 2/3)	Address Resolution Protocol	ARP	Used to map layer 3 IP addresses to layer 2 physical network addresses. See Chapter 13.
	Reverse Address Resolution Protocol	RARP	Determines the layer 3 address of a machine from its layer 2 address. Now mostly superseded by BOOTP and DHCP. See Chapter 14.
Internet Layer (Layer 3)	Internet Protocol, Internet Protocol Version 6	IP, IPv6	Provides encapsulation and connectionless delivery of transport layer messages over a TCP/IP network. Also responsible for addressing and routing functions. See Part II-3 and Part II-4.
	IP Network Address Translation	IP NAT	Allows addresses on a private network to be automatically translated to different addresses on a public network, thereby providing address sharing and security benefits. (Note that some people don't consider IP NAT to be a protocol in the strict sense of that word.) See Chapter 28.
	IP Security	IPsec	A set of IP-related protocols that improve the security of IP transmissions. See Chapter 29.
	Internet Protocol Mobility Support	Mobile IP	Resolves certain problems with IP associated with mobile devices. See Chapter 30.
	Internet Control Message Protocol	ICMP/ ICMPv4, ICMPv6	A support protocol for IP and IPv6 that provides error reporting and information request-and-reply capabilities to hosts. See Part II-6.
	Neighbor Discovery Protocol	NDP	A new support protocol for IPv6 that includes several functions performed by ARP and ICMP in conventional IP. See Chapter 36.
	Routing Information Protocol, Open Shortest Path First, Gateway-to-Gateway Protocol, HELLO Protocol, Interior Gateway Routing Protocol, Enhanced Interior Gateway Routing Protocol, Border Gateway Protocol, Exterior Gateway Protocol	RIP, OSPF, GGP, HELLO, IGRP, EIGRP, BGP, EGP	Protocols used to support the routing of IP datagrams and the exchange of routing information. See Part II-7.
Host-to-Host Transport Layer (Layer 4)	Transmission Control Protocol	TCP	The main transport layer protocol for TCP/IP. Establishes and manages connections between devices and ensures reliable and flow-controlled delivery of data using IP. See Part II-8.

(continued)

Table 8-1: TCP/IP Protocols (continued)

TCP/IP Layer	Protocol Name	Protocol Abbr.	Description
Host-to-Host Transport Layer (Layer 4) *continued*	User Datagram Protocol	UDP	A transport protocol that can be considered a severely stripped-down version of TCP. It is used to send data in a simple way between application processes, without the many reliability and flow-management features of TCP, but often with greater efficiency. See Chapter 44.
Application Layer (Layer 5/6/7)	Domain Name System	DNS	Provides the ability to refer to IP devices using names instead of just numerical IP addresses. Allows machines to resolve these names into their corresponding IP addresses. See Part III-1.
	Network File System	NFS	Allows files to be shared seamlessly across TCP/IP networks. See Chapter 58.
	Bootstrap Protocol	BOOTP	Developed to address some of the issues with RARP and used in a similar manner: to allow the configuration of a TCP/IP device at startup. Generally superseded by DHCP. See Chapter 60.
	Dynamic Host Configuration Protocol	DHCP	A complete protocol for configuring TCP/IP devices and managing IP addresses. The successor to RARP and BOOTP, it includes numerous features and capabilities. See Part III-3.
	Simple Network Management Protocol	SNMP	A full-featured protocol for remote management of networks and devices. See Part III-4.
	Remote Monitoring	RMON	A diagnostic "protocol" (really a part of SNMP) used for remote monitoring of network devices. See Chapter 69.
	File Transfer Protocol, Trivial File Transfer Protocol	FTP, TFTP	Protocols designed to permit the transfer of all types of files from one device to another. See Part III-6.
	RFC 822, Multipurpose Internet Mail Extensions, Simple Mail Transfer Protocol, Post Office Protocol, Internet Message Access Protocol	RFC 822, MIME, SMTP, POP, IMAP	Protocols that define the formatting, delivery, and storage of email messages on TCP/IP networks. See Part III-7.
	Network News Transfer Protocol	NNTP	Enables the operation of the Usenet online community by transferring Usenet news messages between hosts. See Chapter 85.
	Hypertext Transfer Protocol	HTTP	Transfers hypertext documents between hosts; implements the World Wide Web. See Part III-8.
	Gopher Protocol	Gopher	An older document-retrieval protocol, now largely replaced by the World Wide Web. See Chapter 86.
	Telnet Protocol	Telnet	Allows a user on one machine to establish a remote terminal session on another. See Chapter 87.
	Berkeley "r" Commands	—	Permit commands and operations on one machine to be performed on another. See Chapter 87.
	Internet Relay Chat	IRC	Allows real-time chatting between TCP/IP users. See Chapter 87.
	Administration and Troubleshooting Utilities and Protocols	—	A collection of software tools that allows administrators to manage, configure, and troubleshoot TCP/IP internetworks. See Chapter 88.

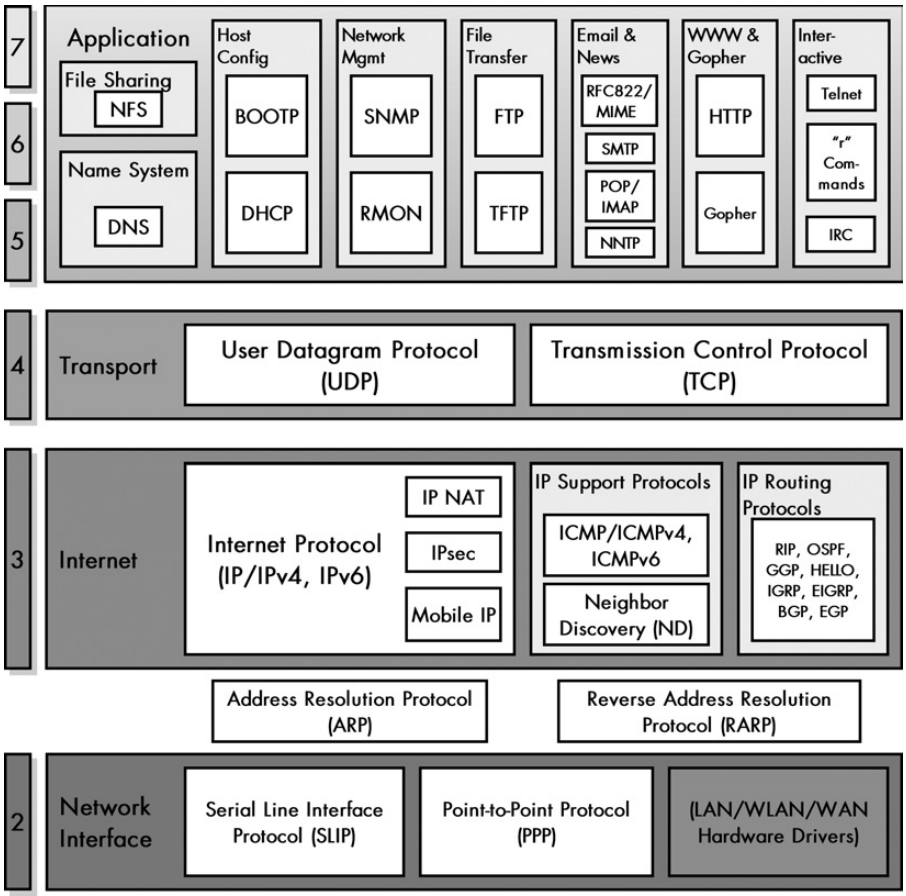

Figure 8-3: TCP/IP protocols *This diagram shows all the TCP/IP protocols covered in this book, arranged by TCP/IP and OSI Reference Model layer (with the exception of the administration utilities).*

You can see in the previous table and figure that ARP and RARP are the oddballs. In some ways they belong in both layer 2 and layer 3, and in other ways they belong in neither. They really serve to link together the network interface layer and the Internet layer. For this reason, I believe they belong *between* these two and call them "layer connection" protocols. See Chapters 13 and 14 for more on this issue.