



TCP/IP Illustrated: v. 3: TCP for Transactions, HTTP, NNTP and the Unix Domain Protocols (Addison-Wesley Professional Computing Series)

By W. Richard Stevens

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Praised by reviewers and practicing TCP/IP programmers alike, the TCP/IP Illustrated series examines the many facets of the TCP/IP protocol suite using a unique and highly-effective visual approach that describes the inner workings of TCP/IP with detail, insight, and clarity. Volume 3 provides detailed coverage of four essential topics with which today's TCP/IP programmers and network administrators must be thoroughly familiar: *T/TCP (TCP for Transactions), an extension to TCP that makes client-server transactions faster, more efficient, and more reliable; *HTTP (Hypertext Transfer Protocol), the foundation for the rapidly expanding World Wide Web; *NNTP (the Network News Transfer Protocol), the basis for the Usenet news system; and *UNIX Domain Protocols, a set of protocols used heavily in UNIX implementations. As in the previous two volumes, the book is filled with examples and implementation details within the 4.4BSD-Lite networking code. The TCP/IP Illustrated series provides a complete picture of the protocol suite that drives the Internet, and gives programmers, system administrators, and serious users the information, understanding, and skills they need to remain at the forefront of networking technology.

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Editorial Review

From the Back Cover

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- T/TCP (TCP for Transactions), an extension to TCP that makes client-server transactions faster, more efficient, and more reliable;
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- UNIX Domain Protocols, a set of protocols used heavily in UNIX implementations.

As in the previous two volumes, the book is filled with examples and implementation details within the 4.4BSD-Lite networking code.

The **TCP/IP Illustrated** series provides a complete picture of the protocol suite that drives the Internet, and gives programmers, system administrators, and serious users the information, understanding, and skills they need to remain at the forefront of networking technology.

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About the Author

We are deeply saddened to learn of the death of noted author **W. Richard Stevens**. His passing is obviously a tremendous loss for the technical community, but it is a personal one for us as well. Rich was both a gifted colleague and a valued friend who will be greatly missed. We extend our sympathies to his family.

Obituary from the *Arizona Daily Star*:

STEVENS, W. Richard, noted author of computer books died on September 1. He is best known for his "UNIX Network Programming" series (1990, 1998, 1999), "Advanced Programming in the UNIX Environment" (1992), and "TCP/IP Illustrated" series (1994, 1995, 1996). Richard was born in 1951 in Luanshya, Northern Rhodesia (now Zambia), where his father worked for the copper industry. The family moved to Salt Lake City, Hurley, New Mexico, Washington, DC and Phalaborwa, South Africa. Richard attended Fishburne Military School in Waynesboro, Virginia. He received a B.S.C. in Aerospace Engineering from the University of Michigan in 1973, and an M.S. (1978) and Ph.D. (1982) in Systems Engineering from the University of Arizona. He moved to Tucson in 1975 and from then until 1982 he was employed at Kitt Peak National Observatory as a computer programmer. From 1982 until 1990 he was Vice President of Computing Services at Health Systems International in New Haven,

CT, moving back to Tucson in 1990. Here he pursued his career as an author and consultant. He was also an avid pilot and a part-time flight instructor during the 1970's.

He is survived by his loving wife of 20 years, Sally Hodges Stevens; three wonderful children, Bill, Ellen and David; sister, Claire Stevens of Las Vegas, NV; brother, Bob and wife Linda Stevens of Dallas, TX; nieces, Laura, Sarah, Collette, Christy; and nephew, Brad. He is predeceased by his parents, Royale J. Stevens (1915-1984); and Helen Patterson Stevens (1916-1997). Helen lived in Tucson from 1991-1997, and Royale lived here in the early 1930's attending Tucson High School while his father was treated for TB at the Desert Sanitorium (now TMC). The family asks that in lieu of flowers, donations be made in Richard's name to Habitat for Humanity, 2950 E. 22nd Street, Tucson, AZ 85713. A memorial service for Richard will be held at St. Phillip's in the Hills Episcopal Church on Tuesday, September 7th at 12:00 noon. Following the service there will be a reception in the Murphy Gallery of the Church. Please wear colorful clothing to the service; Richard loved colors.

W. Richard Stevens was an acknowledged UNIX and networking expert and the highly-respected author of several books. He was also a sought-after instructor and consultant.

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Introduction and Organization of the Book

This book is a logical continuation of the **TCP/IP Illustrated** series: Stevens 1994, which we refer to as **Volume 1**, and Wright and Stevens 1995, which we refer to as **Volume 2**.

This book is divided into three parts, each covering a different topic:

TCP for transactions, commonly called T/TCP. This is an extension to TCP designed to make client-server transactions faster, more efficient, and reliable. This is done by omitting TCP's three-way handshake at the beginning of a connection and shortening the TIME_WAIT state at the end of a connection. We'll see that T/TCP can match UDP's performance for a client-server transaction and that T/TCP provides reliability and adaptability, both major improvements over UDP.

A transaction is defined to be a client request to a server, followed by the server's reply. (The term transaction does not mean a database transaction, with locking, two-phase commit, and backout.)

TCP/IP applications, specifically HTTP (the Hypertext Transfer Protocol, the foundation of the World Wide Web) and NNTP (the Network News Transfer Protocol, the basis for the Usenet news system).

The Unix domain protocols. These protocols are provided by all Unix TCP/IP implementations and on many non-Unix implementations. They provide a form of interprocess communication (IPC) and use the same sockets interface used with TCP/IP. When the client and server are on the same host, the Unix domain protocols are often twice as fast as TCP/IP.

Part 1, the presentation of T/TCP, is in two pieces. Chapters 1-4 describe the protocol and provide numerous examples of how it works. This material is a major expansion of the brief presentation of T/TCP in Section 24.7 of **Volume 1**. The second piece, Chapters 5-12, describes the actual implementation of T/TCP within the 4.4BSD-Lite networking code (i.e., the code presented in **Volume 2**). Since the first T/TCP implementation was not released until September 1994, about one year after **Volume 1** was published and right as **Volume 2** was being completed, the detailed presentation of T/TCP, with examples and all the implementation details, had to wait for another volume in the series.

Part 2, the HTTP and NNTP applications, are a continuation of the TCP/IP applications presented in Chapters 25-30 of **Volume 1**. In the two years since **Volume 1** was published, the popularity of HTTP has grown enormously, as the Internet has exploded, and the use of NNTP has been growing about 75% per year for more than 10 years. HTTP is also a wonderful candidate for T/TCP, given its typical use of TCP: short connections with small amounts of data transferred, where the total time is often dominated by the connection setup and teardown. The heavy use of HTTP (and therefore TCP) on a busy Web server by thousands of different and varied clients also provides a unique opportunity to examine the actual packets at the server (Chapter 14) and look at many features of TCP/IP that were presented in **Volumes 1 and 2**.

The Unix domain protocols in Part 3 were originally considered for **Volume 2** but omitted when its size reached 1200 pages. While it may seem odd to cover protocols other than TCP/IP in a series titled **TCP/IP Illustrated**, the Unix domain protocols were implemented almost 15 years ago in 4.2BSD alongside the first implementation of BSD TCP/IP. They are used heavily today in any Berkeley-derived kernel, but their use is typically "under the covers," and most users are unaware of their presence. Besides being the foundation for Unix pipes on a Berkeley-derived kernel, another heavy user is the X Window System, when the client and server are on the same host (i.e., on typical workstations). Unix domain sockets are also used to pass descriptors between processes, a powerful technique for interprocess communication. Since the sockets API (application program interface) used with the Unix domain protocols is nearly identical to the sockets API used with TCP/IP, the Unix domain protocols provide an easy way to enhance the performance of local applications with minimal code changes.

Each of the three parts can be read by itself.

Readers

As with the previous two volumes in the series, this volume is intended for anyone wishing to understand how the TCP/IP protocols operate: programmers writing network applications, system administrators responsible for maintaining computer systems and networks utilizing TCP/IP, and users who deal with TCP/IP applications on a daily basis.

Parts 1 and 2 assume a basic understanding of how the TCP/IP protocols work. Readers unfamiliar with TCP/IP should consult the first volume in this series, Stevens 1994, for a thorough description of the TCP/IP protocol suite. The first half of Part 1 (Chapters 1-4, the concepts behind T/TCP along with examples) can be read independent of **Volume 2**, but the remainder of Part 1 (Chapters 5-12, the implementation of T/TCP) assumes familiarity with the 4.4BSD-Lite networking code, as provided with **Volume 2**. Many forward and backward references are provided throughout the text, to both topics within this text, and to relevant sections of **Volumes 1 and 2** for readers interested in more details. A thorough index is

provided, and a list of all the acronyms used throughout the text, along with the compound term for the acronym, appears on the inside front covers. The inside back covers contain an alphabetical cross-reference of all the structures, functions, and macros described in the book and the starting page number of the description. This cross-reference also refers to definitions in **Volume 2**, when that object is referenced from the code in this volume.

Source Code Copyright

All the source code in this book that is taken from the 4.4BSD-Lite release contains the following copyright notice:

The routing table code in Chapter 6 contains the following copyright notice:

Acknowledgments

First and foremost I thank my family, Sally, Bill, Ellen, and David, who have endured another book along with all my traveling during the past year. This time, however, it really is a "small" book.

I thank the technical reviewers who read the manuscript and provided important feedback on a tight timetable: Sami Boulos, Alan Cox, Tony DeSimone, Pete Haverlock, Chris Heigham, Mukesh Kacker, Brian Kernighan, Art Mellor, Jeff Mogul, Marianne Mueller, Andras Olah, Craig Partridge, Vern Paxson, Keith Sklower, Ian Lance Taylor, and Gary Wright. A special thanks to the consulting editor, Brian Kernighan, for his rapid, thorough, and helpful reviews throughout the course of the book, and for his continued encouragement and support.

Special thanks are also due Vern Paxson and Andras Olah for their incredibly detailed reviews of the entire manuscript, finding many errors and providing valuable technical suggestions. My thanks also to Vern Paxson for making available his software for analyzing Tcpdump traces, and to Andras Olah for his help with T/TCP over the past year. My thanks also to Bob Braden, the designer of T/TCP, who provided the reference source code implementation on which Part 1 of this book is based.

Others helped in significant ways. Gary Wright and Jim Hogue provided the system on which the data for Chapter 14 was collected. Doug Schmidt provided a copy of the public domain TTCP program that uses Unix domain sockets, for the timing measurements in Chapter 16. Craig Partridge provided a copy of the RDP source code to examine. Mike Karels answered lots of questions.

My thanks once again to the National Optical Astronomy Observatories (NOAO), Sidney Wolff, Richard Wolff, and Steve Grandi, for providing access to their networks and hosts.

Finally, my thanks to all the staff at Addison-Wesley, who have helped over the past years, especially my editor John Wait.

As usual, camera-ready copy of the book was produced by the author, a Troff die-hard, using the Groff package written by James Clark. I welcome electronic mail from any readers with comments, suggestions, or bug fixes.

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Tucson, Arizona
November 1995

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Users Review

From reader reviews:

Catherine Crider:

As people who live in the modest era should be up-date about what going on or information even knowledge to make these individuals keep up with the era and that is always change and move ahead. Some of you maybe will probably update themselves by reading through books. It is a good choice for you personally but the problems coming to you actually is you don't know what kind you should start with. This TCP/IP Illustrated: v. 3: TCP for Transactions, HTTP, NNTP and the Unix Domain Protocols (Addison-Wesley Professional Computing Series) is our recommendation so you keep up with the world. Why, as this book serves what you want and need in this era.

Gerald Morin:

People live in this new day of lifestyle always aim to and must have the extra time or they will get wide range of stress from both day to day life and work. So , if we ask do people have free time, we will say absolutely yes. People is human not really a huge robot. Then we ask again, what kind of activity do you possess when the spare time coming to you actually of course your answer will unlimited right. Then do you ever try this one, reading publications. It can be your alternative inside spending your spare time, the particular book you have read is actually TCP/IP Illustrated: v. 3: TCP for Transactions, HTTP, NNTP and the Unix Domain Protocols (Addison-Wesley Professional Computing Series).

Don Morris:

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Arlene Farrar:

Is it you actually who having spare time subsequently spend it whole day through watching television programs or just lying on the bed? Do you need something new? This TCP/IP Illustrated: v. 3: TCP for Transactions, HTTP, NNTP and the Unix Domain Protocols (Addison-Wesley Professional Computing Series) can be the answer, oh how comes? A fresh book you know. You are therefore out of date, spending your extra time by reading in this fresh era is common not a geek activity. So what these publications have than the others?

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