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# TCP/IP 详解

卷3: T/TCP、HTTP、NNTP  
和UNIX域协议 **英文版**

TCP/IP Illustrated

Volume 3: TCP for Transactions, HTTP,  
NNTP, and the UNIX Domain Protocols

[美] W. Richard Stevens 著

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## 内 容 提 要

本书是TCP/IP领域的经典之作! 书中重点讲述高级协议, 覆盖了当今TCP/IP编程人员和网络管理员必须熟练掌握的T/TCP (TCP事务协议)、HTTP (超文本传送协议)、NNTP (网络新闻传送协议) 和Unix域协议。与前面两卷一样, 本书有丰富的例子和实现的细节。

本书适合希望了解TCP/IP协议如何实现的读者阅读, 是TCP/IP领域研究人员和开发人员的权威参考书。

图灵原版计算机科学系列

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# 前 言

## 概述及本书的结构

本书是《TCP/IP详解》系列书的自然延续：[Stevens, 1994]，本书中称为卷1 (Volume 1)；[Wright and Stevens, 1995]，本书中称为卷2 (Volume 2)。本书可以分为三部分，每一部分包含一个不同的主题。

(1) TCP事务协议，一般简称T/TCP。这是TCP的扩展，用来使客户-服务器事务更快、更有效，同时也更加可靠。这是通过省略连接开始时的三次握手并缩短连接结束时的TIME\_WAIT状态来实现的。我们将看到，对于客户-服务器事务，T/TCP可以达到UDP的性能，而T/TCP还提供了可靠性和适应性，这是与UDP相比的重要改进。

事务可以定义为客户向服务器提出的请求以及服务器相应的应答。(术语“事务”指的不是包含加锁、两段提交和回退过程的数据库事务。)

(2) TCP/IP应用具体是指HTTP (超文本传送协议，万维网的基础)和NNTP (网络新闻传送协议，Usenet新闻系统的基础)。

(3) Unix域协议。所有的Unix TCP/IP实现都提供这些协议，许多非Unix实现也提供这些协议。它们提供了一种进程间通信 (IPC) 的形式，并使用与TCP/IP一样的套接字接口。当客户和服务器在同一台主机上时，Unix域协议的速度一般是TCP/IP的两倍。

第一部分（T/TCP的描述）分为两块内容。第1章至第4章对这一协议进行了描述，并提供大量的示例说明其工作原理。卷1的24.7节曾对T/TCP进行了简单描述，本书的这部分内容对其进行了大幅扩展。第二块是第5章至第12章，描述的是4.4BSD-Lite网络代码（即卷2给出的代码）中T/TCP的实际实现。由于第一个T/TCP实现直到1994年9月才发布，而此时卷1已经出版一年，卷2也基本完成，因此T/TCP的示例和实现细节只能在本套书的这一卷中进行详细描述。

第二部分（HTTP和NNTP应用）是卷1的第25章至第30章介绍的TCP/IP应用的延续。在卷1出版后两年的时间里，HTTP技术随着因特网的兴起迅速流行开来，NNTP技术的使用在十几年时间中每年增长75%左右。由于常见的TCP使用方式是在数据交换极少的短连接里（连接的建立和销毁操作占用大部分时间），因此HTTP还是T/TCP的理想候补技术。在繁忙的Web服务器上由数以千计不同类型的客户大量使用HTTP（进而大量使用TCP）使我们可以检测服务器上的实际分组（第14章），并更好地理解卷1和卷2中描述的很多TCP/IP特性。

第三部分的Unix域协议本来是计划安排在卷2中的，但是由于卷2的篇幅已达到1200页，所以删掉了。在题为《TCP/IP详解》的一套书中讲述非TCP/IP协议看上去有点奇怪，但是Unix域协议早在将近15年前的4.2BSD版本中就首次实现了，与BSD TCP/IP的首次实现时间差不多。Berkeley衍生内核中大量使用了Unix域协议，但通常都是“在掩护下”使用的，大多数用户感觉不到它们的存在。除了作为Berkeley衍生内核中Unix管道的基础技术外，Unix域协议还大量用于客户和服务器的同一台主机（常见的工作站）上的X Window系统。Unix域套接字技术用于在进程之间传递描述符，这是一种用于进程间通信的强大技术。由于Unix域协议中套接字API（应用程序接口）与TCP/IP中的套接字API几乎相同，因此只需要改动很少的代码，Unix域协议就可以轻松地提高应用程序的性能。

以上三部分内容可以独立阅读。

## 致读者

与前两卷相似，本卷面向所有希望了解TCP/IP协议运行原理的读者：编写网络应用的程序员、利用TCP/IP维护计算机系统与网络的系统管理员以及那些需要每天与TCP/IP应用打交道的用户。

前两部分内容要求读者对TCP/IP协议的工作原理有基本的了解。对TCP/IP协议不是很熟悉的读者首先应参考卷1[Stevens, 1994]，该书对TCP/IP协议族有比较透彻的讲述。第一部分的前一块内容（第1章至第4章，T/TCP基本概念及示例）可以独立于卷2阅读，但其余内容（第5~12章，T/TCP的实现）要求读者对卷2中提供的4.4BSD-Lite网络代码比较熟悉。

本书贯穿了一些交叉引用，不仅参考了本卷中的内容，还参考了卷1和卷2中相应的章节。本书提供了完整的索引，并把用到的所有缩略词及相应的复合术语都详细列在本

书的最前面。索引后还按照字母表顺序给出了书中所用到的结构体、函数和宏的交叉引用，以及相关详细信息的起始页码。当本卷的代码需要引用卷2中的内容时，交叉引用也会提及卷2中的相关定义。

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在展示交互式的输入和输出时，我们用粗体显示键入内容，以等宽正体显示计算机的输出，以斜体显示注释，示例如下：

```

sun % telnet www.aw.com 80      connect to the discard server
Trying 192.207.117.2...          this line and next output by Telnet client
Connected to aw.com.

```

另外，我们将系统名（本例中是sun）作为shell提示符的一部分，以表明命令正在哪种主机上运行。正文中提到的程序的名字通常用首字母大写（如Telnet和Tcpcdump）以避免过多的字体变化。

整本书中，我们随时会插入缩进的小字号段落来描述历史问题或实现细节。

## 致谢

首先我要感谢我的家人Sally、Bill、Ellen和David。在过去的一年中，他们又一次忍受了我外出旅行完成这本书的过程。不过，这一次做的确实是一本“小型”书。

感谢百忙之中拨冗阅读本书书稿并给出重要反馈的技术审稿人：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和Gary Wright。特别感谢顾问编辑Brian Kernighan，在完成本书的过程中，他提出了很多及时、透彻、很有帮助的评审意见，并始终鼓励和支持着我。

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的基础。

还有一些人也提供了很重要的帮助。Gary Wright和Jim Hogue提供了第14章中采集数据所需要的系统。Doug Schmidt为第16章的时间度量提供了使用Unix域套接字的公共域TTCP程序的副本。Craig Partridge提供了一份RDP源代码的副本来帮助测试。Mike Karels解答了很多问题。

再次感谢美国国家光学天文台，尤其是授权我们接入其网络和主机的Sidney Wolff、Richard Wolff和Steve Grandi。

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跟以前一样，作者用James Clark编写的Groff包制作了本书的最终电子版——Troff硬拷贝。欢迎读者以电子邮件的方式反馈意见、提出建议或订正错误。

W. Richard Stevens

1995年11月于亚利桑那州图森市

# Contents

<b>Part 1. TCP for Transactions</b>	<b>1</b>
<hr/>	
<b>Chapter 1. T/TCP Introduction</b>	<b>3</b>
1.1 Introduction	3
1.2 UDP Client–Server	3
1.3 TCP Client–Server	9
1.4 T/TCP Client–Server	17
1.5 Test Network	20
1.6 Timing Example	21
1.7 Applications	22
1.8 History	24
1.9 Implementations	26
1.10 Summary	28
<b>Chapter 2. T/TCP Protocol</b>	<b>29</b>
2.1 Introduction	29
2.2 New TCP Options for T/TCP	30
2.3 T/TCP Implementation Variables	33
2.4 State Transition Diagram	34
2.5 T/TCP Extended States	36
2.6 Summary	38

<b>Chapter 3.</b>	<b>T/TCP Examples</b>	<b>39</b>
3.1	Introduction	39
3.2	Client Reboot	40
3.3	Normal T/TCP Transaction	42
3.4	Server Receives Old Duplicate SYN	43
3.5	Server Reboot	44
3.6	Request or Reply Exceeds MSS	45
3.7	Backward Compatibility	49
3.8	Summary	51
<b>Chapter 4.</b>	<b>T/TCP Protocol (Continued)</b>	<b>53</b>
4.1	Introduction	53
4.2	Client Port Numbers and TIME_WAIT State	53
4.3	Purpose of the TIME_WAIT State	56
4.4	TIME_WAIT State Truncation	59
4.5	Avoiding the Three-Way Handshake with TAO	62
4.6	Summary	68
<b>Chapter 5.</b>	<b>T/TCP Implementation: Socket Layer</b>	<b>69</b>
5.1	Introduction	69
5.2	Constants	70
5.3	sosend Function	70
5.4	Summary	72
<b>Chapter 6.</b>	<b>T/TCP Implementation: Routing Table</b>	<b>73</b>
6.1	Introduction	73
6.2	Code Introduction	74
6.3	radix_node_head Structure	75
6.4	rtentry Structure	75
6.5	rt_metrics Structure	76
6.6	in_inithead Function	76
6.7	in_addroute Function	77
6.8	in_matroute Function	78
6.9	in_clsroute Function	78
6.10	in_rtqtime Function	79
6.11	in_rtqkill Function	82
6.12	Summary	85
<b>Chapter 7.</b>	<b>T/TCP Implementation: Protocol Control Blocks</b>	<b>87</b>
7.1	Introduction	87
7.2	in_pcbladdr Function	88
7.3	in_pcbconnect Function	89
7.4	Summary	90
<b>Chapter 8.</b>	<b>T/TCP Implementation: TCP Overview</b>	<b>91</b>
8.1	Introduction	91
8.2	Code Introduction	91

8.3	TCP protocol Structure	92	
8.4	TCP Control Block	93	
8.5	tcp_init Function	94	
8.6	tcp_slowtimo Function	94	
8.7	Summary	95	
<b>Chapter 9.</b>	<b>T/TCP Implementation: TCP Output</b>		<b>97</b>
9.1	Introduction	97	
9.2	tcp_output Function	97	
9.3	Summary	104	
<b>Chapter 10.</b>	<b>T/TCP Implementation: TCP Functions</b>		<b>105</b>
10.1	Introduction	105	
10.2	tcp_newtcpcb Function	105	
10.3	tcp_rtlookup Function	106	
10.4	tcp_gettaocache Function	108	
10.5	Retransmission Timeout Calculations	108	
10.6	tcp_close Function	112	
10.7	tcp_msssend Function	113	
10.8	tcp_mssrcvd Function	114	
10.9	tcp_dooptions Function	121	
10.10	tcp_reass Function	122	
10.11	Summary	124	
<b>Chapter 11.</b>	<b>T/TCP Implementation: TCP Input</b>		<b>125</b>
11.1	Introduction	125	
11.2	Preliminary Processing	125	
11.3	Header Prediction	129	
11.4	Initiation of Passive Open	130	
11.5	Initiation of Active Open	134	
11.6	PAWS: Protection Against Wrapped Sequence Numbers	141	
11.7	ACK Processing	142	
11.8	Completion of Passive Opens and Simultaneous Opens	142	
11.9	ACK Processing (Continued)	143	
11.10	FIN Processing	145	
11.11	Summary	147	
<b>Chapter 12.</b>	<b>T/TCP Implementation: TCP User Requests</b>		<b>149</b>
12.1	Introduction	149	
12.2	PRU_CONNECT Request	149	
12.3	tcp_connect Function	150	
12.4	PRU_SEND and PRU_SEND_EOF Requests	154	
12.5	tcp_usrclosed Function	155	
12.6	tcp_sysctl Function	155	
12.7	T/TCP Futures	156	
12.8	Summary	158	

---

**Part 2. Additional TCP Applications** **159**

---

**Chapter 13. HTTP: Hypertext Transfer Protocol** **161**

- 13.1 Introduction 161
- 13.2 Introduction to HTTP and HTML 162
- 13.3 HTTP Protocol 165
- 13.4 An Example 170
- 13.5 HTTP Statistics 172
- 13.6 Performance Problems 173
- 13.7 Summary 175

**Chapter 14. Packets Found on an HTTP Server** **177**

- 14.1 Introduction 177
- 14.2 Multiple HTTP Servers 180
- 14.3 Client SYN Interarrival Time 181
- 14.4 RTT Measurements 185
- 14.5 `listen` Backlog Queue 187
- 14.6 Client SYN Options 192
- 14.7 Client SYN Retransmissions 195
- 14.8 Domain Names 196
- 14.9 Timing Out Persist Probes 196
- 14.10 Simulation of T/TCP Routing Table Size 200
- 14.11 Mbuf Interaction 202
- 14.12 TCP PCB Cache and Header Prediction 203
- 14.13 Summary 205

**Chapter 15. NNTP: Network News Transfer Protocol** **207**

- 15.1 Introduction 207
- 15.2 NNTP Protocol 209
- 15.3 A Simple News Client 212
- 15.4 A More Sophisticated News Client 214
- 15.5 NNTP Statistics 215
- 15.6 Summary 216

---

**Part 3. The Unix Domain Protocols** **219**

---

**Chapter 16. Unix Domain Protocols: Introduction** **221**

- 16.1 Introduction 221
- 16.2 Usage 222
- 16.3 Performance 223
- 16.4 Coding Examples 224
- 16.5 Summary 225

---

<b>Chapter 17.</b>	<b>Unix Domain Protocols: Implementation</b>	<b>227</b>
17.1	Introduction	227
17.2	Code Introduction	227
17.3	Unix domain and protocols Structures	228
17.4	Unix Domain Socket Address Structures	230
17.5	Unix Domain Protocol Control Blocks	231
17.6	uipc_usrreq Function	233
17.7	PRU_ATTACH Request and unp_attach Function	233
17.8	PRU_DETACH Request and unp_detach Function	236
17.9	PRU_BIND Request and unp_bind Function	237
17.10	PRU_CONNECT Request and unp_connect Function	240
17.11	PRU_CONNECT2 Request and unp_connect2 Function	245
17.12	socketpair System Call	249
17.13	pipe System Call	253
17.14	PRU_ACCEPT Request	253
17.15	PRU_DISCONNECT Request and unp_disconnect Function	255
17.16	PRU_SHUTDOWN Request and unp_shutdown Function	257
17.17	PRU_ABORT Request and unp_drop Function	258
17.18	Miscellaneous Requests	259
17.19	Summary	261
<b>Chapter 18.</b>	<b>Unix Domain Protocols: I/O and Descriptor Passing</b>	<b>263</b>
18.1	Introduction	263
18.2	PRU_SEND and PRU_RCVD Requests	263
18.3	Descriptor Passing	269
18.4	unp_internalize Function	274
18.5	unp_externalize Function	276
18.6	unp_discard Function	277
18.7	unp_dispose Function	278
18.8	unp_scan Function	278
18.9	unp_gc Function	280
18.10	unp_mark Function	288
18.11	Performance (Revisited)	288
18.12	Summary	289
<b>Appendix A.</b>	<b>Measuring Network Times</b>	<b>291</b>
A.1	RTT Measurements Using Ping	292
A.2	Protocol Stack Measurements	294
A.3	Latency and Bandwidth	300
<b>Appendix B.</b>	<b>Coding Applications for T/TCP</b>	<b>303</b>
	<b>Bibliography</b>	<b>309</b>
	<b>Index</b>	<b>315</b>

*Part 1*

# ***TCP for Transactions***





# T/TCP Introduction

## 1.1 Introduction

This chapter introduces the concepts of a client–server transaction. We start with a UDP client–server application, the simplest possible. We then write the client and server using TCP and examine the resulting TCP/IP packets that are exchanged between the two hosts. Next we use T/TCP, showing the reduction in packets and the minimal source code changes required on both ends to take advantage of T/TCP.

We then introduce the test network used to run the examples in the text, and look at a simple timing comparison between the UDP, TCP, and T/TCP client–server applications. We look at some typical Internet applications that use TCP and see what would change if the two end systems supported T/TCP. This is followed by a brief history of transaction processing protocols within the Internet protocol suite, and a description of existing T/TCP implementations.

Throughout this text and throughout the T/TCP literature, the term *transaction* means a request sent by a client to a server along with the server’s reply. A common Internet example is a client request to a Domain Name System (DNS) server, asking for the IP address corresponding to a domain name, followed by the server’s response. We do *not* use the term to imply the semantics often associated with database transactions: locking, two-phase commit, backout, and so on.

## 1.2 UDP Client–Server

We begin with a simple UDP client–server example, showing the client source code in Figure 1.1. The client sends a request to the server, the server processes the request and sends back a reply.