

# OpenSS7 Linux Native SCTP Installation and Reference Manual

---

Version 0.2 Edition 27  
Updated 2008-10-31  
Package sctp-0.2.27

Brian Bidulock <[bidulock@openss7.org](mailto:bidulock@openss7.org)> for  
The OpenSS7 Project <<http://www.openss7.org/>>

---

Copyright © 2001-2008 OpenSS7 Corporation <<http://www.openss7.com/>>  
Copyright © 1997-2000 Brian F. G. Bidulock <[bidulock@openss7.org](mailto:bidulock@openss7.org)>  
All Rights Reserved.

Published by OpenSS7 Corporation  
1469 Jefferys Crescent  
Edmonton, Alberta T6L 6T1  
Canada

This is texinfo edition 27 of the OpenSS7 Linux Native SCTP manual, and is consistent with SCTP 0.2. This manual was developed under the **OpenSS7 Project** and was funded in part by **OpenSS7 Corporation**.

Permission is granted to make and distribute verbatim copies of this manual provided the copyright notice and this permission notice are preserved on all copies.

Permission is granted to copy and distribute modified versions of this manual under the conditions for verbatim copying, provided that the entire resulting derived work is distributed under the terms of a permission notice identical to this one.

Permission is granted to copy and distribute translations of this manual into another language, under the same conditions as for modified versions.

## Short Contents

Preface .....	1
Quick Start Guide .....	9
1 Introduction .....	13
2 Objective .....	15
3 Reference .....	17
4 Conformance .....	55
5 Releases .....	57
6 Installation .....	71
7 Troubleshooting .....	123
Licenses .....	133
Indices .....	167



# Table of Contents

<b>Preface</b>	<b>1</b>
Notice	1
Abstract	1
Objective	1
Intent	1
Audience	1
Revisions	2
Version Control	2
ISO 9000 Compliance	3
Disclaimer	3
U.S. Government Restricted Rights	4
Acknowledgements	4
Sponsors	4
Contributors	5
Authors	5
Maintainer	5
Web Resources	5
<b>Quick Start Guide</b>	<b>9</b>
OpenSS7 Linux Native SCTP	9
Release	9
Prerequisites	10
Installation	10
Brief Installation Instructions	11
Detailed Installation Instructions	12
<b>1 Introduction</b>	<b>13</b>
1.1 Overview	13
1.2 Organization of this Manual	13
1.3 Conventions and Definitions	13
<b>2 Objective</b>	<b>15</b>
<b>3 Reference</b>	<b>17</b>
3.1 Files	17
3.2 Kernel Modules	20
3.2.1 Stream Control Transmission Protocol (SCTP) Module (sctp)	20
3.3 Libraries	20
3.4 Utilities	20
3.4.1 test-sctp-dc	20
3.4.2 test-sctp-ds	20

3.4.3	test-sctp-sc.....	20
3.4.4	test-sctp-ss.....	20
3.4.5	test-sctp-tc.....	20
3.4.6	test-sctp-ts.....	20
3.4.7	test-sctpc.....	20
3.4.8	test-sctps.....	20
3.4.9	test-tcp-dc.....	20
3.4.10	test-tcp-ds.....	20
3.4.11	test-tcp-tc.....	20
3.4.12	test-tcp-ts.....	21
3.4.13	test-tcpc.....	21
3.4.14	test-tcps.....	21
3.4.15	test-udpc.....	21
3.4.16	test-udps.....	21
3.5	Development.....	21
3.6	SCTP Reference Page.....	21
	NAME.....	21
	SYNOPSIS .....	21
	DESCRIPTION.....	21
	Connection Establishment.....	22
	Sending Data .....	22
	Receiving Data .....	23
	ADDRESS FORMATS.....	24
	SOCKET CALLS.....	25
	FEATURES .....	28
	SYSCTLS .....	29
	SOCKET OPTIONS.....	35
	IOCTLS.....	49
	ERROR HANDLING .....	49
	NOTES.....	50
	ERRORS .....	50
	NETWORK STATISTICS .....	50
	Protocol Information.....	50
	Connection Information .....	52
	Socket Usage Information .....	52
	CAVEATS .....	53
	AUTHOR.....	54
<b>4</b>	<b>Conformance.....</b>	<b>55</b>

<b>5</b>	<b>Releases</b>	<b>57</b>
5.1	Prerequisites	57
5.2	Compatibility	57
5.2.1	GNU/Linux Distributions	57
5.2.2	Kernel	59
5.2.3	Architectures	60
5.3	Release Notes	60
	Major changes for release sctp-0.2.27	60
	Major changes for release sctp-0.2.26	61
	Major changes for release sctp-0.2.25	61
	Major changes for release sctp-0.2.24	62
	Major changes for release sctp-0.2.23	63
	Major changes for release sctp-0.2.22	63
	Major changes for release sctp-0.2.21	63
	Initial release sctp-0.2.20-1	63
5.4	Maturity	63
5.4.1	Pre-Alpha Releases	63
5.4.2	Alpha Releases	64
5.4.3	Beta Releases	64
5.4.4	Gamma Releases	64
5.4.5	Production Releases	64
5.4.6	Unstable Releases	64
5.5	Bugs	65
5.5.1	Defect Notices	65
5.5.2	Known Defects	65
5.5.3	Defect History	65
5.6	Schedule	65
5.7	History	69
<b>6</b>	<b>Installation</b>	<b>71</b>
6.1	Repositories	71
6.1.1	Repositories for YUM	71
6.1.2	Repositories for APT	72
6.2	Downloading	73
6.2.1	Downloading with YUM	73
6.2.2	Downloading with APT	75
6.2.3	Downloading the Binary RPM	75
6.2.4	Downloading the Debian DEB	78
6.2.5	Downloading the Source RPM	81
6.2.6	Downloading the Debian DSC	81
6.2.7	Downloading the Tar Ball	82
6.2.8	Downloading from CVS	82
6.3	Configuration	85
6.3.1	Configuring the Binary RPM	85
6.3.2	Configuring the Debian DEB	87
6.3.3	Configuring the Source RPM	87
6.3.4	Configuring the Debian DSC	93
6.3.5	Configuring the Tar Ball	93

6.3.5.1	Configure Options .....	93
6.3.5.2	Environment Variables .....	103
6.3.5.3	Build .....	106
6.4	Building .....	106
6.4.1	Building from the Source RPM .....	106
6.4.2	Building from the Debian DSC .....	106
6.4.3	Building from the Tar Ball .....	107
6.4.3.1	Native Build .....	107
6.4.3.2	Cross-Build .....	108
6.5	Installing .....	108
6.5.1	Installing the Binary RPM .....	108
6.5.2	Installing the Debian DEB .....	109
6.5.3	Installing the Tar Ball .....	109
6.6	Removing .....	109
6.6.1	Removing the Binary RPM .....	109
6.6.2	Removing the Debian DEB .....	109
6.6.3	Removing the Source RPM .....	110
6.6.4	Removing the Debian DSC .....	110
6.6.5	Removing the Tar Ball .....	110
6.7	Loading .....	110
6.7.1	Normal Module Loading .....	110
6.7.1.1	Linux Fast-STREAMS Module Loading .....	111
6.7.1.2	Linux STREAMS Module Loading .....	111
6.8	Maintenance .....	111
6.8.1	Makefile Targets .....	111
6.8.1.1	User Targets .....	112
6.8.1.2	Maintainer Targets .....	114
6.8.1.3	Clean Targets .....	114
6.8.1.4	Manual Page Targets .....	115
6.8.1.5	Release Targets .....	115
6.8.1.6	Logging Targets .....	116
6.8.1.7	Problem Report Targets .....	118
6.8.1.8	Release Archive Targets .....	118
6.8.1.9	RPM Build Targets .....	119
6.8.1.10	Debian Build Targets .....	120
6.8.1.11	Documentation Targets .....	121
<b>7</b>	<b>Troubleshooting .....</b>	<b>123</b>
7.1	Test Suites .....	123
7.1.1	Pre-installation Checks .....	123
7.1.1.1	Pre-Installation System Checks .....	123
7.1.1.2	Pre-Installation Maintenance Checks .....	124
7.1.1.3	Specific Pre-Installation Checks .....	124
7.1.2	Post-installation Checks .....	126
7.1.2.1	Running Test Suites .....	127
7.2	Problem Reports .....	127
7.2.1	Problem Report Guidelines .....	128
7.2.2	Generating Problem Reports .....	128



7.2.3 Automatic Problem Reports.....	129
7.2.4 Stand Alone Problem Reports.....	130
7.3 Known Problems.....	131
<b>Licenses.....</b>	<b>133</b>
GNU Affero General Public License .....	134
Preamble .....	134
How to Apply These Terms to Your New Programs.....	144
GNU General Public License .....	145
Preamble .....	145
How to Apply These Terms to Your New Programs.....	156
GNU Lesser General Public License .....	157
Terms and Conditions.....	157
GNU Free Documentation License.....	160
Preamble .....	160
Terms and Conditions for Copying, Distribution and Modification	
.....	160
How to use this License for your documents .....	166
<b>Indices .....</b>	<b>167</b>
Index of Concepts.....	167
Index of Data Types .....	169
Index of Functions and Macros .....	170
Index of Variables and Constants.....	171
Index of Files and Programs.....	172
Index of Configuration Options.....	173
Index of Makefile Targets .....	174
Index of Authors.....	175
Index of Manual Pages Referenced.....	176



# Preface

## Notice

This package is released and distributed under the *GNU Affero General Public License* (see [\[undefined\]](#), page [\[undefined\]](#)). Please note, however, that there are different licensing terms for the manual pages and some of the documentation (derived from OpenGroup<sup>1</sup> publications and other sources). Consult the permission notices contained in the documentation for more information.

This manual, is released under the *GNU Free Documentation License* (see [\[GNU Free Documentation License\]](#), page 160) with no sections invariant.

## Abstract

This manual provides a *Installation and Reference Manual* for *OpenSS7 Linux Native SCTP*.

## Objective

The objective of this manual is to provide a guide for the *STREAMS* programmer when developing *STREAMS* modules, drivers and application programs for *OpenSS7 Linux Native SCTP*.

This guide provides information to developers on the use of the *STREAMS* mechanism at user and kernel levels.

*STREAMS* was incorporated in UNIX System V Release 3 to augment the character input/output (I/O) mechanism and to support development of communication services.

*STREAMS* provides developers with integral functions, a set of utility routines, and facilities that expedite software design and implementation.

## Intent

The intent of this manual is to act as an introductory guide to the *STREAMS* programmer. It is intended to be read alone and is not intended to replace or supplement the *OpenSS7 Linux Native SCTP* manual pages. For a reference for writing code, the manual pages (see [STREAMS\(9\)](#)) provide a better reference to the programmer. Although this describes the features of the *OpenSS7 Linux Native SCTP* package, [OpenSS7 Corporation](#) is under no obligation to provide any software, system or feature listed herein.

## Audience

This manual is intended for a highly technical audience. The reader should already be familiar with *Linux* kernel programming, the *Linux* file system, character devices, driver input and output, interrupts, software interrupt handling, scheduling, process contexts, multiprocessor locks, etc.

The guide is intended for network and systems programmers, who use the *STREAMS* mechanism at user and kernel levels for *Linux* and *UNIX* system communication services. Readers of the guide are expected to possess prior knowledge of the *Linux* and *UNIX* system, programming, networking, and data communication.

---

<sup>1</sup> Formerly X/Open and UNIX International.

## Revisions

Take care that you are working with a current version of this manual: you will not be notified of updates. To ensure that you are working with a current version, contact the [Author](#), or check [The OpenSS7 Project](#) website for a current version.

A current version of this manual is normally distributed with the *OpenSS7 Linux Native SCTP* package.

## Version Control

```
sctp.texi,v
Revision 0.9.2.28  2008-09-20 11:04:25  brian
- added package patchlevel

Revision 0.9.2.27  2008-08-03 06:03:27  brian
- protected against texinfo commands in log entries

Revision 0.9.2.26  2008/07/27 08:48:51  brian
- no invariant sections, more libtool ignores

Revision 0.9.2.25  2008-04-29 08:49:51  brian
- updated headers for Affero release

Revision 0.9.2.24  2008-04-25 11:50:44  brian
- updates to AGPLv3

Revision 0.9.2.23  2007/08/12 06:43:57  brian
- updated licenses in manuals

Revision 0.9.2.22  2007/02/28 06:30:29  brian
- updates and corrections, #ifdef instead of #if

Revision 0.9.2.21  2006/09/18 01:06:21  brian
- updated manuals and release texi docs

Revision 0.9.2.20  2006/08/28 10:46:54  brian
- correction

Revision 0.9.2.19  2006/08/28 10:32:45  brian
- updated references

Revision 0.9.2.18  2006/08/27 12:26:34  brian
- finalizing auto release files

Revision 0.9.2.17  2006/08/26 09:16:38  brian
- better release file generation

Revision 0.9.2.16  2006/08/23 11:00:26  brian
- added preface, corrections and updates for release

Revision 0.9.2.14  2006-03-29 04:27:45 -0700  brian
- corrections for rerelease, see ChangeLog

Revision 0.9.2.13  2006-03-22 03:01:59 -0700  brian
- added makefile target index

Revision 0.9.2.12  2006-03-04 22:51:50 -0700  brian
- minor updates of some release info for next release
```

```

Revision 0.9.2.11  2005-07-08 07:15:51 -0600  brian
- updates to documentation

Revision 0.9.2.10  2005-06-24 07:38:58 -0600  brian
- added troubleshooting section to manuals

Revision 0.9.2.9   2005-05-14 02:29:32 -0600  brian
- copyright header correction

Revision 0.9.2.8   2005-04-12 17:01:41 -0600  brian
- correct docs

Revision 0.9.2.7   2005-04-12 03:28:55 -0600  brian
- corrections

Revision 0.9.2.6   2005-03-14 17:56:58 -0700  brian
- Updated version numbering in texinfo files.

Revision 0.9.2.5   2005-03-14 17:51:55 -0700  brian
- Updated version numbering in texinfo files.

Revision 0.9.2.4   2005-02-17 13:00:07 -0700  brian
- Fixes for texi documentation.

Revision 0.9.2.3   2005-01-24 04:57:59 -0700  brian
- Updated texinfo headers.

Revision 0.9.2.2   2004-12-21 15:20:24 -0700  brian
- Some corrections.

Revision 0.9.2.1   2004-12-20 03:18:19 -0700  brian
- Big start on autoconf release of Linux Native SCTP.

Revision 0.9       1996-12-31 17:00:00 -0700  brian
*** empty log message ***

```

## ISO 9000 Compliance

Only the T<sub>E</sub>X, texinfo, or roff source for this manual is controlled. An opaque (printed, postscript or portable document format) version of this manual is an **UNCONTROLLED VERSION**.

## Disclaimer

*OpenSS7 Corporation* disclaims all warranties with regard to this documentation including all implied warranties of merchantability, fitness for a particular purpose, non-infringement, or title; that the contents of the manual are suitable for any purpose, or that the implementation of such contents will not infringe on any third party patents, copyrights, trademarks or other rights. In no event shall *OpenSS7 Corporation* be liable for any direct, indirect, special or consequential damages or any damages whatsoever resulting from loss of use, data or profits, whether in an action of contract, negligence or other tortious action, arising out of or in connection with any use of this manual or the performance or implementation of the contents thereof.

*OpenSS7 Corporation* reserves the right to revise this software and documentation for any reason, including but not limited to, conformity with standards promulgated by various agencies, utilization of advances in the state of the technical arts, or the reflection of changes in the design of any techniques, or procedures embodied, described, or referred to herein. *OpenSS7 Corporation* is under no obligation to provide any feature listed herein.

## U.S. Government Restricted Rights

If you are licensing this Software on behalf of the U.S. Government ("Government"), the following provisions apply to you. If the Software is supplied by the Department of Defense ("DoD"), it is classified as "Commercial Computer Software" under paragraph 252.227-7014 of the DoD Supplement to the Federal Acquisition Regulations ("DFARS") (or any successor regulations) and the Government is acquiring only the license rights granted herein (the license rights customarily provided to non-Government users). If the Software is supplied to any unit or agency of the Government other than DoD, it is classified as "Restricted Computer Software" and the Government's rights in the Software are defined in paragraph 52.227-19 of the Federal Acquisition Regulations ("FAR") (or any successor regulations) or, in the cases of NASA, in paragraph 18.52.227-86 of the NASA Supplement to the FAR (or any successor regulations).

## Acknowledgements

As with most open source projects, this project would not have been possible without the valiant efforts and productive software of the *Free Software Foundation* and the *Linux Kernel Community*.

## Sponsors

Funding for completion of the *OpenSS7 OpenSS7 Linux Native SCTP* package was provided in part by:

- *OpenSS7 Corporation*

Additional funding for *The OpenSS7 Project* was provided by:

- *OpenSS7 Corporation*
- *Lockheed Martin Co.*
- *Motorola*
- *HOB International*
- *Comverse Ltd.*
- *Sonus Networks Inc.*
- *France Telecom*
- *SS8 Networks Inc.*
- *Nortel Networks*
- *Verisign*
- *eServGlobal (NZ) Pty Ltd.*
- *NetCentrex S. A.*
- *SysMaster Corporation*
- *GeoLink SA*
- *AirNet Communications*
- *TECORE*

- Tumsan Oy
- Vodare Ltd.
- Excel Telecommunications

## Contributors

The primary contributor to the *OpenSS7 Linux Native SCTP* package is **Brian F. G. Bidulock**. The following is a list of significant contributors to **The OpenSS7 Project**:

- Per Berquist
- John Boyd
- Chuck Winters
- Peter Courtney
- Tom Chandler
- Gurol Ackman
- Kutluk Testicioglu
- John Wenker
- Others

## Authors

The authors of the *OpenSS7 Linux Native SCTP* package include:

- **Brian Bidulock**

See [\[Index of Authors\]](#), [page 175](#), for a complete listing and cross-index of authors to sections of this manual.

## Maintainer

The maintainer of the *OpenSS7 Linux Native SCTP* package is:

- **Brian Bidulock**

Please send bug reports to [bugs@openss7.org](mailto:bugs@openss7.org) using the ‘**send-pr**’ script included in the package, only after reading the ‘BUGS’ file in the release, or See [Section 7.2 \[Problem Reports\]](#), [page 127](#).

## Web Resources

The **OpenSS7 Project** provides a website dedicated to the software packages released by the **OpenSS7 Project**.

## Bug Reports

Please send bug reports to [bugs@openss7.org](mailto:bugs@openss7.org) using the ‘**send-pr**’ script included in the *OpenSS7 Linux Native SCTP* package, only after reading the ‘BUGS’ file in the release, or See [Section 7.2 \[Problem Reports\]](#), [page 127](#). You can access the **OpenSS7 GNATS database** directly via the web, however, the preferred method for sending new bug reports is via mail with the ‘**send-pr**’ script.

## Mailing Lists

The **OpenSS7 Project** provides a number of general discussion **Mailing Lists** for discussion concerning the *OpenSS7 Linux Native SCTP* package as well as other packages released by **The OpenSS7 Project**.

These are **mailman** mailing lists and so have convenient web interfaces for subscribers to control their settings. See <http://www.openss7.org/maillinglist.html>.

The mailing lists are as follows:

**‘openss7’** The ‘openss7’ mailing list is for general enquiries, information exchange and announcements regarding the **OpenSS7 Project**. This is our original mailing list and takes the highest amount of traffic.

**‘openss7-announce’**

The ‘openss7-announce’ mailing list is for announcements related to the **OpenSS7 Project**. This list will accept announcements posted by subscribers. Subscribe to this list if you are interested in announcements from the **OpenSS7 Project**, subscribers and sponsors, related to the **OpenSS7 Project** or STREAMS, SS7, SIGTRAN or SCTP in general.

**‘openss7-cvs’**

The ‘openss7-cvs’ mailing list is for automatic CVS log reporting. You must get permission of the owner to subscribe to this list. Subscribers are not allowed to post to this list, this is merely for distributing notification of changes to the CVS repository.h

**‘openss7-develop’**

The ‘openss7-develop’ mailing list is for email exchange related to the development projects under the **OpenSS7 Project**. This includes development requests, proposals, requests for comment or proposal. Subscribe to this list if you are interested in ongoing development details regarding the **OpenSS7 Project**.

**‘openss7-test’**

The ‘openss7-test’ mailing list is for email exchange related to the testing of code under the **OpenSS7 Project**. This specifically relates to conformance testing, verification testing, interoperability testing and beta testing. Subscribe to this list if you are interested in participating in and receiving ongoing details of test activities under the **OpenSS7 Project**.

**‘openss7-bugs’**

The ‘openss7-bugs’ mailing list is specifically tailored to bug tracking. The mailing list takes a feed from the **OpenSS7 GNATS** bug tracking system and accepts posting of responses to bug reports, tracking and resolution. Subscribe to this list if you are interested in receiving detailed *OpenSS7* release code bug tracking information. This list is not archived; for historical information on problem reports, see our **GNATS databases**.

**‘openss7-updates’**

The ‘openss7-updates’ mailing list provides updates on **OpenSS7 Project** code releases and ongoing activities. Subscribers are not allowed to post to this list;



this list is for official **OpenSS7 Project** announcements only. Subscribe to this list if you are interested in receiving updates concerning official releases and activities of the **OpenSS7 Project**.

#### **‘openss7-streams’**

The ‘openss7-streams’ mailing list is for email exchange related to the *STREAMS* development projects under the **OpenSS7 Project**. This includes development requests, proposals, requests for comment or proposal. Subscribe to this list if you are interested in ongoing development details regarding the **OpenSS7 Project** *STREAMS* components.

#### **‘linux-streams’**

The ‘linux-streams’ mailing list is for mail exchange related to *Linux Fast-STREAMS* or *Linux STREAMS*. This includes patches, development requests, proposals, requests for comment or proposal. Subscribe to this list if you are interested in ongoing development details regarding the *STREAMS* for Linux components. This is the the new (September 2006) home of the ‘linux-streams’ list formerly of `gsync.escet.urjc.es`.

## **Spam**

To avoid spam being sent to the members of the *OpenSS7* mailing list(s), we have blocked mail from non-subscribers. Please subscribe to the mailing list before attempting to post to them. (Attempts to post when not subscribed get bounced.)

As an additional measure against spam, subscriber lists for all *OpenSS7* mailing lists are not accessible to non-subscribers; for most lists subscriber lists are only accessible to the list administrator. This keeps your mailing address from being picked off our website by bulk mailers.

## **Acceptable Use Policy**

It is acceptable to post professional and courteous messages regarding the *OpenSS7* package or any general information or questions concerning *STREAMS*, *SS7*, *SIGTRAN*, *SCTP* or telecommunications applications in general.

## **Large Attachments**

The mailing list is blocked from messages of greater than 40k. If you have attachments (patches, test programs, etc.) and you mail them to the list, it will bounce to the list administrator. If you are interested in making your patches, test programs, test results or other large attachments available to the members of the mailing list, state in the message that you would like them posted and the list administrator will place them in the mail archives.



# Quick Start Guide

## OpenSS7 Linux Native SCTP

Package sctp-0.2.27 was released under AGPLv3 2008-10-31.

The OpenSS7 Linux Native SCTP package is the OpenSS7 Linux Native (Sockets) Kernel implementation of *Stream Control Transmission Protocol (SCTP)*.

sctp-0.2.27 is the 0.2.27 version of a Linux Kernel native implementation of *RFC 2960* Stream Control Transmission Protocol. For information on using the implementation see the ‘[man/sctp.7](#)’ Linux manual page and look at the test programs in ‘[sctp-0.2.27/test/](#)’.

*Warning:* This is pre-release code. It is Beta but rather stable. Nevertheless, it is possible it will crash or lock your machine in some situations. Please remember that there is *NO WARRANTY* with this code and take appropriate precautions when attempting to run it.

This distribution is only currently applicable to *Linux* 2.4 kernels and was targeted at *ix86*, *x86\_64*, *ppc* and *ppc64* architectures, but should build and install for other architectures as well.

## Release

This is the sctp-0.2.27 package, released 2008-10-31. This ‘0.2.27’ release, and the latest version, can be obtained from the [download area](#) of [The OpenSS7 Project](#) website using a command such as:

```
$> wget http://www.openss7.org/tarballs/sctp-0.2.27.tar.bz2
```

The release is available as an [autoconf\(1\)](#) tarball, ‘[src.rpm](#)’ or ‘[dsc](#)’, as a set of binary ‘[rpm](#)’s or ‘[deb](#)’s, or as a [yum\(8\)](#) or [apt\(8\)](#) repository. See the [download page](#) for the [autoconf\(1\)](#) tarballs, ‘[src.rpm](#)’s, ‘[dsc](#)’s, or repository access instructions. See the [sctp package page](#) for tarballs, source and binary packages.

Please see the ‘[NEWS](#)’ file for release notes and history of user visible changes for the current version, and the ‘[ChangeLog](#)’ file for a more detailed history of implementation changes. The ‘[TODO](#)’ file lists features not yet implemented and other outstanding items.

Please see the ‘[INSTALL](#)’, ‘[INSTALL-sctp](#)’ and ‘[README-make](#)’, files (or see [Chapter 6 \[Installation\]](#), page 71) for installation instructions.

When working from [cvs\(1\)](#) or [git\(1\)](#), please see the ‘[README-cvs](#)’, file (or see [Section 6.2.8 \[Downloading from CVS\]](#), page 82). An abbreviated installation procedure that works for most applications appears below.

This release of the package is published strictly under Version 3 of the *GNU Affero Public License* which can be found in the file ‘[COPYING](#)’. Package specific licensing terms (if any) can be found in the file ‘[LICENSES](#)’. Please respect these licensing arrangements. If you are interested in different licensing terms, please contact the copyright holder, or [OpenSS7 Corporation](#) <[sales@openss7.com](mailto:sales@openss7.com)>.

See ‘[README-alpha](#)’ (if it exists) for alpha release information.

## Prerequisites

The quickest and easiest way to ensure that all prerequisites are met is to download and install this package from within the *OpenSS7 Master Package*, `openss7-0.9.2.G`, instead of separately.

Prerequisites for the OpenSS7 Linux Native SCTP package are as follows:

1. *Linux* distribution, somewhat *Linux Standards Base* compliant, with a 2.4 or 2.6 kernel and the appropriate tool chain for compiling out-of-tree kernel modules. Most recent *Linux* distributions are usable out of the box, but some development packages must be installed. For more information, see [Section 5.2 \[Compatibility\]](#), page 57.
  - A fairly LSB compliant GNU/Linux distribution.<sup>1</sup>
  - Linux 2.4 kernel (2.4.10 - 2.4.27).
  - glibc2 or better.
  - GNU groff (for man pages).<sup>2</sup>
  - GNU texinfo (for info files).

When configuring and building multiple *OpenSS7 Project* release packages, place all of the source packages (unpacked tarballs) at the same directory level and all build directories at the same directory level (e.g. all source packages under ‘/usr/src’).

When installing packages that install as kernel modules, it is necessary to have the correct kernel development package installed. For the following distributions, use the following commands:

```
Ubuntu:  $> apt-get install linux-headers
Debian:  $> apt-get install kernel-headers
Fedora:  $> yum install kernel-devel
```

You also need the same version of `gcc(1)` compiler with which the kernel was built. If it is not the default, add ‘`CC=kgcc`’ on the line after ‘`./configure`’, for example:

```
$> ../sctp-0.2.27/configure CC='gcc-3.4'
```

## Installation

The following commands will download, configure, build, check, install, validate, uninstall and remove the package:

```
$> wget http://www.openss7.org/tarballs/sctp-0.2.27.tar.bz2
$> tar -xjvf sctp-0.2.27.tar.bz2
$> mkdir build
$> pushd build
$> ../sctp-0.2.27/configure --enable-autotest
$> make
$> make check
$> sudo make install
$> sudo make installcheck
$> sudo make uninstall
$> popd
```

<sup>1</sup> See [Section 5.2.1 \[GNU/Linux Distributions\]](#), page 57, for more information.

<sup>2</sup> If you are using a Debian release, please make sure to install the groff extension package (‘`groff_ext`’), as it contains the `refer` or `grefer` commands necessary for including references in the manual pages.

```
$> sudo rm -rf build
$> rm -rf sctp-0.2.27
$> rm -f sctp-0.2.27.tar.bz2
```

If you have problems, try building with the logging targets instead. If the make of a logging target fails, an automatic problem report will be generated that can be mailed to [The OpenSS7 Project](#).<sup>3</sup> Installation steps using the logging targets proceed as follows:

```
$> wget http://www.openss7.org/tarballs/sctp-0.2.27.tar.bz2
$> tar -xjvf sctp-0.2.27.tar.bz2
$> mkdir build
$> pushd build
$> ../sctp-0.2.27/configure --enable-autotest
$> make compile.log
$> make check.log
$> sudo make install.log
$> sudo make installcheck.log
$> sudo make uninstall.log
$> popd
$> sudo rm -rf build
$> rm -rf sctp-0.2.27
$> rm -f sctp-0.2.27.tar.bz2
```

See [‘README-make’](#) for additional specialized make targets.

For custom applications, see the [‘INSTALL’](#) and [‘INSTALL-sctp’](#) files or the see [Chapter 6 \[Installation\]](#), [page 71](#), as listed below. If you encounter troubles, see [Chapter 7 \[Troubleshooting\]](#), [page 123](#), before issuing a bug report.

## Brief Installation Instructions

The OpenSS7 Linux Native SCTP package is available from the [downloads area of The OpenSS7 Project website](#) using a command such as:

```
$> wget http://www.openss7.org/tarballs/sctp-0.2.27.tar.bz2
```

Unpack the tarball using a command such as:

```
$> tar -xjvf sctp-0.2.27.tar.bz2
```

The tarball will unpack into the relative subdirectory named after the package name: `sctp-0.2.27`.

The package builds using the GNU `autoconf` utilities and the `configure` script. To build the package, we recommend using a separate `build` directory as follows:

```
$> mkdir build
$> cd build
$> ../sctp-0.2.27/configure
```

In general, the package configures and builds without adding any special options to the `configure` script. For general options to the `configure` script, see the GNU [‘INSTALL’](#) file in the distribution:

---

<sup>3</sup> Please see [Section 7.2 \[Problem Reports\]](#), [page 127](#), or the file [‘PROBLEMS’](#) in the release directory for more information on filing a proper *Problem Report*.

```
$> less ../sctp-0.2.27/INSTALL
```

For specific options to the ‘configure’ script, see the ‘**INSTALL-sctp**’ file in the distribution, or simply execute the configure script with the ‘--help’ option like so:

```
$> ../sctp-0.2.27/configure --help
```

After configuring the package, the package can be compiled simply by issuing the ‘make’ command:

```
$> make
```

Some specialized makefile targets exists, see the ‘**README-make**’ file in the distribution or simply invoke the ‘help’ target like so:

```
$> make help | less
```

After successfully building the package, the package can be checked by invoking the ‘check’ make target like so:

```
$> make check
```

After successfully checking the package, the package can be installed by invoking the ‘install’ make target (as root) like so:

```
$> sudo make install
```

The test suites that ship with the package can be invoked after the package has been installed by invoking the ‘installcheck’ target. This target can either be invoked as root, or as a normal user, like so:

```
$> make installcheck
```

(Note: you must add the ‘--enable-autotest’ flag to ‘configure’, above for the test suites to be invoked with ‘make installcheck’.)

The package can be cleanly removed by invoking the ‘uninstall’ target (as root):

```
$> sudo make uninstall
```

Then the build directory and tarball can be simply removed:

```
$> cd ..
$> rm -rf build
$> rm -rf sctp-0.2.27
$> rm -f sctp-0.2.27.tar.bz2
```

## Detailed Installation Instructions

More detailed installation instructions can be found in the **Chapter 6 [Installation]**, page 71, contained in the distribution in ‘text’, ‘info’, ‘html’ and ‘pdf’ formats:

```
$> cd ../sctp-0.2.27
$> less doc/manual/sctp.txt
$> lynx doc/manual/sctp.html
$> info doc/manual/sctp.info
$> xpdf doc/manual/sctp.pdf
```

The ‘text’ version of the manual is always available in the ‘**MANUAL**’ file in the release.

The current manual is also always available online from *The OpenSS7 Project* website at:

```
$> lynx http://www.openss7.org/sctp_manual.html
```

# 1 Introduction

This manual documents the design, implementation, installation, operation and future development schedule of the *OpenSS7 Linux Native SCTP* package.

## 1.1 Overview

This manual documents the design, implementation, installation, operation and future development of the *OpenSS7 Linux Native SCTP* package.

The OpenSS7 Linux Native SCTP package is an Open Linux SCTP package for Linux. It includes development tools, header files and manual pages for SCTP.

The OpenSS7 Linux Native SCTP package is essential to the development and support of SCTP networking modules and drivers and provides a fundamental set of header files and manual pages for such development.

## 1.2 Organization of this Manual

This manual is organized (loosely) into several sections as follows:

Chapter 1 [Introduction], page 13.	This introduction
Chapter 2 [Objective], page 15.	Objective of the package
Chapter 3 [Reference], page 17.	Contents of the package
Chapter 4 [Conformance], page 55.	Conformance of the package
Chapter 5 [Releases], page 57.	Releases of the package
Chapter 6 [Installation], page 71.	Installation of the package
Chapter 7 [Troubleshooting], page 123.	Troubleshooting of the package

## 1.3 Conventions and Definitions

This manual uses *texinfo* typographic conventions.





## 2 Objective



## 3 Reference

### 3.1 Files

*SCTP* creates the following kernel modules files in the kernel modules directory, `/lib/modules/2.4.20-28.7/`:<sup>1</sup>

`modules.sctp`

*SCTP* installs the following kernel module files in the kernel modules directory, `/lib/modules/2.4.20-28.7/kernel/net/ipv4/`:<sup>2</sup>

`sctp.o` This kernel module contains the SCTP protocol module.

*SCTP* installs the following header files in the system include directory, `/usr/include/netinet/`:

`sctp.h` This file contains SCTP and socket option definitions.

*SCTP* installs the following test programs in the system libexec directory, `/usr/libexec/sctp/`:<sup>3</sup>

`send-pr`

`send-pr.config`

The `send-pr` stand-alone shell script can be used for the automatic generation of problem reports for the *OpenSS7 Linux Native SCTP* package. The `send-pr.config` file provides localized definitions used by the `send-pr` program. For more information on problem reports, See [Section 7.2 \[Problem Reports\]](#), page 127, and, in particular, See [Section 7.2.4 \[Stand Alone Problem Reports\]](#), page 130.

`test-sctp-dc`

This binary contains a test program for delay test client for SCTP.

`test-sctp-ds`

This binary contains a test program for delay test server for SCTP.

`test-sctp-sc`

This binary contains a test program for socket test client for SCTP.

`test-sctp-ss`

This binary contains a test program for socket test server for SCTP.

`test-sctp-tc`

This binary contains a test program for throughput test client for SCTP.

`test-sctp-ts`

This binary contains a test program for throughput test server for SCTP.

`test-sctpc`

This binary contains a test program for a general testing test client for SCTP.

<sup>1</sup> The kernel version '2.4.20-28.7' is just an example. For the running kernel, `uname -r` is expected.

<sup>2</sup> The kernel version '2.4.20-28.7' is just an example. For the running kernel, `uname -r` is expected.

<sup>3</sup> Note that on some systems, `/usr/libexec` does not exist, and `/usr/lib` is used instead.

- `'test-sctps'`  
This binary contains a test program for a general testing test server for SCTP.
- `'test-tcp-dc'`  
This binary contains a test program for delay test client for TCP.
- `'test-tcp-ds'`  
This binary contains a test program for delay test server for TCP.
- `'test-tcp-tc'`  
This binary contains a test program for throughput test client for TCP.
- `'test-tcp-ts'`  
This binary contains a test program for throughput test server for TCP.
- `'test-tcpc'`  
This binary contains a test program for a general testing test client for TCP.
- `'test-tcps'`  
This binary contains a test program for a general testing test server for TCP.
- `'test-udpc'`  
This binary contains a test program for a general testing test client for UDP.
- `'test-udps'`  
This binary contains a test program for a general testing test server for UDP.
- `'testsuite'`
- `'atlocal'` The `testsuite` stand-alone shell script invokes test cases in the test programs above as compiled into a comprehensive regression, troubleshooting and validation test suite for the *OpenSS7 Linux Native SCTP* drivers. The `'atlocal'` file provides localized definitions used by the `testsuite` program. For more information on test suites, See [Section 7.1 \[Test Suites\]](#), page 123, and, in particular, See [Section 7.1.2.1 \[Running Test Suites\]](#), page 127.

*SCTP* installs the following init scripts in the system init directory, `'/etc/rc.d/init.d/'` (non-Debian) or `'/etc/init.d/'` (Debian):

- `'sctp'` This is the name of the system init script on non-Debian based systems.
- `'sctp.sh'` This is the name of the system init script on Debian based systems.

*SCTP* installs the following system configuration files in the configuration directory, `'/etc/'`:

- `'sctp.conf'`  
This file provided configuration information for any system controls affected by the `'SCTP'` package.
- `'modutils/sctp'`  
This file provides module definitions and demand loading aliases for the `'sctp'` package. This file is really only applicable to older 2.4 kernels.

*SCTP* installs the following system configuration file in the system configuration directory, `'/etc/sysconfig/'` (non-Debian) or `'/etc/default/'` (Debian):

`'sctp'` This file provides system configuration information used by init scripts for the 'SCTP' package. Some options of init script execution can be controlled by this file.

*SCTP* installs the following info files in the system info directory, `'/usr/share/info/':`

`'sctp.info'`

`'sctp.info-1'`

`'sctp.info-2'`

These files contain this manual in *GNU info* format.

*SCTP* installs the following manual page macros and reference database files in the system man directory, `'/usr/share/man/':`<sup>4</sup>

`'sctp.macros'`

This file contains manual page macro definitions included by the manual pages included in the package.

`'sctp.refs'`

This file contains a reference database referenced by the manual pages included in the package.

*SCTP* installs the following manual pages in the system man directory, `'/usr/share/man/man7/':`

`'sctp.7'` This is the SCTP manual page.

*SCTP* installs the following manual pages in the system man directory, `'/usr/share/man/man8/':`

`'test-sctp-dc.8'`

`'test-sctp-ds.8'`

`'test-sctp-sc.8'`

`'test-sctp-ss.8'`

`'test-sctp-tc.8'`

`'test-sctp-ts.8'`

`'test-sctpc.8'`

`'test-sctps.8'`

`'test-tcp-dc.8'`

`'test-tcp-ds.8'`

`'test-tcp-tc.8'`

`'test-tcp-ts.8'`

`'test-tcpc.8'`

`'test-tcps.8'`

`'test-udpc.8'`

`'test-udps.8'`

These are the test program manual pages.

---

<sup>4</sup> Note that macro and reference database files are not installed if the package is configured for cooked manpages.

## 3.2 Kernel Modules

### 3.2.1 Stream Control Transmission Protocol (SCTP) Module (sctp)

#### Licensing

The ‘sctp’ module was originally written by Brian F. G. Bidulock and is licensed under the GNU Affero General Public License Version 3 See [\[GNU Affero General Public License\]](#), page 134.

## 3.3 Libraries

## 3.4 Utilities

### 3.4.1 test-sctp-dc

Note that test-sctp-dc is maintained as a manual page, [test-sctp-dc\(8\)](#).

### 3.4.2 test-sctp-ds

Note that test-sctp-ds is maintained as a manual page, [test-sctp-ds\(8\)](#).

### 3.4.3 test-sctp-sc

Note that test-sctp-sc is maintained as a manual page, [test-sctp-sc\(8\)](#).

### 3.4.4 test-sctp-ss

Note that test-sctp-ss is maintained as a manual page, [test-sctp-ss\(8\)](#).

### 3.4.5 test-sctp-tc

Note that test-sctp-tc is maintained as a manual page, [test-sctp-tc\(8\)](#).

### 3.4.6 test-sctp-ts

Note that test-sctp-ts is maintained as a manual page, [test-sctp-ts\(8\)](#).

### 3.4.7 test-sctpc

Note that test-sctpc is maintained as a manual page, [test-sctpc\(8\)](#).

### 3.4.8 test-sctps

Note that test-sctps is maintained as a manual page, [test-sctps\(8\)](#).

### 3.4.9 test-tcp-dc

Note that test-tcp-dc is maintained as a manual page, [test-tcp-dc\(8\)](#).

### 3.4.10 test-tcp-ds

Note that test-tcp-ds is maintained as a manual page, [test-tcp-ds\(8\)](#).

### 3.4.11 test-tcp-tc

Note that test-tcp-tc is maintained as a manual page, [test-tcp-tc\(8\)](#).

### 3.4.12 test-tcp-ts

Note that `test-tcp-ts` is maintained as a manual page, `test-tcp-ts(8)`.

### 3.4.13 test-tcpc

Note that `test-tcpc` is maintained as a manual page, `test-tcpc(8)`.

### 3.4.14 test-tcps

Note that `test-tcps` is maintained as a manual page, `test-tcps(8)`.

### 3.4.15 test-udpc

Note that `test-udpc` is maintained as a manual page, `test-udpc(8)`.

### 3.4.16 test-udps

Note that `test-udps` is maintained as a manual page, `test-udps(8)`.

## 3.5 Development

*OpenSS7 Linux Native SCTP* does not currently install any libraries. The socket library normally available under *Linux* in ‘libc’ are sufficient. *OpenSS7 Linux Native SCTP* does, however, install the ‘/usr/include/netinet/sctp.h’ header file for development of applications programs that use the ‘sctp’ kernel module.

## 3.6 SCTP Reference Page

### NAME

sctp - Stream Control Transmission Protocol (SCTP).

### SYNOPSIS

```
#include <sys/socket.h>
#include <netinet/in.h>
#include <netinet/sctp.h>

sctp_socket = socket(PF_INET, SOCK_SEQPACKET, 0);
sctp_socket = socket(PF_INET, SOCK_SEQPACKET, IPPROTO_SCTP);
sctp_socket = socket(PF_INET, SOCK_STREAM, IPPROTO_SCTP);
sctp_socket = socket(PF_INET, SOCK_RDM, 0IPPROTO_SCTP
```

### DESCRIPTION

*SCTP* is an implementation of the SCTP (Stream Control Transmission Protocol) defined in *RFC 2960*. *SCTP* provides reliable delivery of ordered or unordered packets over a full duplex connection between two ‘SOCK\_SEQPACKET’ sockets on top of `ip(7)`. *SCTP* can guarantee that the data arrives in order on a stream, if requested, and retransmits lost packets. It generates and checks a per packet checksum to catch transmission errors.

*SCTP* provides the following socket types:

**‘SOCK\_SEQPACKET’**

A standard ‘SOCK\_SEQPACKET’ socket that preserves message boundaries, Nagles at the association level, and provides ordered and unordered reliable and partial reliable, acknowledged and unacknowledged delivery on multiple streams.

**‘SOCK\_STREAM’**

A **tcp(7)** compatible ‘SOCK\_STREAM’ socket that does not preserve message boundaries, Nagles at the stream level, and provides ordered and out-of-band unacknowledged delivery on a single stream. This is an optional capability of *SCTP* which provides for maximum compatibility with applications written for **tcp(7)**. This socket type is available when *SCTP* is compiled with the kernel configuration parameter ‘CONFIG\_SCTP\_TCP\_COMPATIBLE’ set.

**‘SOCK\_RDM’**

An **udp(7)** compatible ‘SOCK\_RDM’ socket that preserves message boundaries, does not Nagle, and provides only unordered but reliable or partially reliable delivery on multiple streams. This is an optional capability of *SCTP* which provides for maximum compatibility with applications written for **udp(7)**. This socket type is available when *SCTP* is compiled with the kernel configuration parameter ‘CONFIG\_SCTP\_UDP\_COMPATIBLE’ set.

## Connection Establishment

A fresh *SCTP* socket has no remote or local address and is not fully specified. To create an outgoing *SCTP* association use **connect(2)** to establish an association with another *SCTP* endpoint. To receive incoming associations **bind(2)** the socket first to a number of local addresses and a port and then call **listen(2)** to put the socket into listening state. Then a new socket for each incoming association can be accepted using **accept(2)**. A socket that has had **accept(2)** or **connect(2)** successfully called on it is fully specified and may transmit data. Data cannot be transmitted on listening or not yet connected sockets.

*SCTP* supports large windows to support links with high latency or bandwidth. Large *SCTP* windows can be used by increasing the send and receive buffer sizes. They can be set globally with the ‘net.core.wmem\_default’ and ‘net.core.rmem\_default’ system controls, or on individual sockets by using the ‘SO\_SNDBUF’ and ‘SO\_RCVBUF’ socket options. The maximum sizes for socket buffers are limited by the ‘net.core.wmem\_max’ and ‘net.core.rmem\_max’ system controls. See **socket(7)** for more information.

## Sending Data

When sending data, the specific destination address within the association to which to send the data can be specified by providing a valid destination address as an argument to **sendto(2)** or **sendmsg(2)**. Data sent with **send(2)** or **write(2)** will use *SCTP*’s destination transport address selection policies for transmission and retransmission to single- and multi-homed hosts. The stream upon which to send the data can also be set with the ‘SCTP\_SID’ socket option on a socket basis with **setsockopt(2)** or on a per-message basis with ‘SCTP\_SID’ control message to **sendmsg(2)**. In addition, the **ip(7)** ‘IP\_PKTINFO’ option can be used with **sendmsg(2)** to specify the interface, first-hop destination address and source address to be used in the outbound packet on ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets. IP options can also be specified for the outbound packet with the **ip(7)** ‘IP\_OPTIONS’ or ‘IP\_RETOPTS’ control messages to **sendmsg(2)**.



For ‘SOCK\_SEQPACKET’ socket, send operations may also use the ‘MSG\_MORE’ flag when sending with `send(2)`, `sendto(2)` or `sendmsg(2)` to indicate that the next write operation will provide additional data belonging to the same packet. ‘SOCK\_STREAM’ sockets do not support send options and do not return the ‘MSG\_TRUNC’ flag on send operations.

If a ‘SOCK\_SEQPACKET’ or ‘SOCK\_STREAM’ socket does not have sufficient room to buffer the sent data, it buffers what it can and returns the amount of user data buffered. ‘SOCK\_RDM’ sockets wait for sufficient room to buffer the entire sent packet before returning. ‘SOCK\_SEQPACKET’ and ‘SOCK\_STREAM’ sockets will segment large data writes in to smaller segments for delivery to the peer.

*SCTP* provides a mechanism for receiving positive and negative acknowledgements of sent data on ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets. When the socket option ‘SCTP\_DISPOSITION’ is set to ‘SCTP\_DISPOSITION\_ACKED’, or when data is sent using the ‘MSG\_CONFIRM’ flag to `send(2)`, `sendto(2)` or `sendmsg(2)`, message confirmation or delivery failures can be received by passing the ‘MSG\_CONFIRM’ flag to `recv(2)`, `recvfrom(2)` or `recvmsg(2)`. This mechanism also provides for retrieval and disposition of undelivered messages after the association has aborted or shut down, but before a call to `close(2)`.

## Receiving Data

For ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets, all receive operations return only one packet, or a portion of one packet. When the packet is smaller than the passed buffer only that much data is returned, when it is larger the packet is truncated and the ‘MSG\_TRUNC’ flag is set for ‘SOCK\_RDM’ sockets. Subsequent `recv` or `read(2)`, or a subsequent `recvfrom(2)` or `recvmsg(2)` for the same stream will return the remainder of the packet for ‘SOCK\_SEQPACKET’ sockets. ‘SOCK\_SEQPACKET’ sockets also return the ‘MSG\_EOR’ flag when the end of the packet has been received successfully. For ‘SOCK\_STREAM’ sockets, all receive operations return only the amount of data available on the current stream. ‘MSG\_TRUNC’ and ‘MSG\_EOR’ are never set for ‘SOCK\_STREAM’ sockets.

IP options may be sent or received using the socket options described in `ip(7)`. They are only processed by the kernel when the appropriate system control is enabled (but still passed to the user even when it is turned off). See `ip(7)`.

When the ‘MSG\_DONTROUTE’ flag is set on sending, the destination address must refer to a local interface address and the packet is only sent to that interface.

*SCTP* fragments a packet when its total length exceeds the association MTU (Maximum Transmission Unit). A more network friendly alternative is to use path MTU discovery as described in the ‘IP\_PMTU\_DISCOVER’ section of `ip(7)`.

*SCTP* supports urgent data similar to `tcp(7)`. Urgent data is used to signal the receiver that some important message is part of the data stream and that it should be processed as soon as possible. Urgent data is always sent out of order. To send urgent (or out of order) data specify the ‘MSG\_OOB’ option to `send(2)`, `sendto(2)`, or `sendmsg(2)`. When urgent data is received, the kernel sends a ‘SIGURG’ signal to the reading process or the process or process group that has been set for the socket using the ‘FIOCSPGRP’ or ‘FIOCSETOWN’ I/O controls. When the ‘SO\_OOBINLINE’ socket option is enabled, urgent data is put into the normal data stream (and can be tested for by the ‘SIOCATMARK’ I/O control), otherwise it can only be received when the ‘MSG\_OOB’ flag is set for `recvmsg(2)`.

## ADDRESS FORMATS

*SCTP* is built on top of **IP** (see [ip\(7\)](#)). The address formats defined by [ip\(7\)](#) apply to *SCTP*. *SCTP* uses the IPv4 **sockaddr\_in** address format described in [ip\(7\)](#).

*SCTP* supports multiple-stream point-to-point communication within multi-homed associations; broadcasting and multi-casting are not supported.

In addition to normal IP addressing, *SCTP* provides extensions on the [bind\(2\)](#), [accept\(2\)](#), [connect\(2\)](#), [getsockname\(2\)](#), and [getpeername\(2\)](#) system calls. These functions normally take or return a single **sockaddr\_in** as an address argument. When used in conjunction with an *SCTP* socket on or to a multi-homed host, these calls will accept or return an array of **sockaddr\_in** structures. The number of addresses in the structure is indicated by the length of the structure and the protocol family of the socket. *SCTP* will only support one port number being specified in the address list, and each **sockaddr\_in** structure in the list must contain the same *sin\_port*. (Note: Linux uses 'MAX\_SOCK\_ADDR' as a maximum size of the socket address length. This is currently only 128 bytes or eight (8) **sockaddr\_in** structures. Eight (8) addresses should be sufficient for most applications.)

Multiple addresses provided to the [bind\(2\)](#) system call will be interpreted as multiple local addresses to provide to the peer at connection time as well as the local address/port combinations upon which a listening socket will accept incoming associations. A call to [accept\(2\)](#) requesting the source address of the peer will return multiple transport addresses if the connecting peer is multi-homed. Multiple addresses provided to the [connect\(2\)](#) system call will be interpreted as multiple destination address/port combinations to which to attempt to form an association. The [getpeername\(2\)](#) system call returns the list of destination address/port combinations to which the socket is connected. The [getsockname\(2\)](#) system call returns the list of local address/port combinations to which the socket is bound.

### [getsockname\(2\)](#)

A call to [getsockname\(2\)](#) can provide multiple bound transport addresses for a multi-homed host when the socket is bound to multiple addresses or 'INADDR\_ANY' using [bind\(2\)](#). The first address in the list is the primary address to which the socket is bound. This is the first address that will be attempted to be used as a source address when sending an INIT chunk to the *SCTP* peer as a result of a call to [connect\(2\)](#). Otherwise, the order of the addresses has no significance. When the socket is not bound to any address, the call to [getsockname\(2\)](#) returns a socket address with address family 'AF\_UNSPEC'.

As a result of binding to 'INADDR\_ANY' or the **ADD-IP** extension, subsequent calls to [getsockname\(2\)](#) may return different addresses depending on the state of the connection or resulting from the exchange of ASCONF control chunks. This list of transport addresses returned by [getsockname\(2\)](#) represents the current list of local transport addresses bound to the endpoint. When the connection is multi-homed or supports **ADD-IP**, this behaviour is different from [tcp\(7\)](#) and other connection-oriented protocols, whose bound address does not change during the lifespan of a connection.

### [getpeername\(2\)](#)

A call to [getpeername\(2\)](#) can provide multiple peer transport addresses for a multi-homed peer when the socket is connecting or connected to multiple addresses using [connect\(2\)](#). The first address is always the current primary des-

termination transport address. The current primary destination transport address is the address to which all messages will be sent in the absence of congestion or failure.

As a result of connecting to multiple transport addresses using `connect(2)` or the **ADD-IP** extension, the membership of the list of transport addresses returned by `getpeername(2)` may change due to the state of the socket or resulting from the exchange of ASCONF control chunks. When the *SCTP* connection is multi-homed or supports **ADD-IP**, this behaviour is different from `tcp(7)` and other connection-oriented protocol, whose peer address does not change during the lifespan of a connection.

## SOCKET CALLS

Socket calls for ‘SOCK\_STREAM’, ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets are different in some respects (addressing and options) than their `tcp(7)` or `udp(7)` counterparts. These differences are described here. For common behaviour, please see the indicated manual page in Section 2.

**bind(2)** A call to `bind(2)` can provide multiple address if the host is multi-homed. Binds to ‘INADDR\_ANY’ will result in a binding to all of the local transport addresses belonging to the host that do not cause a conflict at the time that a connection is formed. As with other sockets, the local port number is assigned at the time that `bind(2)` is called.

As with other sockets, binding to a socket address with address family ‘AF\_UNSPEC’ will cause the socket to be unbound from all transport addresses.

Consistent with `tcp(7)`, *SCTP* supports binding of multiple sockets to the same transport address providing that the socket option ‘SO\_REUSEADDR’ (see `socket(7)`) is set on the sockets and that no sockets have executed `listen(2)` bound to the same transport address.

**accept(2)** A call to `accept(2)` requesting the peer address of the connection will return multiple transport addresses if the connecting peer is multi-homed. The first transport address in the list is the primary transport address of the connecting peer. The primary transport address is the address upon which the INIT message was received. Otherwise, the `accept(2)` operation is unchanged.

**connect(2)** A call to `connect(2)` can provide multiple destination transport addresses if the peer host is multi-homed. If an INIT chunk sent to the first destination transport address is not acknowledged, the next INIT chunk will be sent to the next address in the list. This will occur until an acknowledgement is received from one of the addresses or the connection attempt times out. Each address will be retried `sctp_max_init_retries` times before the connection process is considered to have timed out. Broadcast and multicast addresses are permitted for the call to `connect(2)` but will not form an endpoint address in the association. This feature permits fast and reliable initialization of associations.

As with other connection-oriented sockets, connecting to a socket address with address family ‘AF\_UNSPEC’ will cause a socket engaged in active connections to be disconnected.

```
read(2)
recv(2)
recvfrom(2)
recvmsg(2)
```

*SCTP* preserves message boundaries on read for ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets. Message boundaries are never preserved for ‘SOCK\_STREAM’ sockets.

The following message flags to, or returned from, `recv(2)`, `recvfrom(2)` and `recvmsg(2)` have special interpretations for *SCTP*:

‘MSG\_OOB’ *SCTP* supports the return of the ‘MSG\_OOB’ flag from `recv(2)`, `recvfrom(2)` and `recvmsg(2)`. Data read with the ‘MSG\_OOB’ flag set indicates that the data was received on the specified *SCTP* stream with the Unordered bit set. Operation is similar to `tcp(7)`.

‘MSG\_EOR’ For ‘SOCK\_SEQPACKET’ sockets, the ‘MSG\_EOR’ flag returned from `recv(2)`, `recvfrom(2)` or `recvmsg(2)` indicates that the data read has been read to the end of a record. The ‘MSG\_EOR’ flag is not used for ‘SOCK\_STREAM’ or ‘SOCK\_RDM’ sockets.

‘MSG\_TRUNC’

*SCTP* supports the use of the ‘MSG\_TRUNC’ flag to `recv(2)`, `recvfrom(2)` and `recvmsg(2)`. Data read with the ‘MSG\_TRUNC’ flag set will return the number of bytes available in the packet rather than the number of bytes read.

When the ‘MSG\_TRUNC’ flag is returned from `recv(2)`, `recvfrom(2)` and `recvmsg(2)`, it indicates that the record was truncated. ‘MSG\_TRUNC’ will only be returned on ‘SOCK\_RDM’ sockets. ‘MSG\_TRUNC’ is never set on return for ‘SOCK\_STREAM’ and ‘SOCK\_SEQPACKET’ sockets.

‘MSG\_CONFIRM’

*SCTP* supports the use of the ‘MSG\_CONFIRM’ flag to `recv(2)`, `recvfrom(2)` and `recvmsg(2)`. Data read with the ‘MSG\_CONFIRM’ flag set will return messages receipt acknowledgements as well as messages which have exceeded their life-times, messages which have been dropped by **PR-SCTP**, and messages held for retrieval after abort or shutdown.

When the ‘MSG\_CONFIRM’ flag is returned from `recv(2)`, `recvfrom(2)` and `recvmsg(2)`, it indicates that the read data represents data that was confirmed as acknowledged by the peer. See also ‘SCTP\_DISPOSITION’ under **SOCKET OPTIONS**.

Other message flags have the same interpretation as described in `recv(2)`, `recvfrom(2)` and `recvmsg(2)`.

`write(2)`  
`send(2)`  
`sendto(2)`  
`sendmsg(2)`

*SCTP* preserves message boundaries on write for ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets. Message boundaries are never preserved for ‘SOCK\_STREAM’ sockets.

The following message flags to `send(2)`, `sendto(2)` and `sendmsg(2)` have special interpretations for *SCTP*:

‘MSG\_OOB’ *SCTP* supports the use of the ‘MSG\_OOB’ flag to `send(2)`, `sendto(2)` and `sendmsg(2)`. Data written with the ‘MSG\_OOB’ flag set indicates that the data is to be sent on the specified *SCTP* stream with the Unordered bit set.

‘MSG\_MORE’ *SCTP* supports the use of the ‘MSG\_MORE’ flag to `send(2)`, `sendto(2)` and `sendmsg(2)`. Data written with the ‘MSG\_MORE’ flag set indicates that the data of a subsequent send operation on the same stream contains additional data belonging to the same record. Use of the ‘MSG\_MORE’ flag is only supported for ‘SOCK\_SEQPACKET’ sockets. Data written with `write(2)` is assumed to contain an entire record.

‘MSG\_PROBE’ *SCTP* supports the use of the ‘MSG\_PROBE’ flag to `send(2)`, `sendto(2)` and `sendmsg(2)`. Data written with the ‘MSG\_PROBE’ flag set indicates that the data is to be used to fill out the heartbeat data in a HEARTBEAT chunk and request that *SCTP* send a HEARTBEAT to the peer. Use of the ‘MSG\_PROBE’ flag is supported on all socket types.

‘MSG\_EOF’ *SCTP* supports the use of the ‘MSG\_EOF’ flag to `send(2)`, `sendto(2)` and `sendmsg(2)`. Data written with the ‘MSG\_EOF’ flag will be the last data sent on the association and then a shutdown initiated.

‘MSG\_CONFIRM’ *SCTP* supports the use of the ‘MSG\_CONFIRM’ flag to `send(2)`, `sendto(2)` and `sendmsg(2)` for ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets. Records or packets written with the ‘MSG\_CONFIRM’ flag set are marked for acknowledgement. Acknowledgements can be received with the ‘MSG\_CONFIRM’ flag to `recv(2)`, `recvfrom(2)` and `recvmsg(2)` as described above. See also ‘SCTP\_DISPOSITION’ under **SOCKET OPTIONS**.

Other message flags have the same interpretation as described in `send(2)`, `sendto(2)` and `sendmsg(2)`.

`shutdown(2)`

`close(2)` *SCTP* supports orderly release using `shutdown(2)` and both orderly and abortive release using `close(2)` similar to `tcp(7)`.

When the ‘SHUT\_RD’ flag is given to `shutdown(2)`, receive will be disabled locally and further receive operations on the socket will fail. When the ‘SHUT\_WR’ or ‘SHUT\_RDWR’ flag is given to `shutdown(2)`, orderly release will be initiated and further send operations on the socket will fail.

Distinctions between orderly and abortive release when `close(2)` or `exit(2)` are called are similar to that of `tcp(7)`.

## FEATURES

*SCTP* provides the following basic features:

- Compiled into kernel or as a loadable module.
- Standards support for socket type ‘SOCK\_SEQPACKET’.
- Supports a partial packet delivery interface on all packets. ‘MSG\_TRUNC’ set when receiving a packet does not discard the remainder of the packet but permits subsequent reads to read the remainder of the packet.
- Silly Window Syndrome (SWS) avoidance per [RFC 1122](#). Section 4.2.3.2 and 4.2.3.3 as recommended in the *SCTP Implementor’s Guide*.
- Nagle algorithm per [RFC 896](#) and [RFC 1122](#). Section 4.2.3 with delayed ACK modifications presented by Minshall in [<draft-minshall-tsvwg-nagle-01.txt>](#).
- Message disposition and retrieval on connection shutdown or abort, lifetime expiry, and receipt confirmation acknowledgement.
- Support for hardware assisted checksum for drivers which support ‘NETIF\_F\_HW\_CSUM’.
- Support for hardware assisted scatter/gather and fragmentation for devices which support ‘NETIF\_F\_SG’ and ‘NETIF\_F\_FRAGLIST’.
- For security of HMACs, *SCTP* includes a re-keying algorithm for secret keys that rotates secret keys after the key’s first cookie lifetime to provide for maximum security for HMACs.
- High performance routing algorithm alters multi-homed routes on a per-packet basis.
- Wide range of settings for timers and protocol parameters permitting fast (average 5ms with 100Hz tick clock; 0.5ms with 1000Hz tick clock) fail-over between failed destination addresses on high-speed networks.
- Deferral of checksum calculation until after socket lookup for protection from software checksum DoS attacks.
- Support for the changes and modifications in the *SCTP Implementers Guide* [<rfc4460.txt>](#). (See **CAVEATS**.).

*SCTP* provides the following added features:

- A `tcp(7)`-compatible mode for sockets of type ‘SOCK\_STREAM’ when *SCTP* is compiled with kernel configuration parameter ‘CONFIG\_SCTP\_TCP\_COMPATIBLE’ set.
- A `udp(7)`-compatible mode for sockets of type ‘SOCK\_RDM’ when *SCTP* is compiled with kernel configuration parameter ‘CONFIG\_SCTP\_UDP\_COMPATIBLE’ set.



- Support for both Adler32 and CRC-32c checksums with automatic detection of checksum on receive when *SCTP* is compiled with kernel configuration parameters ‘CONFIG\_SCTP\_ADLER\_32’ or ‘CONFIG\_SCTP\_CRC\_32C’ set.
- Support for multiple HMAC types when compiled with kernel configuration parameters ‘CONFIG\_SCTP\_HMAC\_SHA\_1’ or ‘CONFIG\_SCTP\_HMAC\_MD5’.
- Support for [RFC 2960](#) Appendix A and [RFC 3168](#) compatible Explicit Congestion Notification when compiled with kernel configuration parameter ‘CONFIG\_SCTP\_ECN’ set.
- Support for [<draft-ietf-tsvwg-addip-sctp-08.txt>](#) Adaptation Layer Indication when compiled with kernel configuration parameter ‘CONFIG\_SCTP\_ADAPTATION\_LAYER\_INFO’ set.
- Support for **ADD-IP** extensions from [<draft-ietf-tsvwg-addip-sctp-08.txt>](#) when compiled with kernel configuration parameter ‘CONFIG\_SCTP\_ADD\_IP’ set.
- Support for **PR-SCTP** extensions as described in [RFC 3758](#) when compiled with kernel configuration parameter ‘CONFIG\_SCTP\_PARTIAL\_RELIABILITY’ set.

## SYSCTLs

*SCTP* provides and supports a number of system controls that can be accessed using the ‘/proc/sys/net/ipv4/\*’ files, with the `sysctl(2)` interface or using `sysctl(8)`.

*SCTP* supports all `socket(7)` system controls `rmem_default`, `rmem_max`, `wmem_default`, `wmem_max`, `msg_cost`, `msg_burst`, `netdev_max_backlog` and `optmem_max` in the normal fashion. For more information, see `socket(7)`.

*SCTP* supports `ip(7)` system controls `ip_default_ttl`, `ip_dynaddr`, `ip_autoconfig`, `ip_local_port_range` and `ip_no_pmtu_disc` in the normal fashion. `ip(7)` system controls `ip_forward`, `ipfrag_high_thresh`, `ipfrag_low_thresh` and `ip_always_defrag` are not applicable to *SCTP*. For more information, see `ip(7)`.

The following *SCTP* specific system controls are provided by *SCTP*:

### sctp\_csум\_type

Defines the default checksum algorithm that will be used when checksumming packets associated with a socket. Valid values are as follows:

#### SCTP\_CSUM\_ADLER\_32

for the [RFC 2960](#) Appendix B algorithm. To set this value, *SCTP* must have been compiled with ‘CONFIG\_SCTP\_ADLER\_32’ or without ‘CONFIG\_SCTP\_CRC\_32C’. When computed in software, Adler 32 checksum algorithm is more amenable to Van Jacobson partial checksum and copy from user approaches and exhibits higher performance than CRC-32c.

#### SCTP\_CSUM\_CRC\_32C

for the [RFC 3309](#) CRC-32c checksum algorithm. To set this value, *SCTP* must have been compiled with ‘CONFIG\_SCTP\_CRC\_32C’. When computed in software, CRC-32c checksum is more processor intensive than Adler-32.

As [RFC 3309](#) has been approved and replaces [RFC 2960](#) checksum algorithm, the default value for this system control is now ‘SCTP\_CSUM\_CRC\_32C’. This

value may also be set for a given socket using the ‘SCTP\_CKSUM\_TYPE’ socket option as described in **SOCKET OPTIONS**. This system control will soon be deprecated, should always be set to ‘SCTP\_CSUM\_CRC\_32C’ and should not be used by portable programs.

#### sctp\_mac\_type

Defines the default MAC (Message Authentication Code) type that will be used when signing cookies in INIT-ACK messages. Valid values are:

##### SCTP\_HMAC\_SHA\_1

for the *FIPS 180-1 Secure Hash Algorithm* SHA-1 HMAC. SHA-1 performs well on big-endian machines. This option setting is only supported if *SCTP* was compiled with the kernel configuration parameter ‘CONFIG\_SCTP\_HMAC\_SHA1’ set.

##### SCTP\_HMAC\_MD5

for the **RFC 1321** *Message Digest 5* HMAC. MD5 performs well on little-endian machines. This option setting is only supported if *SCTP* was compiled with the kernel configuration parameter ‘CONFIG\_SCTP\_HMAC\_MD5’ set.

##### SCTP\_HMAC\_NONE

for no secure signature. Not signing the cookie performs well on all machines; however, this option should only be used if some other mechanism provides security (such as IPsec) or the system is closed and trusted. This option setting is always supported.

There is no required or recommended value in **RFC 2960**. The default value is (in priority of availability) ‘SCTP\_HMAC\_MD5’, ‘SCTP\_HMAC\_SHA\_1’, then ‘SCTP\_HMAC\_NONE’. This system control defines the default for new sockets. The MAC for a given socket can be changed before the call to **listen(2)**, or before receiving a passive connection attempt, with the socket option ‘SCTP\_MAC\_TYPE’ as described under **SOCKET OPTIONS**.

#### sctp\_valid\_cookie\_life

Defines the default time interval (in milliseconds) in conjunction with **sctp\_cookie\_inc** beyond which a COOKIE-ECHO received with a cookie sent in an INIT-ACK will not longer be accepted. For *SCTP*, this also limits the default maximum time interval for which the HMAC secret key for the cookie will be valid. Valid values are zero (0) or greater (**INT\_MAX**). Values of zero (0) will be converted to a Linux system clock tick (1000/HZ milliseconds). The default value is the value recommended in **RFC 2960** (60,000 milliseconds). This system control defines the default for new sockets. The value for a given socket can be changed with the socket option ‘SCTP\_COOKIE\_LIFE’ before a call to **listen(2)**, or before receiving passive connection attempt, as described under **SOCKET OPTIONS**.

Reducing this value will increase the chances that passive connection attempts will fail due to expired cookies. Increasing the value will reduce the overall security of the system by permitting attackers and increased interval to crack HMACs and guess verification tags. This value may be adjusted in



conjunction with **sctp\_cookie\_inc** to meet most objectives for successful passive connection attempts with the best security afforded by smaller values of **sctp\_valid\_cookie\_life**.

Unfortunately the ‘SCTP\_COOKIE\_LIFE’ and ‘SCTP\_COOKIE\_INC’ must be adjusted to accommodate the slowest peer on the slowest connection. The default setting is adequate for Internet applications.

#### **sctp\_cookie\_inc**

Defines the default time increment (in milliseconds) that will be added to the lifespan of the cookie in an INIT ACK if the received INIT requests cookie preservative to lengthen the lifespan of the cookie. Valid values are zero (0) or greater (INT\_MAX). The default value is the value recommended in [RFC 2960](#) 5.2.6 (1,000 milliseconds). This system control defines the default for new sockets. The cookie lifetime increment for a given socket can be changed before a call to **listen(2)**, or before receiving a passive connection attempt, with the socket option ‘SCTP\_COOKIE\_INC’ as described under **SOCKET OPTIONS**.

This value can be adjusted in conjunction with **sctp\_valid\_cookie\_life**, above, to meet objectives of successful passive connection attempts and security. The default setting is adequate for Internet applications.

#### **sctp\_throttle\_itvl**

Defines the default time interval (in milliseconds) within which the receiver will not accept more than one INIT or COOKIE ECHO. Zero (don’t throttle) is a valid value. The default value is 50 milliseconds. This system control defines the default for new sockets. The throttle interval for a given socket can be changed before the call to **listen(2)**, or before a passive connection attempt, with the socket option ‘SCTP\_THROTTLE\_ITVL’ as described under **SOCKET OPTIONS**.

When the HMAC type is SHA-1 or MD5, and when CRC-32c software checksum is used, the implementation is particularly vulnerable to DoS flood attacks using bogus INIT or COOKIE ECHO messages. When *SCTP* is compiled with ‘CONFIG\_SCTP\_THROTTLE\_PASSIVEOPENS’, this permits the throttling of INIT and COOKIE ECHO messages. Only one INIT and one COOKIE ECHO message will be accepted in the interval set by this control.

#### **sctp\_max\_istreams**

Defines the default maximum number of inbound streams that will be requested when forming or receiving connections on a socket. Valid values are in the range from 1 to 65,535 streams. This system control defines the default for new sockets. The actual value used by a socket for both outgoing and incoming connections can be changed with the socket option ‘SCTP\_ISTREAMS’ before a call to **connect(2)** or **accept(2)** as described under **SOCKET OPTIONS**.

Usable default values for **sctp\_max\_istreams** are highly dependent upon the intended applications. **SIGTRAN** UAs, for example, seldom need more than 257 inbound or outbound streams. The default valid is set to thirty-three (33) streams for ‘SOCK\_SEQPACKET’ sockets. This system control only affects ‘SOCK\_SEQPACKET’ sockets: ‘SOCK\_STREAM’ sockets always have both inbound and outbound streams set to one (1).

**sctp\_req\_ostreams**

Defines the default requested number of outbound streams that will be requested when forming or receiving connections on a socket. Valid values are in the range from 1 to 65,535 streams. This system control defines the default for new sockets. The actual value used by a socket for both outgoing and incoming connections can be changed with socket option 'SCTP\_OSTREAMS' before a call to **connect(2)** or **accept(2)** as described under **SOCKET OPTIONS**.

Usable default values for **sctp\_max\_istreams** are highly dependent upon the intended applications. **SIGTRAN** UAs, for example, seldom need more than 257 inbound or outbound streams. The default valid is set to one (1) streams for 'SOCK\_SEQPACKET' sockets. This system control only affects 'SOCK\_SEQPACKET' sockets: 'SOCK\_STREAM' sockets always have both inbound and outbound streams set to one (1).

**sctp\_ecn** Defines a default flag that allows disabling of Explicit Congestion Notification (ECN) operation for *SCTP* when cleared. This system control defines the default for new sockets. ECN can be overridden on a per-socket basis with the socket option 'SCTP\_ECN', as described under **SOCKET OPTIONS**. For this system control to have any effect, the kernel must have been compiled with both kernel configuration parameters 'CONFIG\_INET\_ECN' and 'CONFIG\_SCTP\_ECN' set.

**sctp\_adaptation\_layer\_info**

Defines the default adaptation layer information flags that will be sent in an INIT or INIT-ACK message. Valid values include any 32-bit unsigned integer. The default value for backward compatibility is zero (0) which indicates to not send the Adaptation Layer Information parameter in INIT and INIT-ACK. This system control defines the default for new sockets. The actual value for both outgoing and incoming connections can be changed with socket option 'SCTP\_ALI' before a call to **connect(2)** or **listen(2)**, or before a passive connection indication on a listening socket, as described under **SOCKET OPTIONS**. For this system control to have any effect, the kernel must have been compiled with kernel configuration parameter 'CONFIG\_SCTP\_ADAPTATION\_LEVEL\_INFO' set.

**sctp\_partial\_reliability**

Defines the default partial reliability preference that will be used for the socket. Valid values include zero (0) \- no partial reliability reported, one (1) partial reliability support preferred but not required, and two (2), partial reliability support required. The default value for backward compatibility is zero (0). This system control defines the default for new sockets. The actual value for both outgoing and incoming connections can be changed with socket option 'SCTP\_PR' before a call to **connect(2)** or **listen(2)**, or before a passive connection indication on a listening socket, as described under **SOCKET OPTIONS**. For this system control to have any effect, the kernel must have been compiled with kernel configuration parameter 'CONFIG\_SCTP\_PARTIAL\_RELIABILITY' set.

**sctp\_wmem**

Defines three values (lower, default, upper) for the socket write buffer. The value associated with a given socket can also be changed with the ‘SO\_SNDBUF’ option, see [socket\(7\)](#).

**sctp\_rmem**

Defines three values (lower, default, upper) for the socket read buffer. The value associated with a given socket can also be changed with the ‘SO\_RCVBUF’ option, see [socket\(7\)](#).

**sctp\_max\_init\_retries**

Defines the default number of times that an INIT or COOKIE-ECHO will be resent to a given destination before abandoning an active open attempt. Valid values are zero (0) or greater (INT\_MAX). The default value is the value recommended in [RFC 2960](#) (8 retries). This system control defines the default for new sockets. The value for a given socket can be changed with the socket option ‘SCTP\_MAX\_INIT\_RETRIES’ as described under **SOCKET OPTIONS**.

**sctp\_max\_burst**

Defines the default maximum number of MTUs of new data chunks that will be sent in a burst in accordance with [<rfc4460.txt>](#). Valid values are one (1) or greater (INT\_MAX). The default value is the value recommended in [<rfc4460.txt>](#) (4 MTUs). This system control defines the default for new sockets. The value for a given socket can be changed with the socket option ‘SCTP\_MAX\_BURST’ as described under **SOCKET OPTIONS**.

**sctp\_assoc\_max\_retrans**

Defines the number of times that the sending endpoint will attempt retransmitting a packet on any active destination transport address before it aborts the association. Valid values are zero (0) or greater (INT\_MAX). The default value is the value recommended in [RFC 2960](#) (10 retries). This system control defines the default for new sockets. The value for a given socket can be changed with the socket option ‘SCTP\_ASSOC\_MAX\_RETRANS’ as described under **SOCKET OPTIONS**.

This value should be larger than the sum of the **sctp\_path\_max\_retrans** values of each of the destinations. Setting this value to less than sum of the **sctp\_path\_max\_retrans** values for all of the destinations has the interesting effect of permitting a connection to persist even when all destinations have been deemed inactive.

**sctp\_max\_sack\_delay**

Defines the default interval of time (in milliseconds) that the sending endpoint is permitted to delay an acknowledgement of received data. Valid values are in the range from zero (0) to 500 milliseconds. ([RFC 2960](#) forbids setting this value larger than 500 milliseconds.) The default value is the value recommended in [RFC 2960](#) (200 milliseconds). This system control defines the default for new sockets. The value for a given socket can be changed with the socket option ‘SCTP\_SACK\_DELAY’ as described under **SOCKET OPTIONS**.

**sctp\_rto\_min**

Defines the default time interval (in milliseconds) that will be used as a RTO (Retransmission Time Out) value when sending packets to a destination transport address. Valid values are zero (0) or greater (**INT\_MAX**) and must be less than or equal to both **sctp\_rto\_initial** and **sctp\_rto\_max**. The default value is the value recommended in **RFC 2960** (1,000 milliseconds). The actual value used can be changed with the socket option ‘**SCTP\_RTO\_MIN**’ before a call to **connect(2)** or **accept(2)** or before a new destination transport address is added by the peer. After a socket is connected or a destination transport address has been added, the destination-specific value can be changed using the socket option ‘**SCTP\_RTO**’ as described under **SOCKET OPTIONS**.

In general, **sctp\_rto\_min** should not be less than the peer’s **sctp\_max\_sack\_delay**. Otherwise, excessive retransmissions might occur while the peer is delaying acknowledgements.

**sctp\_rto\_initial**

Defines the default time interval (in milliseconds) that will be used as an initial RTO (Retransmission Time Out) value when sending packets to a destination for the first time, or after the destination has been idle for some time. Valid values are zero (0) or greater (**INT\_MAX**) and must be in the range from **sctp\_rto\_min** to **sctp\_rto\_max**. The default value is the value recommended in **RFC 2960** (3,000 milliseconds). This system control defines the default for new sockets. The actual value used can be changed with the socket option ‘**SCTP\_RTO\_INITIAL**’ before a call to **connect(2)** or **accept(2)** or before a new destination transport address is added by the peer. After a socket is connected or a destination transport address has been added, the destination-specific value can be changed using the socket option ‘**SCTP\_RTO**’ as described under **SOCKET OPTIONS**.

In general, **sctp\_rto\_initial** should not be less than the peer’s **sctp\_max\_sack\_delay**. Otherwise, excessive retransmissions might occur while the peer is delaying acknowledgements.

**sctp\_rto\_max**

Defines the default time interval (in milliseconds) that will be used as a maximum RTO (Retransmission Time Out) value when sending packets to a destination. Valid values are zero (0) or greater (**INT\_MAX**) and must be greater than or equal to both **sctp\_rto\_min** and **sctp\_rto\_initial**. The default value is the value recommended in **RFC 2960** (60,000 milliseconds). This system control defines the default maximum for new sockets. The actual value used can be changed with the socket option ‘**SCTP\_RTO\_MAX**’ before a call to **connect(2)** or **accept(2)** or before a new destination transport address is added by the peer. After an socket is connected or a destination transport address has been added, the destination-specific value can be changed using the socket option ‘**SCTP\_RTO**’ as described under **SOCKET OPTIONS**.

In general, **sctp\_rto\_initial** should not be less than the peer’s **sctp\_max\_sack\_delay**. Otherwise, excessive retransmissions might occur while the peer is delaying acknowledgements.

**sctp\_path\_max\_retrans**

Defines the default number of times that *SCTP* will attempt retransmitting a packet on to a given destination transport address before it considers that destination transport address inactive. Valid values are zero (0) or greater (`INT_MAX`). The default value is the value recommended in [RFC 2960](#) (5 retries). This system control defines the default maximum for new sockets. The actual value used can be changed with the socket option ‘`SCTP_PATH_MAX_RETRANS`’ before a call to `connect(2)` or `accept(2)` or before a new destination transport address is added by the peer. After a socket is connected or a destination transport address has been added, the destination-specific value can be changed using the socket option ‘`SCTP_RTO`’ as described under **SOCKET OPTIONS**.

Adjusting this value has an effect on the period of time taken to fail-over between destinations for multi-homed connections. Lower values (including zero) will yield faster fail-over response times. Lower values, however, may cause thrashing between destinations contributing to congestion in the network. Default values are applicable to Internet applications.

**sctp\_heartbeat\_itvl**

Defines the default interval (in seconds) between successive HEARTBEAT messages used to probe destination transport address for RTT calculation and activity. Valid values are 1 second or greater. The default value is the value recommended in [RFC 2960](#) (30 seconds). This system control defines the default for new sockets. The actual value used can be changed with the socket option ‘`SCTP_HEARTBEAT_ITVL`’ before a call to `connect(2)` or `accept(2)` or before a new destination transport address is added by the peer. After a socket is connected or a destination transport address has been added, the destination-specific value can be changed using the socket option ‘`SCTP_HB`’ as described under **SOCKET OPTIONS**.

If the kernel configuration parameter ‘`CONFIG_SCTP_THROTTLE_HEARTBEATS`’ is set, then half this value is also used for throttling heartbeats. Then only two heartbeats per interval are permitted, any additional heartbeats are discarded.

**SOCKET OPTIONS**

To set or get a socket option, call `getsockopt(2)` to read or `setsockopt(2)` to write the option with the socket *level* argument set to ‘`SOL_SCTP`’. In addition, most ‘`SOL_SOCKET`’ and ‘`SOL_IP`’ socket options are valid on *SCTP* sockets. For more information see [socket\(7\)](#) and [ip\(7\)](#).

The following ‘`SOL_SOCKET`’ [socket\(7\)](#) socket options are supported by *SCTP*:

**SO\_KEEPALIVE**

Set or get a flag that controls heartbeats for the entire association. See [socket\(7\)](#) for additional information.

Normally *SCTP* is required to send HEARTBEAT chunks on a per-destination basis. Clearing this flag (setting ‘`SO_KEEPALIVE`’ to zero) disables exchanging heartbeats on an association level. Exchanging heartbeats is an essential part of the Stream Control Transmission Protocol (SCTP). It is required for clearing retransmission counts against destinations that otherwise will not be cleared if

no data is sent and acknowledged to that destination. Disabling heartbeats is provided for in the SCTP specifications ([RFC 2960](#)); however, disabling heartbeats is not recommended. This is in contrast to [tcp\(7\)](#) that only rarely heartbeats and for which heartbeats are neither an essential nor necessary part of the protocol.

Heartbeats can also be enabled or disabled on a destination basis using the ‘SCTP\_HB’ socket option. It is also possible to generate a HEARTBEAT under user control by sending heartbeat data with the ‘MSG\_PROBE’ flag set using [send\(2\)](#), [sendto\(2\)](#) or [sendmsg\(2\)](#).

#### SO\_OOBINLINE

If this option is enabled, out of order data that has been received on a stream will be placed between the ordered data for that stream. Otherwise, out of order data is only returned on a read call when the ‘MSG\_OOB’ flag is set when receiving. This option is ignored for ‘SOCK\_RDM’ sockets and only applies to ‘SOCK\_STREAM’ and ‘SOCK\_SEQPACKET’ sockets. See [socket\(7\)](#) for additional information.

#### SO\_BINDTODEVICE

Binds the socket to a particular device. This is not yet supported for *SCTP*; however, support for it is planned for the future. See [socket\(7\)](#) for additional information.

#### SO\_REUSEADDR

Supported by *SCTP* without modification; however, consideration is made for binding of multiple transport addresses. See [socket\(7\)](#) for additional information.

#### SO\_RCVLOWAT

#### SO\_SNDLOWAT

#### SO\_RCVTIMEO

#### SO\_SNDTIMEO

#### SO\_DEBUG

#### SO\_TYPE

#### SO\_DONTROUTE

#### SO\_SNDBUF

#### SO\_RCVBUF

#### SO\_LINGER

#### SO\_PRIORITY

**SO\_ERROR** These socket options are supported by *SCTP* without modification. See [socket\(7\)](#) for additional information.

The following ‘SOL\_IP’ [ip\(7\)](#) socket options are supported by *SCTP*:

#### IP\_OPTIONS

Set or get the IP options to be sent with every packet from this socket. See [ip\(7\)](#) for additional information.

#### IP\_PKTINFO

Pass an ‘IP\_PKTINFO’ ancillary message that contains the **pktinfo** structure that supplies some information about the incoming or outgoing packet. This



only works for ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets. It is ignored for ‘SOCK\_STREAM’ sockets. For `setsockopt(2)` and `getsockopt(2)`, the argument is a flag that tells the socket whether the ‘IP\_PKTINFO’ message should be passed or not. The message itself can only be sent or retrieved as a control message with a packet using `recvmsg(2)` or `sendmsg(2)`.

```
struct in_pktinfo {
    unsigned int    ipi_ifindex;    /* Interface index    */
    struct in_addr  ipi_spec_dst;   /* Local address      */
    struct in_addr  ipi_addr;       /* Header Dest Address */
};
```

‘ipi\_ifindex’

is the unique index of the interface the packet was received on, or the index of the interface upon which the packet is to be sent;

‘ipi\_spec\_dst’

is the local address of the received packet or sent packet, and

‘ipi\_addr’

is the destination address in the packet header.

If ‘IP\_PKTINFO’ is passed to `sendmsg(2)` then the outgoing packet will be sent over the interface specified in *ipi\_ifindex* with the destination address set to *ipi\_spec\_dst*.

This option is used to control the source (local) address of packets sent with `sendmsg(2)` and to retrieve the destination (local) address of packets received with `recvmsg(2)`. See `ip(7)` for additional information.

Support for ‘IP\_PKTINFO’ is similar to support for this socket option under `udp(7)`. Under `udp(7)`, ‘IP\_PKTINFO’ is used for multi-homed UDP hosts to specify the local address to `sendmsg(2)` and return remote address from `recvmsg(2)`. *SCTP* uses this in a similar fashion where the choice of addresses consists of the address space of the association.

#### IP\_RECVTOS

Set or get the flag indicating whether the `recvmsg(2)` call will return the type of service field for the received packet in an ancillary message as a ‘IP\_TOS’ control message for sockets of type ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’. This option is ignored for ‘SOCK\_STREAM’ sockets. See `ip(7)` for additional information.

#### IP\_RECVTTL

Set or get the flag indicating whether the `recvmsg(2)` call will return the time to live field for the received packet in an ancillary message as a ‘IP\_TTL’ control message for sockets of type ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’. This option is ignored for ‘SOCK\_STREAM’ sockets. See `ip(7)` for additional information.

#### IP\_RECVOPTS

Set or get the flag indicating whether the `recvmsg(2)` call will return the IP options for the received packet in an ancillary message as an ‘IP\_OPTIONS’ control message for sockets of type ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’. This option is ignored for ‘SOCK\_STREAM’ sockets. See `ip(7)` for additional information.

**IP\_RETOPTS**

Set or get the flag indicating whether the `recvmsg(2)` call will return the IP options for the received packet in an ancillary message as an ‘IP\_RETOPTS’ control message for sockets of type ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’. This option is ignored for ‘SOCK\_STREAM’ sockets. See `ip(7)` for additional information.

In contrast to ‘IP\_OPTIONS’, the ‘IP\_RETOPTS’ ancillary message contains raw, unprocessed options, with the time stamp and route record options not filled in for this hop. It is also possible to pass an ‘IP\_RETOPTS’ ancillary message to `sendmsg(2)`.

**IP\_TOS**

Set or get the default type of service to be used in IP packets associated with the connection. For ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets, this option can also be passed to `sendmsg(2)` in the ancillary data and will be used as the type of service field in the IP packet containing the data chunk associated with the user data provided in the call to `sendmsg(2)`. For ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets, this option returns the type of service parameter associated with a packet in the ancillary data returned from a call to `recvmsg(2)` when the ‘IP\_RECVTOS’ option has been set on the socket. This option is ignored for ‘SOCK\_STREAM’ sockets. See `ip(7)` for additional information.

**IP\_TTL**

Set or get the default time to live to be used in IP packets associated with the connection. This option can also be passed to `sendmsg(2)` in the ancillary data and will be used as the time to live field in the IP packet containing the data chunk associated with the user data provided in the call to `sendmsg(2)`. See `ip(7)` for additional information.

**IP\_MTU**

For *SCTP* sockets, this returns only the Path MTU for the association. This value is the minimum MTU of all the peer destinations. See *SCTP* socket options for a mechanism for obtaining MTU on a per-destination basis. When the peer is not multi-homed, this option returns the same value as would be obtained on a per-destination basis. See `ip(7)` for additional information.

**IP\_RECVERR**

For *SCTP* sockets, this enables extended reliable error messages with the use of ‘SO\_ERROR’ as for `tcp(7)`. Error queues are not supported for *SCTP* (they are not supported for `tcp(7)` either). As for `tcp(7)`, *SCTP* does not permit calling `recvmsg(2)` with the ‘MSG\_ERRQUEUE’ flag for ‘SOCK\_SEQPACKET’ and ‘SOCK\_STREAM’ sockets.

**IP\_PMTU\_DISCOVER**

Supported for *SCTP* sockets without modification. See `ip(7)` for additional information.

The following ‘SOL\_SCTP’ socket options are supported: (A number of the following socket options may also be passed as an ancillary message with level ‘SOL\_SCTP’ when calling `sendmsg(2)` or returned as a control message from a call to `recvmsg(2)`.)

**SCTP\_NODELAY**

Turn the Nagle algorithm off. This means that packets are always sent as soon as possible and no unnecessary delays are introduced, at the cost of more packets in the network. Expects an integer boolean flag.



This parallels the ‘TCP\_NODELAY’ socket option for compatibility with `tcp(7)`. ‘SCTP\_NODELAY’ and ‘TCP\_NODELAY’ can be used interchangeably. For ‘SOCK\_STREAM’ sockets, this setting applies to the default stream as set by the ‘SCTP\_SID’ socket option. For regular ‘SOCK\_SEQPACKET’ sockets, this setting applies to the entire association. For ‘SOCK\_STREAM’ sockets, this setting has the same effect as `tcp(7)`. This option has no effect on ‘SOCK\_RDM’ sockets. See `tcp(7)` for additional information.

When Nagle is enabled, *SCTP* uses the Nagle algorithm ([RFC 896](#)) for bundling DATA chunks into a packet. This results in far fewer short packets in the network. The algorithm is that described in [RFC 896](#) and [RFC 1122](#) with the Minshall modifications to accommodate delayed SACK as described in [<draft-minshall-tsvwg-nagle-01.txt>](#). (Note: later versions of `tcp(7)` also include the Minshall modification).

#### SCTP\_MAXSEG

Set or get the maximum segment size for outgoing packets. Values greater than the association MTU are ignored and have no effect.

This parallels the ‘TCP\_MAXSEG’ socket option for compatibility with `tcp(7)`. ‘SCTP\_MAXSEG’ and ‘TCP\_MAXSEG’ can be used interchangeably. This option is applicable to both ‘SOCK\_SEQPACKET’ and ‘SOCK\_STREAM’ sockets.

This value determines the maximum size (in bytes) above which *SCTP* will fragment larger DATA chunks into smaller DATA chunks, and beneath which *SCTP* will bundle DATA chunks into a single packet or combine smaller DATA chunks into larger DATA chunks. Normally this value is the association MTU value minus the size of the current IP and SCTP headers, minus the size of one DATA chunk header. If the user sets this to a lower value, the lower value will be used.

#### SCTP\_CORK

If enabled don’t send out partial frames. All queued partial frames are sent when the option is cleared again. This is useful for prefixing headers before calling `sendfile(2)`, or for throughput optimization. This option cannot be combined with ‘SCTP\_NODELAY’.

This parallels the ‘TCP\_CORK’ socket option for compatibility with `tcp(7)`. ‘SCTP\_CORK’ and ‘TCP\_CORK’ can be used interchangeably. For ‘SOCK\_STREAM’ sockets, this setting applies to the default stream as set by the ‘SCTP\_SIB’ socket option. For regular ‘SOCK\_SEQPACKET’ sockets, this setting applies to the entire association. This option has no effect on ‘SOCK\_RDM’ sockets.

**SCTP\_SID** Set or get the default stream identifier for all outgoing packets associated with the connection. If ‘SCTP\_SID’ is passed to `sendmsg(2)` then the outgoing packet will be sent over the stream specified by the integer stream identifier contained in the ancillary message. If ‘SCTP\_SID’ is received from a call to `recvmsg(2)` then the incoming packet was received over the stream specified by the integer stream identifier contained in the ancillary message. See also ‘SCTP\_RECVSID’.

**SCTP\_PPI** Set or get the default payload protocol identifier for all outgoing packets. If ‘SCTP\_PPI’ is passed to `sendmsg(2)` then the outgoing packet will be sent with

the payload protocol identifier specified by the integer payload protocol identifier contains in the ancillary message. If 'SCTP\_PPI' is received from a call to `recvmsg(2)` then the incoming packet was received with the payload protocol identifier specified the integer payload protocol identifier contained in the ancillary message. See also 'SCTP\_RECVPPI'.

#### SCTP\_RECVSID

When this flag is set, pass a 'SCTP\_SID' control message with the stream identifier for received packets as an integer in an ancillary message that may be received with `recvmsg(2)`. Otherwise, no 'SCTP\_SID' control message will be passed with normal data. 'SCTP\_SID' is always passed for retrieved or negatively acknowledged data.

#### SCTP\_RECVPPI

When this flag is set, pass a 'SCTP\_PPI' control message with the payload protocol identifier for received packets as an integer in an ancillary message that may be received with `recvmsg(2)`. Otherwise, no 'SCTP\_PPI' control message will be passed with normal data. 'SCTP\_PPI' is always passed for retrieved or negatively acknowledged data.

#### SCTP\_HEARTBEAT\_ITVL

Set or get the time interval (in seconds) between successive HEARTBEAT messages used to probe destination transport addresses for RTT calculation and activity. Valid values are zero (0) \- do not heartbeat, or a value of 1 second or greater. The default value is set by the system control `sctp_heartbeat_itvl`. This is the default value that will be assigned to new destinations. Active destinations can be controlled with the socket option 'SCTP\_HB'. This socket option must be set before the call to `connect(2)` or `listen(2)`, or before a passive connection indication is received on a listening socket.

**SCTP\_HB** Set or get the heartbeat activation and interval associated with the specified destination address. The expected value is a `sctp_hbitvl` structure. This option will return an error if it is attempted on a socket in the unconnected state.

```
struct sctp_hbitvl {
    struct sockaddr_in
        dest;    /* destination address */
    uint active; /* activation flag */
    uint itvl;   /* interval in milliseconds */
};
```

The `sctp_hbitvl` structure has the following fields:

- 'dest' is a `sockaddr_in` structure that contains the destination address to which the heartbeat setting applies.
- 'active' is an integer boolean activation flag indicating whether heartbeat is active on the destination.
- 'itvl' is the integer heartbeat interval in milliseconds.

For use with `setsockopt(2)`, *dest* must be one of the valid destination addresses associated with the connection: that is, it must be one of the addresses returned from a call to `getpeername(2)`. Note that heartbeat activity

and interval can also be set on an association basis with ‘SO\_KEEPALIVE’ and ‘SCTP\_HEARTBEAT\_ITVL’.

#### SCTP\_RTO\_INITIAL

Set or get the time interval (in milliseconds) that will be used as an initial RTO (Retransmission Time Out) value when sending packets to a destination for the first time. Valid values are zero or greater and must be within the range from ‘SCTP\_RTO\_MIN’ to ‘SCTP\_RTO\_MAX’. The default value is the value set by **sctp\_rto\_initial**. This socket option must be set before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt, but the value may be controlled on active destination with the ‘SCTP\_RTO’ socket option.

#### SCTP\_RTO\_MIN

Set or get the time interval (in milliseconds) that will be used as a minimum RTO (Retransmission Time Out) value when sending packets. Valid values are zero or greater and must be less than or equal to the value of ‘SCTP\_RTO\_MAX’. The default value is set by the system control **sctp\_rto\_min**. This socket option must be set before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt, but the value associated with active destinations can be controlled using the ‘SCTP\_RTO’ socket option.

#### SCTP\_RTO\_MAX

Set or get the time interval (in milliseconds) that will be used as a maximum RTO (Retransmission Time Out) value when sending packets. Valid values are zero or greater and must be greater than or equal to the value of ‘SCTP\_RTO\_MIN’. The default value is set by the system control **sctp\_rto\_max**. This socket option must be set before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt, but the value associated with active destinations can be controlled using the ‘SCTP\_RTO’ socket option.

#### SCTP\_PATH\_MAX\_RETRANS

Set or get the number of times that the sending endpoint will attempt retransmitting a packet to a given destination transport address before it considers that destination transport address inactive. Valid values include zero. The default value is set by the system control **sctp\_path\_max\_retrans**. This is the default value assigned to destinations before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt. Active destinations can be controlled with the ‘SCTP\_RTO’ socket option.

**SCTP\_RTO** Set or get the retransmission timeout parameters associated with the specified destination address. The expected value is a **sctp\_rtoval** structure. This option will return an error if it is attempted on a socket in the unconnected state.

```
struct sctp_rtoval {
    struct sockaddr_in
        dest;          /* destination address      */
    uint  rto_initial; /* RTO.Initial (milliseconds) */
    uint  rto_min;    /* RTO.Min      (milliseconds) */
    uint  rto_max;    /* RTO.Max      (milliseconds) */
    uint  max_retrans; /* Path.Max.Retrans (retries) */
};
```

The **sctp\_rtoval** structure has the following fields:

- ‘dest’** is a **sockaddr\_in** structure that contains the destination address to which the RTO parameter setting applies.
- ‘rto\_initial’** is the integer initial retransmission timeout value in milliseconds. For expected values see **‘SCTP\_RTO\_INITIAL’**.
- ‘rto\_min’** is the integer minimum retransmission timeout value in milliseconds. For expected values see **‘SCTP\_RTO\_MIN’**.
- ‘rto\_max’** is the integer maximum retransmission timeout value in milliseconds. For expected values see **‘SCTP\_RTO\_MAX’**.
- ‘max\_retrans’** is the integer maximum number of retransmissions. For expected values see **‘SCTP\_PATH\_MAX\_RETRANS’**.

For use with **setsockopt(2)**, *dest* must be one of the valid destination addresses associated with the connection: that is, it must be one of the addresses returned from a call to **getpeername(2)**.

#### SCTP\_CKSUM\_TYPE

Set or get the checksum algorithm associated with socket. Valid values are **‘SCTP\_CSUM\_ADLER\_32’** and **‘SCTP\_CSUM\_CRC\_32C’**. The default value is set by the system control **sctp\_csum\_type**. This socket option must be set before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt on a listening socket.

#### SCTP\_MAC\_TYPE

Set or get the MAC (Message Authentication Code) type that will be used when signing cookies in INIT ACK messages. Valid values are **‘SCTP\_HMAC\_SHA\_1’**, **‘SCTP\_HMAC\_MD5’**, and **‘SCTP\_HMAC\_NONE’**. The default value is set by the system control **sctp\_mac\_type**. This socket option must be set before the call to **listen(2)**, or before a passive connection attempt on a listening socket.

#### SCTP\_COOKIE\_LIFE

Set or get the cookie lifetime associated with a socket. This is the amount of time that cookies sent to a peer endpoint in an INIT-ACK message will be valid. For *SCTP* this also limits the maximum for which the HMAC secret key for the cookie will be valid. The value is a integer time interval in milliseconds. Valid values are zero (0) or greater (**INT\_MAX**). The default value is set by the system control **sctp\_cookie\_life**. This socket option must be set before the call to **listen(2)**, or before receiving a passive connection attempt. When changing this value, the new value will apply to all passive connection attempts (INIT messages) received on a listening socket after the change is made.

Reducing this value will increase the chances that passive connection attempts will fail due to expired cookies. Increasing the value will reduce the overall security of the system by permitting attackers and increased interval to crack HMACs and guess verification tags. This value may be adjusted in conjunction with **‘SCTP\_COOKIE\_INC’** to meet most objectives for successful pas-

sive connection attempts with the best security afforded by smaller values of ‘SCTP\_COOKIE\_LIFE’.

Unfortunately the ‘SCTP\_COOKIE\_LIFE’ and ‘SCTP\_COOKIE\_INC’ must be adjusted to accommodate the slowest peer on the slowest connection. The default setting is adequate for Internet applications.

#### SCTP\_COOKIE\_INC

Set or get the time increment (in milliseconds) that will be added to the lifespan of the cookie in an INIT ACK if the sender of the INIT requested cookie preservation to lengthen the lifespan of the cookie. Valid values include zero. The default value is set by the system control **sctp\_cookie\_inc**. This socket option must be set before the call to **listen(2)**, or before a passive connection attempt on the listening socket, but can be read at any time.

#### SCTP\_THROTTLE\_ITVL

Set or get the interval (in milliseconds) within which the receiver will not accept more than one INIT or COOKIE ECHO. Zero (don’t throttle) is a valid value. The default is set by the system control **sctp\_throttle\_itvl**. This socket option must be set before the call to **listen(2)**, or before a passive connection attempt on the listening socket.

#### SCTP\_ISTREAMS

Set the maximum number of inbound streams or get the actual number of inbound streams associated with a connection. Valid values are from 1 to 16,736. The default value is set by the system control **sctp\_max\_istreams**. This socket option must be set before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt, but can be read at any time. For **tcp(7)**-compatible ‘SOCK\_STREAM’ sockets, the number of inbound streams is fixed at one (1) and this socket option has no effect.

#### SCTP\_OSTREAMS

Set the number of requested outbound streams or get the actual number of outbound streams associated with a connection. Valid values are from 1 to 16,736. The default value is set by the system control **sctp\_req\_ostreams**. This socket option must be set before the call to **connect(2)** or **listen(2)**, or before a passive connection attempt on a listening socket, but can be read at any time. For **tcp(7)**-compatible ‘SOCK\_STREAM’ sockets, the number of outbound streams is fixed at one (1) and this socket option has no effect.

**SCTP\_ECN** When set to zero (0), disables the local transport Explicit Congestion Notification (ECN) capability, or get the transport ECN capability of the peer on a connected socket.

This socket option supports the ECN capability of **RFC 3168** and Appendix A of **RFC 2960** and is only available if *SCTP* was compiled with the kernel configuration parameters ‘CONFIG\_INET\_ECN’ and ‘CONFIG\_SCTP\_ECN’ set.

**SCTP\_ALI** Set the adaptation layer information to be used in the INIT or INIT-ACK on all passive or active connection attempts on the socket, or get the adaptation layer information provided by the peer on a connected socket.

When set to zero (0), no adaptation layer information will be included in the INIT or INIT-ACK; when non-zero, it contains the flag bits that will be sent in the adaptation layer information in the INIT or INIT-ACK when set before the call to `connect(2)` or `listen(2)`, or before a passive connection information is received on a listening socket.

If the socket is in a disconnected state (and has never been connected), getting this option returns zero (0). If the socket has been in a connected state, getting this option returns zero (0) if no adaptation layer information was present during connection, or returns the adaptation layer information bits if provided by the peer.

This socket option supports the adaptation layer information feature described in [<draft-ietf-tsvwg-addip-sctp-08.txt>](#) and is only supported if *SCTP* was compiled with kernel configuration parameter 'CONFIG\_SCTP\_ADAPTATION\_LAYER\_INFO' set.

**SCTP\_PR** Set whether Partial Reliability ([RFC 3758](#)) will be supported or required on connection establishment, or get the indication of support for **PR-SCTP** provided by the peer on a connected socket. Valid values are as follows:

**SCTP\_PR\_NONE**

Do not place or respond with Forward TSN parameter in an INIT or INIT-ACK indicating that this socket does not support **PR-SCTP**.

**SCTP\_PR\_PREFERRED**

Place and respond with a Forward TSN parameter in an INIT or INIT-ACK indicating to the peer that we support **PR-SCTP** for this connection, but do not require the peer to support **PR-SCTP**.

**SCTP\_PR\_REQUIRED**

Place and respond with a Forward TSN parameter in an INIT or INIT-ACK indicating to the peer that we support **PR-SCTP** and require the peer to do the same.

The default setting is provided by the `sctp-pr` system control.

For a connected socket, when this flag is true, it indicates that the peer supports **PR-SCTP**. When this flag is false, it indicates that the peer does not support **PR-SCTP**.

This socket options supports the partial reliability feature ([RFC 3758](#)) and is only available if *SCTP* was compiled with the kernel configuration parameter 'CONFIG\_SCTP\_PARTIAL\_RELIABILITY' set.

**SCTP\_MAX\_INIT\_RETRIES**

Set or get the number of times that an INIT or COOKIE ECHO will be resent before abandoning the association initialization. Valid values include zero. The default value is set by the system control `sctp-max-init-retries`. This socket option must be set before the call to `connect(2)` or `listen(2)`, or before a passive connection attempt on a listening socket.

**SCTP\_MAX\_BURST**

Set or get the number of MTUs of data that will be sent in a single burst as defined by [<rfc4460.txt>](#). Valid values are one (1) or greater. The default



value is set by the system control `sctp_max_burst`. This socket option may be changed at any time during the life of the socket.

#### SCTP\_ASSOC\_MAX\_RETRANS

Set or get the number of times that the sending endpoint will attempt retransmitting a packet on a given association before it aborts the association. Valid values include zero. The default value is set by the system control `sctp_assoc_max_retrans`. This value should be larger than the sum of all the ‘SCTP\_PATH\_MAX\_RETRANS’ values of each of the destinations. This socket option may be changed at any time during the life of the socket.

#### SCTP\_SACK\_DELAY

Set or get the maximum SACK delay as the interval of time (in milliseconds) that the sending endpoint will delay an acknowledgement of a received data chunk. Valid values are in the range from 0 to `INT_MAX`, however, the value of the maximum SACK delay should not exceed 500 milliseconds (setting this value to greater than 500 milliseconds is forbidden by [RFC 2960](#)) for Internet Applications. The default value is set by the system control `sctp_sack_delay`. This socket option may be changed at any time during the life of the socket.

#### SCTP\_DISPOSITION

Gets or sets a flag that determines whether *SCTP* will retain and deliver messages that were not successfully acknowledged by the peer for retrieval, or will deliver confirmation of acknowledgement for messages successfully acknowledged by the peer. If ‘SCTP\_DISPOSITION’ is return in a control message from a call to `recvmsg(2)` with the ‘MSG\_CONFIRM’ flag set, then the read packet represents a packet that was held for retrieval, exceeded its life-time, was dropped by **PR-SCTP** or had message confirmation set and was successfully acknowledged. In addition, if the message was successfully acknowledged, the ‘MSG\_CONFIRM’ flag will be returned in a call to `recv(2)`, `recvfrom(2)` or `recvmsg(2)`. Valid values are:

##### SCTP\_DISPOSITION\_NONE

When this option is set to ‘SCTP\_DISPOSITION\_NONE’, messages will not be retained for retrieval and acknowledgements will not be provided for messages unless overridden with the ‘MSG\_CONFIRM’ flag to `send(2)`, `sendto(2)` or `sendmsg(2)`.

##### SCTP\_DISPOSITION\_UNSENT

When set to ‘SCTP\_DISPOSITION\_UNSENT’, *SCTP* will retain and provide for retrieval only messages that were unsent. When set to ‘SCTP\_DISPOSITION\_UNSENT’ in an ancillary message returned by `recvmsg(2)` called with the ‘MSG\_CONFIRM’ flag set, the read data represents a packet that was unsent at the time that the connection shut down or aborted. When ‘SCTP\_PR’ is enabled on the connection, unsent data that was dropped by **PR-SCTP** will be delivered before shut down or abort.

##### SCTP\_DISPOSITION\_SENT

When set to ‘SCTP\_DISPOSITION\_SENT’, *SCTP* will retain and provide for retrieval all messages that were sent and unacknowledged,

or that were unsent at the time that the connection shut down or aborted. When set to 'SCTP\_DISPOSITION\_SENT' in an ancillary message returned by `recvmsg(2)` called with the 'MSG\_CONFIRM' flag set, then the read data was a packet that was sent but not acknowledged (with a cumulative ack) before the connection was shut down or aborted. When 'SCTP\_PR' is enabled on the connection, sent data that was dropped by **PR-SCTP** will be delivered before shut down or abort.

#### SCTP\_DISPOSITION\_GAP\_ACKED

When set to 'SCTP\_DISPOSITION\_GAP\_ACKED', *SCTP* will retain and provide for retrieval all messages that were sent and gap acknowledged, sent and unacknowledged, or unsent at the time that the connection shut down or aborted. When set to 'SCTP\_DISPOSITION\_GAP\_ACKED' in an ancillary message returned by `recvmsg(2)` called with the 'MSG\_CONFIRM' flag set, then the read data was a packet that was sent but not acknowledged (with a cumulative ack) before the connection was shut down or aborted. When 'SCTP\_PR' is enabled on the connection, gap acknowledged data that was dropped by **PR-SCTP** will be delivered before shut down or abort.

#### SCTP\_DISPOSITION\_ACKED

When set to 'SCTP\_DISPOSITION\_ACKED', *SCTP* will retain and provide for retrieval acknowledgements for all messages that were confirmed delivered (by cumulative ack). When set to 'SCTP\_DISPOSITION\_ACKED' in the ancillary message return by `recvmsg(2)` called with the 'MSG\_CONFIRM' flag set, then the read data was a packet that was sent and acknowledged (with a cumulative ack) before the connection was shut down gracefully or at any time before shut down or abort.

This option permits messages that are unsent, sent but not acknowledged or sent and gap acknowledged, to be retrieved from the socket before close. This is accomplished by setting the 'SCTP\_DISPOSITION' socket option prior to shut down or abort, and then calling `recvmsg(2)` after 'POLLHUP', 'SIGPIPE' or 'EPIPE' indicating shutdown or abort of the connection. Messages then read with the 'MSG\_CONFIRM' flag set on call to `recv(2)`, `recvfrom(2)` or `recvmsg(2)` will have the 'SCTP\_DISPOSITION' ancillary message attached and will indicate whether they were 'SCTP\_DISPOSITION\_UNSENT', 'SCTP\_DISPOSITION\_SENT' or 'SCTP\_DISPOSITION\_GAP\_ACKED'.

If the socket option 'SCTP\_PR' is set on the socket and the peer supports **PR-SCTP**, messages which have failed partial reliable delivery (were dropped) will also be retrieved by `recvmsg(2)` called with the 'MSG\_CONFIRM' flag set, with the 'SCTP\_DISPOSITION' ancillary data message before shutdown. *SCTP* must have been compiled with 'CONFIG\_SCTP\_PARTIAL\_RELIABILITY' for this feature to be available.



Alternatively, if the socket option ‘SCTP\_DISPOSITION’ is set to ‘SCTP\_DISPOSITION\_ACKED’ or messages were sent with the ‘MSG\_CONFIRM’ flag set to `send(2)`, `sendto(2)` or `sendmsg(2)`, then a call to `recv(2)`, `recvfrom(2)` or `recvmsg(2)` with the ‘MSG\_CONFIRM’ flag set will return acknowledgements with a ‘SCTP\_DISPOSITION’ control message set to ‘SCTP\_DISPOSITION\_ACKED’ for all acknowledged messages at the time of the call. Care should be taken when using this receipt confirmation service as the message will be held in the transmit buffers until confirmation has been received by the user. Receipt confirmation also has an impact on the performance of *SCTP*.

#### SCTP\_LIFETIME

Get or set the SCTP lifetime or **PR-SCTP** timed reliability lifetime associated with messages which are sent on this socket. When this option is included as an control message to `sendmsg(2)`, the specified lifetime is associated with the written message.

Ordered messages waiting for acknowledgement beyond this lifetime will cause subsequent writes to the same stream to fail until all failed messages have been retrieved with `recvmsg(2)` with the ‘MSG\_CONFIRM’ flag set. Subsequent unordered writes to the stream will succeed, although unordered data can also be collected by setting both ‘MSG\_OOB’ and ‘MSG\_CONFIRM’ in a call to `recvmsg(2)`.

**SCTP\_ADD** Sets a flag that indicates whether *SCTP* will support the ADD-IP extensions (ADD IP and DEL IP) on this socket, or gets a flags that indicates whether the peer supports the ADD-IP extensions on a connected socket. When the flag is set, requests that *SCTP* respond to ASCONF chunks with ADD IP or DEL IP requests. When the flag is unset, *SCTP* will refuse these requests. The default setting for this flag is unset for new sockets. This option is only available when the kernel is compiled with kernel configuration parameter ‘CONFIG\_SCTP\_ADD\_IP’ set.

#### SCTP\_ADD\_IP

When set, requests that the provided IP address (*addr*), provided in a **sock-addr-in** structure be added to the local IP addresses associated with the connection. If the socket is in a connected or connecting state, this invokes the ASCONF procedure to add the IP address to the association. If the socket is in a disconnected state, setting this option will fail. This option is only available when the kernel is compiled with kernel configuration parameter ‘CONFIG\_SCTP\_ADD\_IP’ set.

If a connected socket was initially bound to ‘INADDR\_ANY’, additional IP addresses may be automatically added to the socket if new network interfaces are added to the system, or if existing network interfaces are configured with `ifconfig(8)` or equivalent commands.

#### SCTP\_DEL\_IP

When set, requests that the provided IP address (*addr*), provided in a **sock-addr-in** structure be deleted from the local IP addresses associated with the connection. If the socket is in a connected or connecting state, this invokes the ASCONF procedure to remove the IP address from the association. If the

socket is in a disconnected state, setting this option will fail. This option is only available when the kernel is compiled with kernel configuration parameter 'CONFIG\_SCTP\_ADD\_IP' set.

If the socket was initially bound to 'INADDR\_ANY', IP addresses may be automatically unbound from the socket if network interfaces are removed from the system, or if network interfaces are reconfigured with `ifconfig(8)` or equivalent commands.

**SCTP\_SET** Sets a flag that indicates whether *SCTP* will support the ADD-IP extensions (SET PRIMARY) on this socket, or gets a flags that indicates whether the peer supports the ADD-IP extensions on a connected socket. When the flag is set, requests that *SCTP* respond to ASCONF chunks with SET PRIMARY requests. When the flag is unset, *SCTP* will refuse these requests. The default setting for this flag is unset for new sockets. This option is only available when the kernel is compiled with kernel configuration parameter 'CONFIG\_SCTP\_ADD\_IP' set.

#### **SCTP\_STATUS**

Gets the association status and the status associated with each of the destination transport addresses forming the association. The returned value is a **sctp\_astat** structure following by *assoc\_nrep* **sctp\_dstat** structures (one for each destination transport address as returned by `getpeername(2)`).

```

struct sctp_astat {
    uint assoc_rwnd; /* receive window          */
    uint assoc_rbuf; /* receive buffer          */
    uint assoc_nrep; /* destinations reported   */
};

struct sctp_dstat {
    struct sockaddr_in
        dest; /* destination address      */
    uint dst_cwnd; /* congestion window        */
    uint dst_unack; /* unacknowledged chunks    */
    uint dst_srtt; /* smoothed round trip time */
    uint dst_rvar; /* rtt variance             */
    uint dst_rto; /* current rto              */
    uint dst_sst; /* slow start threshold     */
};

```

The **sctp\_astat** structure has the following fields:

'assoc\_rwnd'

is the current advertised receive window in bytes.

'assoc\_rbuf'

is the current receive buffer size in bytes.

'assoc\_nrep'

is the number of **sctp\_dstat** structures that follow this structure.

The **sctp\_dstat** structure has the following fields:

<code>'dest'</code>	is the address associated with this <code>sctp_dstat</code> structure.
<code>'dst_cwnd'</code>	is the congestion window for the given destination transport address in bytes.
<code>'dst_unack'</code>	is the number of unacknowledged DATA chunks outstanding to the given destination transport address in chunks.
<code>'dst_srtt'</code>	is the current smoothed round trip time for the destination transport address in milliseconds.
<code>'dst_rvar'</code>	is the RTT variance for the destination transport address in milliseconds.
<code>'dst_rto'</code>	is the current value of the RTO for the destination transport address in milliseconds.
<code>'dst_sst'</code>	is the current value of the slow start threshold in bytes.

**SCTP\_DEBUG\_OPTIONS**

Not Documented. (This socket option provides for special debugging functions intended for developers of *SCTP*.)

**IOCTLS**

These I/O controls can be accessed using `ioctl(2)`. The correct syntax is:

```
int value;
error = ioctl(sctp_socket, ioctl_type, &value);
```

All `socket(7)` I/O controls are supported by *SCTP* without modification: `'SIOCGSTAMP'`, `'SIOCSPGRP'`, `'FIOASYNC'` and `'SIOCGPGRP'`. All `socket(7)` fcntls are supported by *SCTP*: `'FIOCGETOWN'` and `'FIOCSETOWN'`.

The following `tcp(7)` I/O controls are supported by *SCTP*:

**SIOCINQ** Returns the amount of queued unread data in the receive buffer. Argument is a pointer to an integer.

**SIOCATMARK**

Returns true when all urgent data has already been received by the user program. This is used together with `'SO_OOBINLINE'`. Argument is a pointer to an integer for the test result.

**SIOCOUTQ** Returns the amount of unsent data in the socket send queue in the passed integer value pointer.

**ERROR HANDLING**

When a network error occurs, *SCTP* tries to resend the packet. If it doesn't succeed after some time, either `'ETIMEDOUT'` or the last received error on this connection is reported.

Some applications require a quicker error notification. This can be enabled with the `'SOL_IP'` level `'IP_RECVERR'` socket option. When this option is enabled, all incoming errors are

immediately passed to the user program. Use this option with care: it makes *SCTP* less tolerant to routing changes and other normal network conditions.

## NOTES

When an error occurs doing a connection setup occurring in a socket write ‘SIGPIPE’ is only raised when the ‘SO\_KEEPOPEN’ socket option is set.

*SCTP* has no real out-of-band or urgent data; it has out-of-order data. In Linux this means if the other end sends newer out-of-band data the older urgent data may arrive later.

If the socket option ‘SO\_KEEPALIVE’ is not set (see [socket\(7\)](#)), *SCTP* will not generate heartbeats to any destination. For regular ‘SOCK\_SEQPACKET’ and ‘SOCK\_RDM’ sockets, ‘SO\_KEEPALIVE’ defaults to set. For [tcp\(7\)](#)-compatible ‘SOCK\_STREAM’ sockets, ‘SO\_KEEPALIVE’ defaults to unset.

## ERRORS

**EPIPE** The other end closed the socket unexpectedly or a read is executed on a shut down socket.

**ETIMEDOUT**

The other end didn’t acknowledge retransmitted data after some time.

**EAFNOSUPPORT**

Passed socket address type in *sin\_family* was not ‘AF\_INET’ or ‘AF\_UNSPEC’.

Any errors defined for [ip\(7\)](#) or the generic [socket\(7\)](#) layer may also be returned for *SCTP*.

## NETWORK STATISTICS

### Protocol Information

*SCTP* keeps a number of statistics provided for in the the IP MIB. IP protocol statistics are available in ‘/proc/net/snmp’ as well as with the *-s* or *-statistics* flag to [netstat\(8\)](#). For additional information see [proc\(5\)](#) and [netstat\(8\)](#). ICMP Protocol statistics that are applicable to *SCTP* are as follows:

**InErrors** The number of ICMP messages received in error. This represents the value for all protocols including *SCTP*.

*SCTP* provides the following information in the Linux MIB. Linux MIB statistics are available in ‘/proc/net/netstat’. For additional information see [proc\(5\)](#). Linux protocol statistics that are applicable also to *SCTP* are as follows:

**LockDroppedIcmps**

The number of ICMP errors that were dropped because the socket was locked.

**ListenOverflows**

The number of COOKIE-ECHO chunks dropped due to listen queue overflows.

*SCTP* provides for SNMP Protocol Information following the SCTP MIB [<rfc3873.txt>](#). Protocol information is available in ‘/proc/net/snmp’ as well as with the *-s* flag to the [netstat\(8\)](#) command. SCTP Protocol Statistics that are applicable to *SCTP* are as follows:

**RtoAlgorithm**

The algorithm used to determine the timeout value (T3-rtx) used for retransmitting unacknowledged chunks.

**RtoMin**

The minimum value for the transmission timeout value. This value can be obtained by reading the system control **sctp\_rto\_min**. A retransmission time value of zero means immediate retransmission. The value of this object has to be less than or equal to RtoMax's value.

**RtoMax**

The maximum value for the retransmission timeout value. This value can be obtained by reading the system control **sctp\_rto\_max**. A retransmission timeout value of zero means immediate retransmission. The value of this object has to be greater than or equal to RtoMin's value.

**RtoInitial**

The initial value for the retransmission timer. This value can be obtained by reading the system control **sctp\_rto\_initial**. A retransmission time value of zero means immediate retransmission.

**MaxAssoc**

The maximum number of associations. For *SCTP* there is no controllable upper limit on the maximum number of associations. The maximum number of associations is constrained by the system maximum number of file descriptors, the process maximum number of file descriptors, and the amount of memory in the system. Therefore, this value will always be -1.

**ValCookieLife**

The valid cookie life for COOKIES in the initialization procedure. This value can be obtained by reading the system control **sctp\_valid\_cookie\_life**.

**MaxInitRetr**

The maximum number of times that an INIT or COOKIE-ECHO chunk will be retransmitted during the startup of an association. This value can be obtained by reading the system control **sctp\_max\_init\_retries**.

**CurrEstab**

The number of *SCTP* sockets in the established state.

**ActiveEstabs**

The number of times that a **connect(2)** call succeeded on an *SCTP* socket.

**PassiveEstabs**

The number of times that a **accept(2)** call succeeded on an *SCTP* socket.

**Aborted**

The number of times that an established *SCTP* socket completed an abortive release.

**Shutdowns**

The number of times that an established *SCTP* socket completed an orderly release.

**OutOfBlues**

The number of out of the blue packets received. Out of the blue packets are packets for which no corresponding *SCTP* socket could be found.

**ChecksumErrors**

The number of received packets that discovered a checksum error and were discarded.

**OutCtrlChunks**

The number of SCTP Control Chunks that were sent, excluding retransmissions.

**OutOrderChunks**

The number of SCTP Data Chunks that were sent with the Unordered Bit clear, excluding retransmissions.

**OutUnorderChunks**

The number of SCTP Data Chunks that were sent with the Unordered Bit set, excluding retransmissions.

**InCtrlChunks**

The number of SCTP Control Chunks that were received and processed, excluding duplicates.

**InOrderChunks**

The number of SCTP Data Chunks that were received with the Unordered Bit clear, excluding duplicates.

**InUnorderChunks**

The number of SCTP Data Chunks that were received with the Unordered Bit set, excluding duplicates.

**FragUsrMsgs**

The number of times that *SCTP* further fragmented a user message.

**ReasmUserMsgs**

The number of times that *SCTP* reassembled fragmented chunks into a user messages.

**OutSCTPPacks**

The number of packets delivered for transmission to the IP layer.

**InSCTPPacks**

The number of packets received for processing from the IP layer.

**DiscontinuityTime**

The last time at which SCTP statistics suffered a discontinuity.

**Connection Information**

*SCTP* provides for SNMP Connection Information following the SCTP MIB [<rfc3873.txt>](#). Connection information is available in `/proc/net/sctp` but is not yet available with a `-sctp` flag to the `netstat(8)` command. (Extensions to the `netstat(8)` command are required to access this information.)

**Socket Usage Information**

*SCTP* provides for socket usage information available in `/proc/net/sockstat`.

## CAVEATS

*SCTP* does not subscribe to the [RFC 2960](#) restriction to assign sequential TSNs (Transmit Sequence Numbers) to each fragmented DATA chunk of a large record for ‘SOCK\_SEQPACKET’ sockets. Multiple calls to `write(2)`, `send(2)`, `sendto(2)` or `sendmsg(2)` for portions of different records may result in fragments from multiple records being assigned interleaving TSNs. Portable programs should refrain from writing record fragments to more than one stream at a time.

*SCTP* ignores the source address list in INIT and INIT-ACK chunks when searching for Transmission Control Blocks in opposition to [<rfc4460.txt>](#) section 2.18. This is because the procedure described there introduces severe vulnerability to DoS and Spoofing attacks. *SCTP* does not have this vulnerability.

*SCTP* ignores the source address list in INIT chunks when searching for Transmission Control Block matches in opposition to [<rfc4460.txt>](#) section 2.6. This is because the procedure described there introduces severe vulnerability to DoS attacks by revealing detailed information about existing associations. *SCTP* does not have this vulnerability.

*SCTP* does not implement the UDP-like interface of [<draft-ietf-tsvwg-sctpsocket-07.txt>](#). This is because the socket interface presented in that draft provides unorthodox interface to a ‘SOCK\_SEQPACKET’ socket which is against both the traditional and standard usage of ‘SOCK\_SEQPACKET’ sockets in BSD, XNS 5.2, and POSIX. In BSD, XNS 5.2 and POSIX, ‘SOCK\_SEQPACKET’ sockets are strictly connection-oriented, whereas in this draft they are connectionless. A connectionless use of ‘SOCK\_SEQPACKET’ would conflict with common standard socket code used by X.25, AX.25, DECNET, and other users of ‘SOCK\_SEQPACKET’ sockets.

Although similar, *SCTP* does not implement the TCP-like interface of [<draft-ietf-tsvwg-sctpsocket-07.txt>](#). This is because the ‘SOCK\_STREAM’ socket interface presented in that draft only provides limited compatibility with `tcp(7)`. The `tcp(7)` compatible socket interface provided by *SCTP* more closely follows the `tcp(7)` interface making it suitable to use *SCTP* as a drop-in replacement for `tcp(7)` with minimal (‘IPPROTO\_SCTP’) adjustment to applications programs written to `tcp(7)`.

*SCTP* has way too many options. This is mostly because *SCTP* is an new protocol and experimentation with the protocol is high. These options provide close control of the interesting features of the protocol. Unfortunately, when all options are compiled, the performance of *SCTP* is necessarily impacted. Many of these options will become deprecated in future releases. Portable programs should minimize their use of *SCTP*-specific socket options.

Although *SCTP* permits the user maximum control over the various SCTP protocol parameters, it is also possible to set protocol parameters in violation of the requirements of [RFC 2960](#) and subsequent SCTP drafts and RFCs. Internet applications should take extreme care with protocol parameter settings, by either using the default values for all protocol parameters (as recommended in [RFC 2960](#) and others) or by taking care not to adjust protocol parameters outside the ranges recommended in [RFC 2960](#) and subsequent RFCs.

*SCTP* does not currently support IPv6.

*SCTP* host name addresses are not supported.

*SCTP* does not implement **MOBILE-SCTP** extensions due to Intellectual Property Rights claims made against the technologies in **MOBILE-SCTP**.

*SCTP* does not currently support `tcp(7)` undocumented Linux `sendpage(2)` socket call.

Transparent proxy options and other enhanced IP capabilities available with the kernel configuration parameter `'CONFIG_SCTP_EXTENDED_IP_SUPPORT'` are not described, or not implemented.

Providing destination addresses to `send(2)`, `sendto(2)` and `sendmsg(2)` does not work as described (it is largely ignored).

`'SOCK_RDM'` sockets are not fully supported as described.

The use of `'SO_BINDTODEVICE'`, `'IP_OPTIONS'`, `'IP_PKTINFO'`, `'IP_RECVOPTS'`, `'IP_RETOPTS'` and `'SCTP_STATUS'` socket options are not fully implemented and will probably not work as described.

## AUTHOR

Brian F. G. Bidulock.  
The OpenSS7 Project.



## 4 Conformance



## 5 Releases

This is the OpenSS7 Release of the OpenSS7 Linux Native SCTP tools, drivers and modules used with Linux.

The following sections provide information on OpenSS7 Linux Native SCTP releases as well as compatibility information of OpenSS7 release to mainstream UNIX releases of the core, modules and drivers, as well as Linux kernel compatibility.

### 5.1 Prerequisites

The quickest and easiest way to ensure that all prerequisites are met is to download and install this package from within the *OpenSS7 Master Package*, `openss7-0.9.2.G`, instead of separately.

Prerequisites for the OpenSS7 Linux Native SCTP package are as follows:

1. *Linux* distribution, somewhat *Linux Standards Base* compliant, with a 2.4 or 2.6 kernel and the appropriate tool chain for compiling out-of-tree kernel modules. Most recent *Linux* distributions are usable out of the box, but some development packages must be installed. For more information, see [Section 5.2 \[Compatibility\]](#), page 57.
  - A fairly LSB compliant GNU/Linux distribution.<sup>1</sup>
  - Linux 2.4 kernel (2.4.10 - 2.4.27).
  - glibc2 or better.
  - GNU groff (for man pages).<sup>2</sup>
  - GNU texinfo (for info files).

If you need to rebuild the package from sources with modifications, you will need a larger GNU tool chain as described in See [Section 6.2.8 \[Downloading from CVS\]](#), page 82.

### 5.2 Compatibility

This section discusses compatibility with major prerequisites.

#### 5.2.1 GNU/Linux Distributions

*OpenSS7 Linux Native SCTP* is compatible with the following *Linux* distributions:<sup>3</sup>

- CentOS Enterprise Linux 3.4 (centos34) TBD
- CentOS Enterprise Linux 4.0 (centos4) TBD
- CentOS Enterprise Linux 4.92 (centos49) TBD
- CentOS Enterprise Linux 5.0 (centos5)
- CentOS Enterprise Linux 5.1 (centos51)
- CentOS Enterprise Linux 5.2 (centos52)
- Debian 3.0r2 Woody (deb3.0) TBD

<sup>1</sup> See [Section 5.2.1 \[GNU/Linux Distributions\]](#), page 57, for more information.

<sup>2</sup> If you are using a Debian release, please make sure to install the groff extension package (`'groff_ext'`), as it contains the `refer` or `grefer` commands necessary for including references in the manual pages.

<sup>3</sup> Items marked as 'TBD' are scheduled to have support deprecated. That is, in a future release, the distributions marked 'TBD' will not longer be validated before release.

- Debian 3.1r0a Sarge (deb3.1) TBD
- Debian 4.0r1 Etch (deb4.0)
- Debian 4.0r2 Etch (deb4.0)
- Debian 4.0r3 Etch (deb4.0)
- Fedora Core 1 (FC1) TBD
- Fedora Core 2 (FC2) TBD
- Fedora Core 3 (FC3) TBD
- Fedora Core 4 (FC4) TBD
- Fedora Core 5 (FC5) TBD
- Fedora Core 6 (FC6) TBD
- Fedora 7 (FC7)
- Fedora 8 (FC8)
- Fedora 9 (FC9)
- Gentoo 2006.1 (untested) TBD
- Gentoo 2007.1 (untested) TBD
- Lineox 4.026 (LEL4) TBD
- Lineox 4.053 (LEL4) TBD
- Mandrakelinux 9.2 (MDK92) TBD
- Mandrakelinux 10.0 (MDK100) TBD
- Mandrakelinux 10.1 (MDK101) TBD
- Mandriva Linux LE2005 (MDK102) TBD
- Mandriva Linux LE2006 (MDK103) TBD
- Mandriva One (untested)
- RedHat Linux 7.2 (RH7)
- RedHat Linux 7.3 (RH7)
- RedHat Linux 8.0 (RH8) TBD
- RedHat Linux 9 (RH9) TBD
- RedHat Enterprise Linux 3.0 (EL3) TBD
- RedHat Enterprise Linux 4 (EL4)
- RedHat Enterprise Linux 5 (EL5)
- SuSE 8.0 Professional (SuSE8.0) TBD
- SuSE 9.1 Personal (SuSE9.1) TBD
- SuSE 9.2 Professional (SuSE9.2) TBD
- SuSE OpenSuSE (SuSEOSS) TBD
- SuSE 10.0 (SuSE10.0) TBD
- SuSE 10.1 (SuSE10.1) TBD
- SuSE 10.2 (SuSE10.2) TBD
- SuSE 10.3 (SuSE10.3) TBD
- SuSE 11.0 (SuSE11.0)

- SLES 9 (SLES9) TBD
- SLES 9 SP2 (SLES9) TBD
- SLES 9 SP3 (SLES9) TBD
- SLES 10 (SLES10)
- Ubuntu 5.10 (ubu5.10) TBD
- Ubuntu 6.03 LTS (ubu6.03) TBD
- Ubuntu 6.10 (ubu6.10) TBD
- Ubuntu 7.04 (ubu7.04) TBD
- Ubuntu 7.10 (ubu7.10)
- Ubuntu 8.04 (ubu8.04)
- WhiteBox Enterprise Linux 3.0 (WBEL3) TBD
- WhiteBox Enterprise Linux 4 (WBEL4) TBD

When installing from the tarball (see [Section 6.5.3 \[Installing the Tar Ball\]](#), page 109), this distribution is probably compatible with a much broader array of distributions than those listed above. These are the distributions against which the current maintainer creates and tests builds.

## 5.2.2 Kernel

The *OpenSS7 Linux Native SCTP* package compiles as a *Linux* kernel module. It is not necessary to patch the *Linux* kernel to build or use the package.<sup>4</sup> Nor do you have to recompile your kernel to build or use the package. OpenSS7 packages use `autoconf` scripts to adapt the package source to your existing kernel. The package builds and runs nicely against production kernels from the distributions listed above. Rather than relying on kernel versions, the `autoconf` scripts interrogate the kernel for specific features and variants to better adapt to distribution production kernels that have had patches applied over the official [kernel.org](http://kernel.org) sources.

The *OpenSS7 Linux Native SCTP* package is compatible with 2.4 kernel series after 2.4.10 and has been tested up to and including 2.4.27. It has been tested from 2.6.3 up to and including 2.6.26 (with Fedora 9, openSUSE 11.0 and Ubuntu 8.04 patchsets). Please note that your mileage may vary if you use a kernel more recent than 2.6.26.4: it is difficult to anticipate changes that kernel developers will make in the future. Many kernels in the 2.6 series now vary widely by release version and if you encounter problems, try a kernel within the supported series.

UP validation testing for kernels is performed on all supported architectures. SMP validation testing was initially performed on UP machines, as well as on an Intel 3.0GHz Pentium IV 630 with HyperThreading enabled (2x). Because HyperThreading is not as independent as multiple CPUs, SMP validation testing was limited. Current releases have been tested on dual 1.8GHz Xeon HP servers (2x) as well as dual quad-core SunFire (8x) servers.

It should be noted that, while the packages will configure, build and install against XEN kernels, that problems running validation test suites against XEN kernels has been reported. *XEN kernels are explicitly not supported*. This may change at some point in the future if someone really requires running OpenSS7 under a XEN kernel.

---

<sup>4</sup> At a later date, it is possible to move this package into the kernel, however, with continued resistance to STREAMS from within the *Linux* developer community, this is currently unlikely.

### 5.2.3 Architectures

The *OpenSS7 Linux Native SCTP* package compiles and installs on a wide range of architectures. Although it is believed that the package will work on all architectures supported by the Linux kernel being used, validation testing has only been performed with the following architectures:

- ix86
- x86\_64
- ppc (MPC 860)
- ppc64

32-bit compatibility validation testing is performed on all 64-bit architectures supporting 32-bit compatibility. If you would like to validate an OpenSS7 package on a specific machine architecture, you are welcome to sponsor the project with a test machine.

## 5.3 Release Notes

The sections that follow provide information on OpenSS7 releases of the *OpenSS7 Linux Native SCTP* package.

### Major changes for release sctp-0.2.27

This is the twenty-seventh release of the Linux Native (Sockets) SCTP from the OpenSS7 Project. This release, as with other releases, on builds and installs on 2.4 kernels. This package is not as important to the OpenSS7 Project as the STREAMS version of SCTP, which provides the basis for all of the SIGTRAN components for the OpenSS7 stacks. Also, the STREAMS version runs on both 2.4 and 2.6 kernels.

This is a stable production release: it deprecates previous releases. Please upgrade to the current release before reporting bugs.

This is primarily a maintenance release correcting reported bugs, but also includes the latest packaging improvements.

Major features since the last public release are as follows:

- Minor documentation corrections.
- Kernel module license made explicit "GPL v2". And then changed back to "GPL".
- License upgrade to *AGPL Version 3*.
- Ability to strap out major documentation build and installation primarily for embedded targets.
- Improvements to common build process for embedded and cross-compile targets.
- Updated tool chain to 'm4-1.4.12', 'autoconf-2.63' and 'texinfo-4.13'.
- Conversion of RPM spec files to common approach for major subpackages.
- Updated references database for manual pages and roff documents.
- Build system now builds **yum(8)** repositories for RPMs and **apt-get(8)** repositories for DEBs. Installation documentation has been updated to include details of repository install sourcesref.
- Added `MODULE_VERSION` to all modules and drivers.

*This is a public stable production grade release of the package: it deprecates previous releases. Please upgrade to the current release before reporting bugs.*

As with other OpenSS7 releases, this release configures, compiles, installs and builds RPMs and DEBs for a wide range of Linux 2.4 and 2.6 RPM- and DPKG-based distributions, and can be used on production kernels without patching or recompiling the kernel.

This package is publicly released under the *GNU Affero General Public License Version 3*. The release is available as an `autoconf` tarball, SRPM, DSC, and set of binary RPMs and DEBs. See the [downloads page](#) for the `autoconf` tarballs, SRPMs and DSCs. For tarballs, SRPMs, DSCs and binary RPMs and DEBs, see the [sctp package page](#).

See <http://www.openss7.org/codefiles/sctp-0.2.27/ChangeLog> and <http://www.openss7.org/codefiles/sctp-0.2.27/NEWS> in the release for more information. Also, see the ‘`sctp.pdf`’ manual in the release (also in html [http://www.openss7.org/sctp\\_manual.html](http://www.openss7.org/sctp_manual.html)).

For the news release, see [http://www.openss7.org/rel20081029\\_2.html](http://www.openss7.org/rel20081029_2.html).

## Major changes for release sctp-0.2.26

This is the twenty-sixth release of the Linux Native (Sockets) SCTP from the OpenSS7 Project. This release, as with other releases, on builds and installs on 2.4 kernels. This package is not as important to the OpenSS7 Project as the STREAMS version of SCTP, which provides the basis for all of the SIGTRAN components for the OpenSS7 stacks. Also, the STREAMS version runs on both 2.4 and 2.6 kernels.

This is a stable production release: it deprecates previous releases. Please upgrade to the current release before reporting bugs.

This is primarily a maintenance release correcting reported bugs, but also includes the latest packaging improvements.

Major features since the last public release are as follows:

- Support build on openSUSE 10.2.
- Support build on Fedora 7 with 2.6.21 kernel.
- Support build on CentOS 5.0 (RHEL5).
- Support build on Ubuntu 7.04.
- Updated to gettext 0.16.1.
- Changes to support build on 2.6.20-1.2307.fc5 and 2.6.20-1.2933.fc6 kernel.
- Supports build on Fedora Core 6.
- Support for recent distributions and tool chains.

## Major changes for release sctp-0.2.25

This is the twenty-fifth release of the Linux Native (Sockets) SCTP from the OpenSS7 Project. This release, as with other releases, on builds and installs on 2.4 kernels. This package is not as important to the OpenSS7 Project as the STREAMS version of SCTP, which provides the basis for all of the SIGTRAN components for the OpenSS7 stacks. Also, the STREAMS version runs on both 2.4 and 2.6 kernels.

This is a stable production release: it deprecates previous releases. Please upgrade to the current release before reporting bugs.

This is primarily a maintenance release correcting reported bugs, but also includes the latest packaging improvements.

Major features since the last public release are as follows:

- Support for autoconf 2.61, automake 1.10 and gettext 0.16.
- Support for Ubuntu 6.10 distribution and bug fixes for i386 kernels.

## Major changes for release sctp-0.2.24

This is the twenty-fourth release of the Linux Native (Sockets) SCTP from the OpenSS7 Project. This release, as with other releases, on builds and installs on 2.4 kernels. This package is not as important to the OpenSS7 Project as the STREAMS version of SCTP, which provides the basis for all of the SIGTRAN components for the OpenSS7 stacks. Also, the STREAMS version runs on both 2.4 and 2.6 kernels.

This is a stable production release: it deprecates previous releases. Please upgrade to the current release before reporting bugs.

This is primarily a maintenance release correcting reported bugs, but also includes the latest packaging improvements.

Following are highlights of some of the changes since the last release:

- Support for (configure but not build on) most recent 2.6.18 kernels (including Fedora Core 5 with inode diet patch set).
- Added **send-pr** scripts for automatic problem report generation.
- Now builds 32-bit compatibility libraries and tests them against 64-bit kernel modules and drivers. The **'make installcheck'** target will now automatically test both 64-bit native and 32-bit compatibility versions, one after the other, on 64-bit platforms.
- Improved compiler flag generation and optimizations for recent **gcc** compilers and some idiosyncratic behaviour for some distributions (primarily SUSE).
- Optimized compilation is now available also for user level programs in addition to kernel programs. Added new **'--with-optimize'** option to **configure** to accomplish this.
- Better detection of SUSE distributions, release numbers and SLES distributions: support for additional *SuSE* distributions on **ix86** as well as **x86\_64**. Added distribution support includes *SLES 9*, *SLES 9 SP2*, *SLES 9 SP3*, *SLES 10*, *SuSE 10.1*.
- Many documentation updates for all **OpenSS7** packages. Automated release file generation making for vastly improved and timely text documentation present in the release directory.
- Added **--disable-devel configure** option to suppress building and installing development environment. This feature is for embedded or pure runtime targets that do not need the development environment (static libraries, manual pages, documentation).
- Added **send-pr** script for automatic problem report generation.
- Fixed problems with unresolved symbols on some systems. Fixed glaring error in **sctp\_init** preventing kernel module from loading.
- Added init scripts and system control configuration data. Removed old preload approach to kernel module loading.



### Major changes for release sctp-0.2.23

Corrections for and testing of 64-bit clean compile and test runs on x86\_64 architecture. Some bug corrections resulting from gcc 4.0.2 compiler warnings.

Corrected build flags for Gentoo and 2.6.15 kernels as reported on mailing list.

### Major changes for release sctp-0.2.22

This is primarily a bug fixes release and corrections resulting from testing. This is a major bug fix release. The previous release was largely untested.

### Major changes for release sctp-0.2.21

With this release version numbers were changed to reflect an upstream version only to be consistent with other OpenSS7 package releases. All *RPM* release numbers will be ‘-1\$(PACKAGE\_RPMEXTRA)’ and all *Debian* release numbers will be ‘\_0’. If you wish to apply patches and release the package, please bump up the release number and apply a suitable release suffix for your organization. We leave *Debian* release number ‘\_1’ reserved for your use, so you can still bundle the source in the ‘.dsc’ file.

Improved build process.

Not publicly released.

### Initial release sctp-0.2.20-1

Initial autoconf/RPM packaging of the *sctp* release.

The *OpenSS7 Linux Native SCTP* existed before as a kernel patch for the Linux kernel. This is an *autoconf/rpm* packaging release of *Linux Native SCTP* that builds and installs separate from the Linux kernel tree.

Not publicly released.

## 5.4 Maturity

The *OpenSS7 Project* adheres to the following release philosophy:

- pre-alpha release
- alpha release
- beta release
- gamma release
- production release
- unstable release

### 5.4.1 Pre-Alpha Releases

*Pre-alpha* releases are releases that have received no testing whatsoever. Code in the release is not even known to configure or compile. The purpose of a pre-alpha release is to make code and documentation available for inspection only, and to solicit comments on the design approach or other characteristics of the software package.

*Pre-alpha* release packages ship containing warnings recommending that the user not even execute the contained code.

### 5.4.2 Alpha Releases

*Alpha* releases are releases that have received little to no testing, or that have been tested and contains known bugs or defects that make the package unsuitable even for testing. The purpose for an *alpha* release are the same as for the pre-alpha release, with the additional purpose that it is an early release of partially functional code that has problems that an external developer might be willing to fix themselves and contribute back to the project.

*Alpha* release packages ship containing warnings that executing the code can crash machines and might possibly do damage to systems upon which it is executed.

### 5.4.3 Beta Releases

*Beta* releases are releases that have received some testing, but the testing to date is not exhaustive. *Beta* release packages do not ship with known defects. All known defects are resolved before distribution; however, as exhaustive testing has not been performed, unknown defects may exist. The purpose for a *beta* release is to provide a baseline for other organizations to participate in the rigorous testing of the package.

*Beta* release packages ship containing warnings that the package has not been exhaustively tested and that the package may cause systems to crash. Suitability of software in this category for production use is not advised by the project; however, as always, is at the discretion of the user of the software.

### 5.4.4 Gamma Releases

*Gamma* releases are releases that have received exhaustive testing within the project, but external testing has been minimal. *Gamma* release packages do not ship with known defects. As exhaustive internal testing has been performed, unknown defects should be few. Please remember that there is NO WARRANTY on public release packages.

*Gamma* release packages typically resolve problems in previous *beta* releases, and might not have had full regression testing performed. Suitability of software in this category for production use is at the discretion of the user of the software. *The OpenSS7 Project* recommends that the complete validation test suites provided with the package be performed and pass on target systems before considering production use.

### 5.4.5 Production Releases

*Production* releases are releases that have received exhaustive testing within the project and validated on specific distributions and architectures. *Production* release packages do not ship with known defects. Please remember that there is NO WARRANTY on public release packages.

*Production* packages ship containing a list of validated distributions and architectures. Full regression testing of any maintenance changes is performed. Suitability of software in this category for production use on the specified target distributions and architectures is at the discretion of the user. It should not be necessary to preform validation tests on the set of supported target systems before considering production use.

### 5.4.6 Unstable Releases

*Unstable* releases are releases that have received extensive testing within the project and validated on a a wide range of distributions and architectures; however, is has tested unstable and found to be suffering from critical problems and issues that cannot be resolved.

Maintenance of the package has proved impossible. *Unstable* release packages ship with known defects (and loud warnings). Suitability of software in this category for production use is at the discretion of the user of the software. *The OpenSS7 Project* recommends that the problems and issues be closely examined before this software is used even in a non-production environment. Each failing test scenario should be completely avoided by the application. *OpenSS7* beta software is more stable than software in this category.

## 5.5 Bugs

### 5.5.1 Defect Notices

*OpenSS7 Linux Native SCTP* could contain unknown defects. This is a *beta* release. Some defects could be harmful. Validation testing has been performed by the *OpenSS7 Project* on this software for only a restricted set of systems. The software might fail to configure or compile on other systems. The *OpenSS7 Project* recommends that you **do not use this software for purposes other than validation testing and evaluation, and then only with care.** Use at your own risk. Remember that there is **NO WARRANTY**.<sup>5</sup>

**This software is *beta* software. As such, it might crash your kernel. Installation of the software might mangle your header files or Linux distribution in such a way as to make it unusable. Crashes could lock your system and rebooting the system might not repair the problem. You can possibly lose all the data on your system. Because this software might crash your kernel, the resulting unstable system could possibly destroy computer hardware or peripherals making them unusable. You might void the warranty on any system on which you run this software. YOU HAVE BEEN WARNED.**

### 5.5.2 Known Defects

With the exception of packages not originally created by the *OpenSS7 Project*, the *OpenSS7 Project* software does not ship with known bugs in any release stage except *pre-alpha*. *OpenSS7 Linux Native SCTP* had no known bugs at the time of release.

### 5.5.3 Defect History

This section contains historical bugs that were encountered during development and their resolutions. This list serves two purposes:

1. It captures bugs encountered between releases during development that could possibly reoccur (and the Moon is made of blue cheese). It therefore provides a place for users to look if they encounter a problem.
2. It provides a low overhead bug list between releases for developers to use as a ‘TODO’ list.

## Bugs

(no items)

## 5.6 Schedule

---

<sup>5</sup> See sections **Disclaimer of Warranty** and **Limitation of Liability** under [\[GNU Affero General Public License\]](#), [page 134](#).

## Current Plan

The current plan is to largely abandon the OpenSS7 Linux Native Sockets version of SCTP. It was developed for inclusion into mainline and only currently compiles for 2.4 kernels. The OpenSS7 STREAMS version of SCTP (the ‘**strsctp**’ package) implements the same protocol engine core and compiles and installs for 2.4 and 2.6 kernels. The STREAMS version meets the needs of the OpenSS7 Project better: implementing SIGTRAN as pushable modules and multiplexing drivers and allows signalling gateways to be built without messages crossing the user-kernel boundary. Therefore, it is unlikely that this version will have any further development. See the TODO file in the ‘**strsctp**’ package for more information on the current plan for that package.

Nevertheless, the project will continue to build and release this SCTP package against 2.4 kernels and it will continue to be part of the Master Package for some time to come.

## Things to Do

- Perform conformance and performance testing on the sctp-0.2.22 release.  
For conformance testing, my intention was to use the same conformance test tool and available in the strsctp (OpenSS7 STREAMS SCTP) package. This test tool uses the ability to directly send and intercept SCTP packets at the IP level.  
For performance testing, my intention was to use the iperf (OpenSS7 Modified Iperf) package.
- Perform x86\_64 HT SMP testing on sctp-0.2.22.

Things to do to convert to autoconf: (2006-02-23)

- Check for IPPROTO\_SCTP = 132 in /usr/include/netinet/in.h it should be there on more recent releases. It is there as a define as well as an enum. Therefore it is enough to add #ifndef IPPROTO\_SCTP to user files, but it is not as a define in linux/in.h so we will have to run a check against kernel headers.

*\*done\**

What I did was add the #ifndef the hooks.h file included after all other includes. That way if the enum is there and not the define, the define gets done anyway.

- We have our own linux/sctp.h Our linux/sctp.h is not installed. You will find the lksctp linux/sctp.h in the headers for some more recent c headers. It is lucky it is really in the wrong place: it should be in netinet/sctp.h for user programs. That is where we install the header file.

*\*done\**

Our header installs in netinet/sctp.h and has name space pollution protection.

- We need to override the struct sk\_buff definition from linux/skbuff.h to include the sctphdr in the h (transport header) union. We are in real trouble if the size of sctphdr exceeds the existing union.

*\*done\**

What I did was change all references to h.sh to use the macro SCTP\_SKB\_SH that was already defined. The definition of

SCTP\_SKB\_SH is based on the presence or absence of this field. This field is, however, normally absent because lksctp failed to fill it in.

We don't have to check the size of this because the transport header union is a union of pointers. What needs to be checked here is the size of the control block in the sk\_buff (sizeof sk\_buff.cb) against the size of our sctp\_skb\_cb structure that we cast the control block to. This was done using a compiler trick to compare sizes of complex data structures.

- We need to define SOL\_SCTP that should be in linux/socket.h for the socket layer. Some lksctp kernels already have it defined. It needs to be the protocol number of 132 so there is no conflict there.

*\*done\**

Same treatment as IPPROTO\_SCTP above.

- We need to add sysctl definitions for /proc/sys/net/ipv4 to linux/sysctl.h Again, I added these to /proc/sys/net/ipv4 whereas lksctp adds to /proc/sys/net/sctp. So there is no conflict. I don't know whether we should jump the number high enough that it does not conflict with any latter additions to /proc/sys/net/ipv4 or whether to determine the last index at build time. We should also override the /usr/include/linux/sysctl.h version with a patched version. It may be necessary to patch out conflicting SCTP names.
- We need definitions for inet\_sctp\_ops (struct proto\_ops) and need external definitions for inet\_bind(), inet\_multi\_getname() and inet\_ioctl() that are all missing from net/inet-common.h

*\*done\**

The necessary symbols have been ripped in acinclude.m4 and hooked in

- We have our own net/sctp.h lksctp doesn't have one so we're ok there.

*\*done\**

Yes, we just include it.

- net/snmp.h needs definitions for SCTP mibs. lksctp has stolen ours here but have missed some definitions: SctpMaxAssoc and SctpDiscontinuityTime. Fortunately we don't really use these two. Unfortunately, lksctp versions are not cacheline\_aligned. As it is only a structure definition, we don't need to override it, but could anyway.

*\*done\**

We override the mib definition with our own from net/net\_snmp.h

- We need to override struct sock in net/sock.h to include sctp\_opt for af\_sctp On earlier kernels we can simply override the struct but must check that the tp\_pinfo union has sufficient size for our definitions. On latter kernels, lksctp includes there own definition here, but perhaps we can pull some "define" tricks when CONFIG\_IP\_SCTP\_MODULE was set to override them.

*\*done\**

tp\_pinfo is too small, so I defined our sctp\_opt structure to span both tp\_pinfo and protinfo private fields. Configure checks that the spanning is correct and that there is sufficient room in the overlaid structure.

- Unexported netsyms: we will have to rip the following symbols if not exported:

```
EXPORT_SYMBOL(icmp_err_convert);
EXPORT_SYMBOL(icmp_statistics);
EXPORT_SYMBOL(inet_bind);
EXPORT_SYMBOL(inet_ioctl);
EXPORT_SYMBOL(inet_multi_getname);
EXPORT_SYMBOL(ip_build_and_send_pkt);
EXPORT_SYMBOL(ip_cmsg_send);
EXPORT_SYMBOL(ip_getsockopt);
EXPORT_SYMBOL(ip_options_echo);
EXPORT_SYMBOL(ip_rt_min_pmtu);
EXPORT_SYMBOL(ip_rt_mtu_expires);
EXPORT_SYMBOL(ip_rt_update_pmtu);
EXPORT_SYMBOL(ip_setsockopt);
EXPORT_SYMBOL(sysctl_ip_dynaddr);
EXPORT_SYMBOL(sysctl_ip_nonlocal_bind);
EXPORT_SYMBOL(sysctl_rmem_default);
EXPORT_SYMBOL(sysctl_wmem_default)
*done*
```

Actually, we rip a longer list as follows:

```
EXPORT_SYMBOL(icmp_err_convert);
EXPORT_SYMBOL(icmp_statistics);
EXPORT_SYMBOL(inet_bind);
EXPORT_SYMBOL(inet_getname);
EXPORT_SYMBOL(inet_ioctl);
EXPORT_SYMBOL(inet_multi_getname);
EXPORT_SYMBOL(ip_cmsg_send);
EXPORT_SYMBOL(ip_getsockopt);
EXPORT_SYMBOL(ip_route_output_flow);
EXPORT_SYMBOL(__ip_route_output_key);
EXPORT_SYMBOL(ip_rt_min_pmtu);
EXPORT_SYMBOL(ip_rt_mtu_expires);
EXPORT_SYMBOL(ip_rt_update_pmtu);
EXPORT_SYMBOL(ipsec_sk_policy);
EXPORT_SYMBOL(ip_setsockopt);
EXPORT_SYMBOL(sysctl_ip_dynaddr);
EXPORT_SYMBOL(sysctl_ip_nonlocal_bind);
EXPORT_SYMBOL(__xfrm_policy_check);
EXPORT_SYMBOL(xfrm_policy_delete);
EXPORT_SYMBOL(__xfrm_sk_clone_policy);
```

( even a longer list now... )

- We need to figure out what to do net/ipv4/af\_inet.c to get sctp to autoload correctly. Also, we need to override any other loaded sctp.

*\*done\**

We override lksetp by moving it out of the way to sctp\_deprecated. As far as autoloading is concerned we will have to load it manually to begin with.

- lkctp doesn't adjust the `ext_header_len` in `net/ipv4/ip_sockglue` when IP options are set on the socket. We might have to find some way to intercept socket option `IP_OPTIONS`.

*\*addressed\**

IP layer will just have to pull up the `sk_buff` if there is not enough headroom.

- Reporting snmp statistics. lkctp doesn't do this right (i.e. netstat broken.) Although we can generate our own `sctp_get_info`, we need to wrapper `snmp_get_info` and `afinet_get_info`. We can do this by ripping these symbols, indexing into the proc directory structures and then stabbing them. Or we could destroy them and recreate them with the wrapper. All we have to do is print our SCTP info first and then call the wrapper function for both `snmp_get_info` and `afinet_get_info`.

*\*done\**

I wrote wrappers for both `snmp_get_info` and `afinet_get_info` and reload the new version in the right place on module load and unload them later. `sctp_get_info` is defined and loaded under `/proc/net/sctp`.

- For `sysctl` we used to just add our entries to `/proc/sys/net/ipv4` in the kernel. We might be able to just jam the `ipv4_table` pointer in `net_table` to point to a new table which includes the SCTP entries.

*\*done\**

Entries added as before. Indexes start at 200 to avoid conflict with other entries at that level.

... And that's it. Just add compile our `sctp.c` file with our headers. The loading step might be the toughest.

## 5.7 History

For the latest developments with regard to history of changes, please see the 'ChangeLog' file in the release package.





## 6 Installation

### 6.1 Repositories

The OpenSS7 Linux Native SCTP package release can be accessed from the repositories of [The OpenSS7 Project](#). For `rpm(1)` based systems, the package is available in a `yum(8)` repository based on ‘`repomd`’ XML and may also be accessed using `zypper(8)` or `yast(8)`. For `dpkg(1)` based systems, the package is available in a `apt(8)` repository.

By far the easiest (most repeatable and manageable) form for installing and using *OpenSS7* packages is to install packages from the `yum(8)` or `apt(8)` repositories. If your distribution does not support `yum(8)`, `zypper(8)`, `yast(8)` or `apt(8)`, then it is still possible to install the RPMs or DEBs from the repositories using `rpm(1)`, `dpkg(1)`; or by using `wget(1)` and then installing them from RPM or DEB using `rpm(1)` or `dpkg(1)` locally.

If binaries are not available for your distribution or specific kernel, but your distribution supports `rpm(1)` or `dpkg(1)`, the next best method for installing and using *OpenSS7* packages is to download and rebuild the source RPMs or DSCs from the repository. This can also be performed with `yum(8)`, `zypper(8)`, `yast(8)`, `apt(8)`; or directly using `wget(1)`, `rpm(1)` or `dpkg(1)`.

If your architecture does not support `rpm(1)` or `dpkg(1)` at all, or you have special needs (such as cross-compiling for embedded targets), the final resort method is to download, configure, build and install from tarball. In this later case, the easiest way to build and install *OpenSS7* packages from tarball is to use the tarball for the *OpenSS7 Master Package*, `openss7-0.9.2.G`.

#### 6.1.1 Repositories for YUM

To install or upgrade from the *OpenSS7* ‘`repomd`’ repositories, you will need a file in your ‘`/etc/yum.repo.d/`’ directory. This file can be obtained directly from the *OpenSS7 repository*, like so:

```
$> REPOS="http://www.openss7.org/repos/rpms"
$> wget $REPOS/centos/5.2/x86_64/repodata/openss7.repo
$> sudo cp -f openss7.repo /etc/yum.repo.d/
$> sudo yum makecache
```

This example assumes the the distribution is ‘`centos`’ and the distribution release is ‘`5.2`’ and the architecture requires is ‘`x86_64`’. Another example would be ‘`$REPOS/i686/suse/11.0/i686/repodata/openss7.repo`’, for using `yum(8)` with SUSE.

Once the repository is set up, *OpenSS7* includes a number of virtual package definitions that eas the installation and removal of kernel modules, libraries and utilities. Downloading, configuring, building and installation for a single-kernel distribution is as easy as:

```
$> sudo yum install sctp
```

Removing the package is as easy as:

```
$> sudo yum remove sctp
```

If you have difficulty downloading the ‘`openss7.repo`’ file, edit the following information into the file and place it into the ‘`/etc/yum.repo.d/openss7.repo`’ file:

```

-| [openss7]
-| enabled = 1
-| name = OpenSS7 Repository
-| baseurl = http://www.openss7.org/repos/rpms/centos/5.2/x86_64
-| gpgcheck = 1
-| gpgkey = http://www.openss7.org/pubkey.asc

```

Note that it is also possible to point to these repositories as an additional installation source when installing CentOS, RedHat, Fedora, or others. You will have an additional *STREAMS* category from which to choose installation packages.

Some additional installation real or virtual package names and the installations they accomplish are as follows:

**‘sctp’**

This package can be used to install or remove the entire OpenSS7 Linux Native SCTP package. When installing, kernel modules will be installed automatically for the highest version kernel on your system. When removing, all corresponding kernel modules will also be removed.

**‘sctp-devel’**

This package can be used to install or remove the development components of the OpenSS7 Linux Native SCTP package. When installing, ‘sctp’ and appropriate kernel module and kernel module development and debug packages will also be installed. When removing, the development package and all kernel module development and debug packages will also be removed.

**‘sctp-2.4.20-28.7’**

This package can be used to install or remove the package for a specific kernel version. When installing, the ‘sctp’ package will also be installed if necessary. When removing the last kernel module package, the ‘sctp’ package will also be removed.

Note that the version ‘2.4.20-28.7’ is just an example. Use the version returned by ‘\$(uname -r)’ for the kernel for which you wish to install or remove the packages.

**‘sctp-2.4.20-28.7-devel’**

This package can be used to install or remove the development and debug packages for a specific kernel version. When installing, the ‘sctp’ and ‘sctp-devel’ packages will also be installed if necessary. When removing the development and debug for kernel modules for the last kernel, the ‘sctp-devel’ package will also be removed.

Note that the version ‘2.4.20-28.7’ is just an example. Use the version returned by ‘\$(uname -r)’ for the kernel for which you wish to install or remove the packages.

For assistance with specific RPMs, see [Section 6.2.3 \[Downloading the Binary RPM\]](#), [page 75](#).

### 6.1.2 Repositories for APT

For assistance with specific DEBs, see [Section 6.2.4 \[Downloading the Debian DEB\]](#), [page 78](#).

## 6.2 Downloading

The OpenSS7 Linux Native SCTP package releases can be downloaded from the downloads page of [The OpenSS7 Project](#). The package is available as a binary RPM (for popular architectures) a source RPM, Debian binary DEB and source DSC, or as a tar ball. If you are using a browsable viewer, you can obtain the OpenSS7 release of SCTP from the links in the sections that follow.

By far the easiest (most repeatable and manageable) form for installing and using *OpenSS7* packages is to download and install individual packages from binary RPM or DEB. If binary RPMs or DEBs are not available for your distribution, but your distribution supports `rpm(1)` or `dpkg(1)`, the next best method for installing and using *OpenSS7* packages is to download and rebuild the source RPMs or DSCs.

If your architecture does not support `rpm(1)` or `dpkg(1)` at all, or you have special needs (such as cross-compiling for embedded targets), the final resort method is to download, configure, build and install from tarball. In this later case, the easiest way to build and install *OpenSS7* packages from tarball is to use the tarball for the *OpenSS7 Master Package*, `openss7-0.9.2.G`.

### 6.2.1 Downloading with YUM

OpenSS7 repositories support `yum(8)` and `zypper(8)` in repomd XML format as well as YaST and YaST2 formats.

OpenSS7 includes virtual packages that ease the installation and removal of kernel modules, libraries and utilities. Downloading, configuration, building and installation for a single-kernel distribution installation is as easy as:

```
% sudo yum install sctp
```

This and additional packages for installation are detailed as follows:

- ‘sctp’**      Install this package if you need the runtime ‘sctp’ package.
- ```
% sudo yum install sctp
```
- This will install the ‘sctp’, ‘sctp-lib’ and ‘sctp-KVERSION’ RPMs, where ‘KVERSION’ is the highest version number kernel on your system.
- Remove this package if you need to remove all vestages of the ‘sctp’ package.
- ```
% sudo yum remove sctp
```
- This will remove the ‘sctp’, ‘sctp-lib’, ‘sctp-devel’, ‘sctp-KVERSION’ and ‘sctp-devel-KVERSION’ RPMs for all kernels on your system.
- ‘sctp-devel’**      Install this package if you need the development ‘sctp’ package.
- ```
% sudo yum install sctp-devel
```
- This will install the ‘sctp’, ‘sctp-lib’, ‘sctp-devel’, ‘sctp-KVERSION’ and ‘sctp-devel-KVERSION’ RPMs, where ‘KVERSION’ is the highest version number kernel on your system.
- Remove this package if you do not need development capabilities for the ‘sctp’ package for any kernel.

```
% sudo yum remove sctp-devel
```

This will remove the ‘sctp-devel’ and ‘sctp-devel-KVERSION’ RPMs for all kernels on your system.

‘sctp-2.4.20-28.7’

Install this package if you need the runtime ‘sctp’ for kernel version ‘2.4.20-28.7’. The value ‘2.4.20-28.7’ is just an example. For the running kernel, you can install the runtime ‘sctp’ components with:

```
% sudo yum install sctp-$(uname -r)
```

This will install the ‘sctp’, ‘sctp-lib’ and ‘sctp-2.4.20-28.7’ RPMs, where ‘2.4.20-28.7’ is the kernel version specified.

Remove this package if you no longer need the runtime ‘sctp’ for kernel version ‘2.4.20-28.7’. The value ‘2.4.20-28.7’ is just an example. For the running kernel, you can remove the runtime ‘sctp’ components with:

```
% sudo yum remove sctp-$(uname -r)
```

This will remove the ‘sctp-2.4.20-28.7’ and ‘sctp-devel-2.4.20-28.7’ RPMs, where ‘2.4.20-28.7’ is the kernel version specified. Also, if this is the last kernel for which ‘sctp’ was installed, the ‘sctp’ ‘sctp-lib’ and ‘sctp-devel’ RPMs will also be removed.

Note that this is a virtual package name: the actual RPMs installed or removed from the system is a kernel module package whose precise name will depend upon the system being used.

‘sctp-devel-2.4.20-28.7’

Install this package if you need the development ‘sctp’ package for kernel version ‘2.4.20-28.7’. The value ‘2.4.20-28.7’ is just an example. For the running kernel, you can install the kernel development ‘sctp’ components with:

```
% sudo yum install sctp-devel-$(uname -r)
```

This will install the ‘sctp’, ‘sctp-lib’, ‘sctp-devel’, ‘sctp-2.4.20-28.7’ and ‘sctp-devel-2.4.20-28.7’ RPMs, where ‘2.4.20-28.7’ is the kernel version specified.

Remove this package if you no longer need the development capabilities for the ‘sctp’ package for kernel version ‘2.4.20-28.7’. The value ‘2.4.20-28.7’ is just an example. For the running kernel, you can remove the kernel development ‘sctp’ components with:

```
% sudo yum remove sctp-devel-$(uname -r)
```

This will remove the ‘sctp-devel-2.4.20-28.7’ RPMs, where ‘2.4.20-28.7’ is the kernel version specified. Also, if this is the last kernel for which ‘sctp’ was installed, the ‘sctp-devel’ RPMs will also be removed.

Note that this is a virtual package name: the actual RPMs installed or removed from the system is a kernel module package whose precise name will depend upon the system being used.

‘sctp-lib’

This package is an auxillary package that should be removed and inserted automatically by [yum\(8\)](#). In rare instances you might need to remove or install this package explicitly.

## 6.2.2 Downloading with APT

OpenSS7 repositories support **apt(8)** repository digests and signatures.

## 6.2.3 Downloading the Binary RPM

To install from binary RPM, you will need several of the RPM for a complete installation. Binary RPM fall into several categories. To download and install a complete package requires the appropriate RPM from each of the several categories below, as applicable. Some release packages do not provide RPMs in each of the several categories.

To install from Binary RPM, you will need all of the following kernel independent packages for your architecture, and one of the kernel-dependent packages from the next section.

### Independent RPM

Independent RPM are dependent on neither the Linux kernel version, nor the *STREAMS* package. For example, the source package ‘**sctp-source-0.2.27-1.7.2.noarch.rpm**’, is not dependent on kernel nor *STREAMS* package.

All of the following kernel and *STREAMS* independent RPM are required for your architecture. Binary RPMs listed here are for example only: additional binary RPMs are available from the downloads site. If your architecture is not available, you can build binary RPM from the source RPM (see see [Section 6.4.1 \[Building from the Source RPM\]](#), page 106).

### Architecture Independent

#### **sctp-dev-0.2.27-1.7.2.noarch.rpm**

The ‘**sctp-dev**’ package contains the device definitions necessary to run applications programs developed for OpenSS7 Linux Native SCTP.<sup>1</sup>

#### **sctp-doc-0.2.27-1.7.2.noarch.rpm**

The ‘**sctp-doc**’ package contains this manual in plain text, postscript, ‘**pdf**’ and ‘**html**’ forms, along with the meta-information from the ‘**SCTP**’ package. It also contains all of the manual pages necessary for developing OpenSS7 Linux Native SCTP applications and OpenSS7 Linux Native SCTP *STREAMS* modules or drivers.

#### **sctp-init-0.2.27-1.7.2.noarch.rpm**

The ‘**sctp-init**’ package contains the **init** scripts and provides the ‘**postinst**’ scripts necessary to create kernel module preloads and modules definitions for all kernel module ‘**core**’ subpackages.

#### **sctp-source-0.2.27-1.7.2.noarch.rpm**

The ‘**sctp-source**’ package contains the source code necessary for building the OpenSS7 Linux Native SCTP release. It includes the **autoconf(1)** configuration utilities necessary to create and distribute tarballs, ‘**rpm**’ and ‘**deb**’/‘**dsc**’.<sup>2</sup>

<sup>1</sup> Not all distributions support the ‘**%dev**’ RPM macro: a case in point is the SuSE 8.0 distribution which uses an older version of **rpm(1)**. Distributions that do not support the ‘**%dev**’ macro will build devices as a ‘**%post**’ operation. Note also that not all release packages contain devices. Only packages that provide *STREAMS* character device drivers need devices, and then only when the ‘**specfs**’ or ‘**devfsd**’ is not being used.

<sup>2</sup> Note that not all releases have source RPM packages. Release packages that do not contain kernel modules do not generate a source RPM package.

## Architecture Dependent

### sctp-devel-0.2.27-1.7.2.i686.rpm

The ‘sctp-devel’ package contains library archives for static compilation, header files to develop OpenSS7 Linux Native SCTP modules and drivers. This also includes the header files and static libraries required to compile OpenSS7 Linux Native SCTP applications programs.

### sctp-lib-0.2.27-1.7.2.i686.rpm

The ‘sctp-lib’ package contains the run-time shared libraries necessary to run application programs and utilities developed for the ‘SCTP’ package.<sup>3</sup>

## STREAMS-Dependent RPM

*STREAMS*-Dependent RPM are dependent upon the specific *STREAMS* package being used, either *Linux STREAMS* or *Linux Fast-STREAMS*. Packages dependent upon *Linux STREAMS* will have ‘LiS’ in the package name. Packages dependent upon *Linux Fast-STREAMS* will have ‘streams’ in the package name. Note that some *STREAMS*-Dependent RPM are also Kernel-Dependent RPM as described below.

One of the following *STREAMS*-Dependent packages is required for your architecture. If your architecture is not on the list, you can build binary RPM from the source RPM (see see [Section 6.4.1 \[Building from the Source RPM\]](#), page 106).

### sctp-LiS-util-0.2.27-1.7.2.i686.rpm

The ‘sctp-LiS-util’ package provides administrative and configuration test utilities and commands associated with the OpenSS7 Linux Native SCTP package. Because this package must link a *STREAMS*-specific library, it is a *STREAMS*-Dependent package. Use the ‘sctp-LiS-util’ package if you have *LiS* installed.

### sctp-streams-util-0.2.27-1.7.2.i686.rpm

The ‘sctp-streams-util’ package provides administrative and configuration test utilities and commands associated with the OpenSS7 Linux Native SCTP package. Because this package must link a *STREAMS*-specific library, it is a *STREAMS*-Dependent package. Use the ‘sctp-streams-util’ package if you have *streams* installed.

## Kernel-Dependent RPM

Kernel-Dependent RPM are dependent on specific Linux Kernel Binary RPM releases. Packages are provided for popular released *RedHat* kernels. Packages dependent upon *RedHat* or other kernel RPM will have the ‘\_kversion’ kernel package version in the package name.

One of the following Kernel-Dependent packages is required for your architecture and kernel version. If your architecture or kernel version is not on the list, you can build binary RPM from the source RPM (see see [Section 6.4.1 \[Building from the Source RPM\]](#), page 106).<sup>4</sup>

<sup>3</sup> Note that not all release packages contain shared libraries, and, therefore, not all release packages contain this package.

<sup>4</sup> Note that on *Mandrakelinux*, unlike other RPM kernel distributions, kernel packages for the i86 architectures are always placed in i586 architecture packages regardless of the true processor architecture of the kernel package. ‘configure’ detects this and builds the appropriate packages.



**sctp-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm**

The ‘sctp-core’ package contains the loadable kernel modules that depend only on the kernel. This package is heavily tied to the kernel for which it was compiled. This particular package applies to kernel version ‘2.4.20-28.7’.<sup>5</sup>

**sctp-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm**

The ‘sctp-info’ package<sup>6</sup> contains the module symbol version information for the ‘core’ subpackage, above. It is possible to load this subpackage and compile modules that use the exported symbols without loading the actual kernel modules (from the ‘core’ subpackage above). This package is heavily tied to the kernel for which it was compiled. This particular package applies to kernel version ‘2.4.20-28.7’.<sup>7</sup>

**sctp-LiS-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm**

The ‘sctp-LiS-core’ package contains the kernel modules that provide the OpenSS7 Linux Native SCTP *STREAMS* modules and drivers. This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘LiS’ (*Linux STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>8</sup>

**sctp-streams-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm**

The ‘sctp-streams-core’ package contains the kernel modules that provide the OpenSS7 Linux Native SCTP *STREAMS* modules and drivers. This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘streams’ (*Linux Fast-STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>9</sup>

**sctp-LiS-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm**

The ‘sctp-LiS-info’ package<sup>10</sup> contains the module symbol version information for the ‘LiS-core’ subpackage, above. It is possible to load this subpackage and compile modules that use the exported symbols without loaded the actual kernel modules (from the ‘LiS-core’ subpackage above). This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘LiS’ (*Linux STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>11</sup>

<sup>5</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example. Note also that only release packages that contain kernel modules will contain a ‘core’ subpackage.

<sup>6</sup> Note that only release packages that contain kernel modules and that export versioned symbols will contain a ‘info’ subpackage. Also, this subpackage is only applicable to 2.4 series kernels and is not necessary and not built for 2.6 series kernels.

<sup>7</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>8</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>9</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>10</sup> Note that only release packages that contain kernel modules and that export versioned symbols will contain a ‘LiS-info’ subpackage.

<sup>11</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

**sctp-streams-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm**

The ‘**sctp-streams-info**’ package<sup>12</sup> contains the module symbol version information for the ‘**streams-core**’ subpackage, above. It is possible to load this subpackage and compile modules that use the exported symbols without loaded the actual kernel modules (from the ‘**streams-core**’ subpackage above). This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘**streams**’ (*Linux Fast-STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>13</sup>

## Configuration and Installation

To configure, build and install the binary RPM, See [Section 6.3.1 \[Configuring the Binary RPM\]](#), page 85.

### 6.2.4 Downloading the Debian DEB

To install from binary DEB, you will need several of the DEB for a complete installation. Binary DEB fall into several categories. To download and install a complete package requires the appropriate DEB from each of the several categories below, as applicable. Some release packages do not provide DEBs in each of the several categories.

To install from Binary DEB, you will need all of the following kernel independent packages for your architecture, and one of the kernel-dependent packages from the next section.

### Independent DEB

Independent DEB are dependent on neither the Linux kernel version, nor the *STREAMS* package. For example, the source package ‘**sctp-source\_0.2.27-0\_i386.deb**’, is not dependent on kernel nor *STREAMS* package.

All of the following kernel and *STREAMS* independent DEB are required for your architecture. Binary DEBs listed here are for example only: additional binary DEBs are available from the downloads site. If your architecture is not available, you can build binary DEB from the Debian DSC (see see [Section 6.4.2 \[Building from the Debian DSC\]](#), page 106).

### Architecture Independent

**sctp-dev\_0.2.27-0\_all.deb**

The ‘**sctp-dev**’ package contains the device definitions necessary to run applications programs developed for OpenSS7 Linux Native SCTP.<sup>14</sup>

**sctp-doc\_0.2.27-0\_all.deb**

The ‘**sctp-doc**’ package contains this manual in plain text, postscript, ‘pdf’ and ‘html’ forms, along with the meta-information from the ‘**SCTP**’ package. It also contains all of the manual pages necessary for developing OpenSS7 Linux Native SCTP applications and OpenSS7 Linux Native SCTP *STREAMS* modules or drivers.

<sup>12</sup> Note that only release packages that contain kernel modules and that export versioned symbols will contain a ‘**streams-info**’ subpackage.

<sup>13</sup> Note that the ‘**\_kversion**’ of ‘2.4.20-28.7’ is only an example.

<sup>14</sup> Note that not all release packages contain devices. Only packages that provide *STREAMS* character device drivers need devices, and then only when the ‘**specfs**’ or ‘**devfsd**’ is not being used.



**sctp-init\_0.2.27-0\_all.deb**

The ‘**sctp-init**’ package contains the **init** scripts and provides the postinst scripts necessary to create kernel module preloads and modules definitions for all kernel module ‘**core**’ subpackages.

**sctp-source\_0.2.27-0\_all.deb**

The ‘**sctp-source**’ package contains the source code necessary for building the OpenSS7 Linux Native SCTP release. It includes the **autoconf(1)** configuration utilities necessary to create and distribute tarballs, rpms and deb/dscs.<sup>15</sup>

**Architecture Dependent****sctp-devel\_0.2.27-0\_i386.deb**

The ‘**sctp-devel**’ package contains library archives for static compilation, header files to develop OpenSS7 Linux Native SCTP modules and drivers. This also includes the header files and static libraries required to compile OpenSS7 Linux Native SCTP applications programs.

**sctp-lib\_0.2.27-0\_i386.deb**

The ‘**sctp-lib**’ package contains the run-time shared libraries necessary to run application programs and utilities developed for the ‘**SCTP**’ package.<sup>16</sup>

**STREAMS-Dependent DEB**

*STREAMS*-Dependent DEB are dependent upon the specific *STREAMS* package being used, either *Linux STREAMS* or *Linux Fast-STREAMS*. Packages dependent upon *Linux STREAMS* will have ‘**LiS**’ in the package name. Packages dependent upon *Linux Fast-STREAMS* will have ‘**streams**’ in the package name. Note that some *STREAMS*-Dependent DEB are also Kernel-Dependent DEB as described below.

One of the following *STREAMS*-Dependent packages is required for your architecture. If your architecture is not on the list, you can build binary DEB from the Debian DSC (see see [Section 6.4.2 \[Building from the Debian DSC\]](#), [page 106](#)).

**sctp-LiS-util\_0.2.27-0\_i386.deb**

The ‘**sctp-LiS-util**’ package provides administrative and configuration test utilities and commands associated with the OpenSS7 Linux Native SCTP package. Because this package must link a *STREAMS*-specific library, it is a *STREAMS*-Dependent package. Use the ‘**sctp-LiS-util**’ package if you have *LiS* installed.

**sctp-streams-util\_0.2.27-0\_i386.deb**

The ‘**sctp-streams-util**’ package provides administrative and configuration test utilities and commands associated with the OpenSS7 Linux Native SCTP package. Because this package must link a *STREAMS*-specific library, it is a *STREAMS*-Dependent package. Use the ‘**sctp-streams-util**’ package if you have *streams* installed.

<sup>15</sup> Note that not all releases have source DEB packages. Release packages that do not contain kernel modules do not generate a source DEB package.

<sup>16</sup> Note that not all release packages contain shared libraries, and, therefore, not all release packages contain this package.

## Kernel-Dependent DEB

Kernel-Dependent DEB are dependent on specific Linux Kernel Binary DEB releases. Packages are provided for popular released *Debian* kernels. Packages dependent upon *Debian* or other kernel DEB will have the ‘\_kversion’ kernel package version in the package name.

One of the following Kernel-Dependent packages is required for your architecture and kernel version. If your architecture or kernel version is not on the list, you can build binary DEB from the source DEB (see see [Section 6.4.2 \[Building from the Debian DSC\], page 106](#)).<sup>17</sup>

### sctp-core-2.4.20-28.7\_0.2.27-0\_i386.deb

The ‘sctp-core’ package contains the loadable kernel modules that depend only on the kernel. This package is heavily tied to the kernel for which it was compiled. This particular package applies to kernel version ‘2.4.20-28.7’.<sup>18</sup>

### sctp-info-2.4.20-28.7\_0.2.27-0\_i386.deb

The ‘sctp-info’ package<sup>19</sup> contains the module symbol version information for the ‘core’ subpackage, above. It is possible to load this subpackage and compile modules that use the exported symbols without loading the actual kernel modules (from the ‘core’ subpackage above). This package is heavily tied to the kernel for which it was compiled. This particular package applies to kernel version ‘2.4.20-28.7’.<sup>20</sup>

### sctp-LiS-core-2.4.20-28.7\_0.2.27-0\_i386.deb

The ‘sctp-LiS-core’ package contains the kernel modules that provide the OpenSS7 Linux Native SCTP *STREAMS* modules and drivers. This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘LiS’ (*Linux STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>21</sup>

### sctp-streams-core-2.4.20-28.7\_0.2.27-0\_i386.deb

The ‘sctp-streams-core’ package contains the kernel modules that provide the OpenSS7 Linux Native SCTP *STREAMS* modules and drivers. This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘streams’ (*Linux Fast-STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>22</sup>

### sctp-LiS-info-2.4.20-28.7\_0.2.27-0\_i386.deb

The ‘sctp-LiS-info’ package<sup>23</sup> contains the module symbol version information for the ‘LiS-core’ subpackage, above. It is possible to load this subpack-

<sup>17</sup> Note that on *Mandrakelinux*, unlike other DEB kernel distributions, kernel packages for the ix86 architectures are always placed in i586 architecture packages regardless of the true processor architecture of the kernel package. ‘configure’ detects this and builds the appropriate packages.

<sup>18</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example. Note also that only release packages that contain kernel modules will contain a ‘core’ subpackage.

<sup>19</sup> Note that only release packages that contain kernel modules and that export versioned symbols will contain a ‘info’ subpackage. Also, this subpackage is only applicable to 2.4 series kernels and is not necessary and not built for 2.6 series kernels.

<sup>20</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>21</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>22</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>23</sup> Note that only release packages that contain kernel modules and that export versioned symbols will contain a ‘LiS-info’ subpackage.

age and compile modules that use the exported symbols without loaded the actual kernel modules (from the ‘**LiS-core**’ subpackage above). This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘**LiS**’ (*Linux STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>24</sup>

#### sctp-streams-info-2.4.20-28.7-0.2.27-0.i386.deb

The ‘**sctp-streams-info**’ package<sup>25</sup> contains the module symbol version information for the ‘**streams-core**’ subpackage, above. It is possible to load this subpackage and compile modules that use the exported symbols without loaded the actual kernel modules (from the ‘**streams-core**’ subpackage above). This package is heavily tied to the *STREAMS* package and kernel for which it was compiled. This particular package applies to ‘**streams**’ (*Linux Fast-STREAMS*) on kernel version ‘2.4.20-28.7’.<sup>26</sup>

## Configuration and Installation

To configure, build and install the Debian DEB, See [Section 6.3.2 \[Configuring the Debian DEB\]](#), page 87.

### 6.2.5 Downloading the Source RPM

If you cannot obtain a binary RPM for your architecture, or would like to roll you own binary RPM, download the following source RPM.

#### sctp-0.2.27-1.src.rpm

This is the source RPM for the package. From this source RPM it is possible to build binary RPM for any supported architecture and for any 2.4 or 2.6 kernel, for either *Linux STREAMS* or *Linux Fast-STREAMS*.

## Configuration

To configure the source RPM, See [Section 6.3.3 \[Configuring the Source RPM\]](#), page 87.

### 6.2.6 Downloading the Debian DSC

If you cannot obtain a binary DEB for your architecture, or would like to roll your own DEB, download the following Debian DSC.

#### sctp\_0.2.27-0.dsc

#### sctp\_0.2.27-0.tar.gz

This is the Debian DSC for the package. From this Debian DSC it is possible to build binary DEB for any supported architecture and for any 2.4 or 2.6 kernel, for either *Linux STREAMS* or *Linux Fast-STREAMS*.

## Configuration

To configure the source RPM, See [Section 6.3.4 \[Configuring the Debian DSC\]](#), page 93.

<sup>24</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

<sup>25</sup> Note that only release packages that contain kernel modules and that export versioned symbols will contain a ‘**streams-info**’ subpackage.

<sup>26</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

### 6.2.7 Downloading the Tar Ball

For non-`rpm(1)` and non-`dpkg(1)` architectures, download the tarball as follows:

`sctp-0.2.27.tar.gz`  
`sctp-0.2.27.tar.bz2`

These are the `tar(1)` balls for the release. These `tar(1)` balls contain the `autoconf(1)` distribution which includes all the source necessary for building and installing the package. These tarballs will even build Source RPM and Binary RPM on `rpm(1)` architectures and Debian DSC and DEB on `dpkg(1)` architectures.

The tar ball may be downloaded easily with `wget(1)` as follows:

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
```

or

```
% wget http://www.openss7.org/sctp-0.2.27.tar.gz
```

Note that you will need an *OpenSS7 Project* user name and password to download release candidates (which are only available to subscribers and sponsors of the *OpenSS7 Project*).

### Unpacking the Archive

After downloading one of the tar balls, unpack the archive using one of the following commands:

```
% wget http://www.openss7.org/sctp-0.2.27.tar.gz  
% tar -xzf sctp-0.2.27.tar.gz
```

or

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2  
% tar -xjvf sctp-0.2.27.tar.bz2
```

Either will create a subdirectory name ‘`sctp-0.2.27`’ containing all of the files and subdirectories for the Sctp package.

### Configuration

To configure and install the tar ball, See [Section 6.3.5 \[Configuring the Tar Ball\]](#), page 93.

### 6.2.8 Downloading from CVS

If you are a subscriber or sponsor of [The OpenSS7 Project](#) with CVS archive access privileges then you can download release, mid-release or release candidate versions of the ‘Sctp’ package from the project CVS archive.

The OpenSS7 Linux Native Sctp package is located in the ‘`sctp`’ module of ‘`/var/cvs`’. For release tag information, see [Chapter 5 \[Releases\]](#), page 57.

To access the archive from the project CVS pserver, use the following commands to check out a version from the archive:

```
% export CVSR00T='-d:pserver:username@cvs.openss7.com:2401/var/cvs'
% cvs login
Password: *****
% cvs co -r sctp_0.2.27 sctp
% cvs logout
```

It is, of course, possible to check out by date or by other criteria. For more information, see **cvs(1)**.

## Preparing the CVS Working Directory

Although public releases of the ‘SCTP’ package do not require reconfiguration, creating a configurable directory from the CVS archive requires tools not normally distributed with the other releases.

The build host requires the following GNU tools:

- m4 1.4.12
- autoconf 2.63
- automake 1.10.1
- libtool 2.2.4
- gettext 0.17
- flex 2.5.33
- bison 2.3

Most desktop development GNU/Linux distributions will have these tools; however, some non-development or server-style installations might not and they must be installed separately.<sup>27</sup>

Also, these tools can be acquired from the **FSF website** in the free software directory, and also at the following locations:

- **m4-1.4.12**
- **autoconf-2.63**
- **automake-1.10.1**
- **libtool-2.2.4**
- **gettext-0.17**
- **flex-2.5.33**
- **bison-2.3**

It should be stressed that, in particular, the **autoconf(1)**, and **automake(1)**, must be at version releases 2.63 and 1.10.1. *The versions normally distributed in some mainstream*

---

<sup>27</sup> Older version of bison (2.0) and the older version of flex (2.5.4a) are also suitable. Where possible, use the more recent bison 2.3 and flex 2.5.33.

*GNU/Linux distributions are, in fact, much older than these versions.*<sup>28</sup> GNU version of these packages configured and installed to default directories will install in ‘/usr/local/’ allowing them to coexist with distribution installed versions.

For building documentation, the build host also requires the following documentation tools:

- `gs` 6.51 or `ghostscript` 6.51, or newer.
- `tetex` 3.0 or `texlive` 2007, or newer.
- `texinfo` 4.13a or newer.
- `transfig` 3.2.3d or newer.
- `imagemagick` 5.3.8 or `ImageMagick` 5.3.8, or newer.
- `groff` 1.17.2 or newer.
- `gnuplot` 3.7 or newer.
- `latex2html` 1.62 or newer.

Most desktop GNU/Linux distributions will have these tools; however, some server-style installations (e.g. *Ubuntu-server*, *SLES 9* or *Fedora 6* or *7*) will not and they must be installed separately.<sup>29</sup>

Note that `texinfo` 4.12 must not be used as it breaks the build process.

For uncooked manual pages, the entire `groff(1)` package is required on older *Debian* and *Ubuntu* systems (the base package did not include `grefer(1)` which is used extensively by uncooked manual pages). The following will get what you need on older systems:

```
Debian: % apt-get install groff_ext
Ubuntu: % apt-get install groff
```

On newer systems, simply:

```
% apt-get install groff
```

In addition, the build host requires a complete tool chain for compiling for the target host, including kernel tools such as `genksyms(8)` and others.

If you wish to package ‘rpms’ on an `rpm(1)` system, or ‘debs’ on a `dpkg(1)` system, you will need the appropriate tool chain. Systems based on `rpm(1)` typically have the necessary tool chain available, however, `dpkg(1)` systems do not. The following on a *Debian* or *Ubuntu* system will get what you need:

```
% apt-get install debhelper
% apt-get install fakeroot
```

<sup>28</sup> A notable exception is *Debian* and *Fedora 7*. Note that on *Fedora 7* the `gettext-devel` package must be installed.

<sup>29</sup> In particular, for *CentOS*, *Fedora 6* or *7*, the `tetex-latex` and `gnuplot` packages must be loaded as well. Note also that the `latex2html` used to be part of the `textex` package (or subpackages) but is now often packaged on its own. Recent distributions such as *SUSE 11.0* and *Fedora 9* use the `texlive` package instead of the `tetex` package.

To generate a configuration script and the necessary scriptlets required by the GNU **autoconf**(1) system, execute the following commands on the working directory:

```
% autoreconf -fiv sctp
```

where, ‘sctp’ is the name of the directory to where the working copy was checked out under the previous step. This command generates the ‘configure’ script and other missing pieces that are normally distributed with the release Tar Balls, SRPMs and DSCs.

Make sure that ‘autoreconf --version’ returns ‘2.63’. Otherwise, you may need to perform something like the following:

```
% PATH="/usr/local/bin:$PATH"
% autoreconf -fiv sctp
```

After reconfiguring the directory, the package can then be configured and built using the same instructions as are used for the Tar Ball, see [Section 6.3.5 \[Configuring the Tar Ball\]](#), [page 93](#), and [Section 6.4.3 \[Building from the Tar Ball\]](#), [page 107](#).

Do note, however, that **make**(1) will rebuild the documentation that is normally released with the package. Additional tools may be necessary for building the documentation. To avoid building and installing the documentation, use the ‘--disable-devel’ or ‘--disable-docs’ option to configure described in [Section 6.3.5 \[Configuring the Tar Ball\]](#), [page 93](#).

When configuring the package in a working directory and while working a change-compile-test cycle that involves configuration macros or documentation, I find it of great advantage to invoke the GNU ‘configure’ options ‘--enable-maintainer-mode’, ‘--enable-dependency-tracking’ and ‘--disable-devel’. The first of these three options will add maintainer-specific targets to any generated ‘Makefile’, the second option will invoke automatic dependency tracking within the ‘Makefile’ so rebuilds after changes to macro, source or documentation files will be automatically rebuilt; and the last option will suppress rebuilding and reinstalling documentation manual pages and header files. Header files will still be available under the ‘/usr/src’ directory.

## 6.3 Configuration

### 6.3.1 Configuring the Binary RPM

In general the binary RPM do not require any configuration, however, during installation it is possible to relocate some of the installation directories. This allows some degree of customization. Relocations that are available on the binary RPM are as follows:

```
‘sctp-LiS-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm’
‘sctp-streams-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm’
    ‘/lib/modules/2.4.20-28.7’
```

This relocatable directory contains the kernel modules that provide the SCTP *STREAMS* core, drivers and modules.<sup>30</sup>

<sup>30</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

‘sctp-LiS-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm’  
‘sctp-streams-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm’  
    ‘/usr/include/sctp/2.4.20-28.7’  
        This relocatable directory contains the kernel module exported symbol information that allows other kernel modules to be compiled against the correct version of the sctp package.<sup>31</sup>

‘sctp-dev-0.2.27-1.7.2.i686.rpm’  
    (not relocatable)

‘sctp-devel-0.2.27-1.7.2.i686.rpm’  
    ‘/usr/lib’  
        This relocatable directory contains sctp libraries.

    ‘/usr/include/sctp’  
        This relocatable directory contains sctp header files.

‘sctp-doc-0.2.27-1.7.2.i686.rpm’  
    ‘/usr/share/doc’  
        This relocatable directory contains all package specific documentation (including this manual). The subdirectory in this directory is the ‘sctp-0.2.27’ directory.

    ‘/usr/share/info’  
        This relocatable directory contains info files (including the info version of this manual).

    ‘/usr/share/man’  
        This relocatable directory contains manual pages.

‘sctp-LiS-lib-0.2.27-1.7.2.i686.rpm’  
‘sctp-streams-lib-0.2.27-1.7.2.i686.rpm’  
    ‘/usr/lib’  
        This relocatable directory contains the run-time shared libraries necessary to run applications programs and utilities developed for OpenSS7 Linux Native SCTP.

    ‘/usr/share/locale’  
        This relocatable directory contains the locale information for shared library files.

‘sctp-source-0.2.27-1.7.2.i686.rpm’  
    ‘/usr/src’  
        This relocatable directory contains the source code.

‘sctp-LiS-util-0.2.27-1.7.2.i686.rpm’  
‘sctp-streams-util-0.2.27-1.7.2.i686.rpm’  
    ‘/usr/bin’  
        This relocatable directory contains binary programs and utilities.

<sup>31</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example. Also, note that the ‘info’ subpackage is only applicable to the 2.4 kernel series.



|                             |                                                                                              |
|-----------------------------|----------------------------------------------------------------------------------------------|
| <code>‘/usr/sbin’</code>    | This relocatable directory contains system binary programs and utilities.                    |
| <code>‘/usr/libexec’</code> | This relocatable directory contains test programs.                                           |
| <code>‘/etc’</code>         | This relocatable directory contains <code>init</code> scripts and configuration information. |

## Installation

To install the binary RPM, See [Section 6.5.1 \[Installing the Binary RPM\]](#), page 108.

### 6.3.2 Configuring the Debian DEB

In general the binary DEB do not require any configuration.

## Installation

To install the Debian DEB, See [Section 6.5.2 \[Installing the Debian DEB\]](#), page 109.

### 6.3.3 Configuring the Source RPM

When building from the source RPM (see [Section 6.4.1 \[Building from the Source RPM\]](#), page 106), the rebuild process uses a number of macros from the user’s `‘.rpmmacros’` file as described in [rpm\(8\)](#).

Following is an example of the `‘~/rpmmacros’` file that I use for rebuilding RPMS:

```
#
# RPM macros for building rpms
#

%vendor OpenSS7 Corporation
%distribution OpenSS7
%disturl http://www.openss7.org/
%packager Brian Bidulock <bidulock@openss7.org>
%url http://www.openss7.org/

%_signature gpg
%_gpg_path /home/brian/.gnupg
%_gpg_name openss7@openss7.org
%_gpgbin /usr/bin/gpg

%_source_payload w9.bzdio
%_binary_payload w9.bzdio

%_unpackaged_files_terminate_build 1
%_missing_doc_files_terminate_build 1
%_use_internal_dependency_generator 0
%_repackage_all_erasures 0
%_rollback_transaction_on_failure 0

%configure2_5x %configure
%make make
```

When building from the source RPM (see [Section 6.4.1 \[Building from the Source RPM\]](#), [page 106](#)), it is possible to pass a number of additional configuration options to the `rpmbuild(1)` process.

The additional configuration options are described below.

Note that distributions that use older versions of `rpm` do not have the ‘`--with`’ or ‘`--without`’ options defined. To achieve the same effect as:

```
--with someparm=somearg
```

do:

```
--define "_with_someparm --with-someparm=somearg"
```

This is a generic description of common `rpmbuild(1)` options. Not all `rpmbuild(1)` options are applicable to all SRPMs. Options that are kernel module specific are only applicable to SRPMs that build kernel modules. *STREAMS* options are only applicable to SRPMs that provide or require *STREAMS*.

```
--define "_kversion $PACKAGE_KVERSION"
```

Specifies the kernel version other than the running kernel for which to build. If `_kversion` is not defined when rebuilding, the environment variable `PACKAGE_KVERSION` is used. If the environment variable `PACKAGE_KVERSION` is not defined, then the version of the running kernel (i.e. discovered with ‘`uname -r`’) is used as the target version for kernel-dependent packages. This option can also be defined in an ‘`.rpmspec`’ file using the macro name ‘`_kversion`’.

```
--with checks
```

```
--without checks
```

Enable or disable preinstall checks. Each packages supports a number of preinstall checks that can be performed by invoking the ‘`check`’ target with `automake(1)`. These currently consist of checking each kernel module for unresolved kernel symbols, checking for documentation for exported kernel module symbols, checking for documentation for exported library symbols, checking for standard options for build and installable programs, checking for documentation for built and installable programs. Normally these checks are only run in maintainer mode, but can be enabled and disabled with this option.

```
--with k-optimize=HOW
```

```
--without k-optimize
```

Specify ‘`HOW`’ optimization, *normal*, *size*, *speed* or *quick*. *size* compiles kernel modules `-Os`, *speed* compiles kernel modules `-O3`, and *quick* compiles kernel modules `-O0`. The default is *normal*. Use with care.

```
--with cooked-manpages
```

```
--without cooked-manpages
```

Some systems do not like `grefer(1)` references in manual pages.<sup>32</sup> This option will cook `soelim(1)`, `refer(1)`, `tbl(1)` and `pic(1)` commands from the man-

<sup>32</sup> In particular, some *Debian* systems do not load the `groff(1)` extensions package and do not have `grefer(1)` installed. Although this is an oversight on the configuration of the particular *Debian* system, we accomodate such misconfiguration with this feature.

ual pages and also strip **groff(1)** comments. The default is to leave manual pages uncooked: they are actually smaller that way.

**--with public**

**--without public**

Release public packages or private packages. This option has no effect on the ‘SCTP’ package. The default is to release public packages.

**--with k-debug**

**--without k-debug**

Specifies whether kernel debugging is to be performed on the build kernel modules. Mutually exclusive with **test** and **safe** below. This has the effect of removing static and inline attributes from functions and invoking all debugging macros in the code. The default is to not perform kernel debugging.

**--with k-test**

**--without k-test**

Specifies whether kernel testing is to be performed. Mutually exclusive with **debug** above and **safe** below. This has the effect of removing static and inline attributes from functions and invoking most debugging macros in the code. The default is to not perform kernel testing.

**--with k-safe**

**--without k-safe**

Specifies whether kernel safety is to be performed. Mutually exclusive with **debug** and **test** above. This has the effect of invoking some more pedantic assertion macros in the code. The default is not to apply kernel safety.

**--with k-inline**

**--without k-inline**

Specifies whether kernel **inline** functions are to be placed inline. This has the effect of adding the ‘**-finline-functions**’ flag to **CFLAGS** for compiling kernel modules. Linux 2.4 kernels are normally compiled ‘**-O2**’ which does not respect the **inline** directive. This compiles kernel modules with ‘**-finline-functions**’ to get closer to ‘**-O3**’ optimization. For better optimization controls, See [Section 6.3.5 \[Configuring the Tar Ball\]](#), page 93.

**--with k-modversions**

**--without k-modversions**

Specifies whether kernel symbol versions are to be applied to symbols exported by package kernel modules. The default is to version exported module symbols. This package does not export symbols so this option has no effect.

**--with devfs**

**--without devfs**

Specifies whether the build is for a device file system daemon enabled system with autoloading, or not. The default is to build for **devfsd(1)** autoloading when **CONFIG.DEVFS.FS** is defined in the target kernel. The ‘**rebuild**’ target uses this option to signal to the RPM spec file that the ‘**dev**’ subpackage need not be built. This option does not appear when the package has no devices.

`--with devel`

`--without devel`

Specifies whether to build development environment packages such as those that include header files, static libraries, manual pages and `texinfo(1)` documentation. The default is to build development environment packages. This option can be useful when building for an embedded target where only the runtime components are desired.

`--with docs`

`--without docs`

Specifies whether to build and install major documentation such manual pages and `texinfo(1)` documentation. The default is to build and install documentation. This option can be useful when building for an embedded target where only the runtime and static compile components are desired, but not major documentation. This option does not override the setting of `--without devel`.

`--with tools`

`--without tools`

Specifies whether user space packages are to be built. The default is to build user space packages. This option can be useful when rebuilding for multiple architectures and target kernels. The ‘rebuild’ `automake(1)` target uses this feature when rebuilding for all available architectures and kernels, to rebuild user packages once per architecture instead of once per kernel.

`--with modules`

`--without modules`

Specifies whether kernel modules packages are to be built. The default is to build kernel module packages. This option can be useful when rebuilding for multiple architectures and target kernels. The ‘rebuild’ `automake(1)` target uses this feature to rebuild for all available architectures and kernels.

`--with lis`

`--without lis`

Specifies that the package is to be rebuilt against *Linux STREAMS*. The default is to automatically identify whether ‘LiS’ or ‘streams’ is loaded on the build system and build accordingly.

`--with lfs`

`--without lfs`

Specifies that the package is to be rebuilt against *Linux Fast-STREAMS*. The default is to automatically identify whether ‘LiS’ or ‘streams’ is loaded on the build system and build accordingly.

In addition, the following `rpm` options, specific to the OpenSS7 Linux Native SCTP package are available:

`--with sctp-slow-verification`

Enable slow verification of addresses and tags. When a message comes from an SCTP endpoint with the correct verification tag, it is not necessary to check whether it is from a correct source address to identify the SCTP association

to which it belongs. When you disable this feature (`--without sctp-slow-verification`), source addresses are not checked and it is up to firewall implementations to thwart attackers of the verification tag. When you enable this feature (`--enable-sctp-slow-verification`), you get RFC 2960 compliant operation, but at great cost to SCTP performance. This option defaults to 'disabled'.

**--with sctp-throttle-heartbeats**

Enable heartbeat throttling. Special feature of OpenSS7 Linux Native SCTP that is not mentioned in RFC 2960. When you enable this feature (`--with sctp-throttle-heartbeats`), OpenSS7 Linux Native SCTP will throttle the rate at which it responds to heartbeats to the system control *heartbeat\_interval*. This makes SCTP more resilient to implementations which flood heartbeat messages. For RFC 2960 compliant operation, disable this feature (`--without sctp-throttle-heartbeats`). This option defaults to 'disabled'.

**--with sctp-discard-ootb**

Enable discard of out-of-the-blue packets. RFC 2960 requires the implementation to send **ABORT** to some OOTB packets (packets for which no SCTP association exists). Sending **ABORT** chunks to unverified source addresses with the T bit set opens SCTP to blind masquerade attacks. Not sending them may lead to delays at the peer endpoint aborting associations where our **ABORT** has been lost and the socket is already closed or if we have restarted and the peer still has open associations to us. If you enable this feature (`--with sctp-discard-ootb`), SCTP will discard all OOTB packets. This is necessary if another SCTP stack is being run on the same machine. Therefore, if the OpenSS7 Linux Native SCTP package is included on an OpenSS7 SCTP kernel, this feature is automatically enabled. For RFC 2960 compliant operation, disable this feature (`--without sctp-discard-ootb`). This option defaults to 'disabled' for non-OpenSS7 SCTP kernels, and 'enabled' for OpenSS7 SCTP kernels.

**--with sctp-extended-ip-support**

Enable extended IP support for SCTP. This provides extended IP support for SCTP for things like IP Transparent Proxy and IP Masquerading. This is experimental stuff. If in doubt, disable this feature (`--without sctp-extended-ip-support`). This option defaults to 'disabled'.

**--with sctp-hmac-sha1**

Disable SHA-1 HMAC. This provides the ability to use the FIPS 180-1 (SHA-1) message authentication code in SCTP cookies. If you enable this feature (`--with sctp-hmac-sha1`), when the appropriate sysctl is set, SCTP will use the SHA-1 HMAC when signing cookies in the **INIT-ACK** chunk. If disable this feature (`--without sctp-hmac-sha1`), the SHA-1 HMAC will be unavailable for use with SCTP. This option defaults to 'enabled'.

**--with sctp-hmac-md5**

Disable MD5 HMAC. This provides the ability to use the MD5 (RFC 1321) message authentication code in SCTP cookies. If you enable this feature (`--with sctp-hmac-md5`), when the appropriate sysctl is set, SCTP will use the MD5 HMAC when signing cookies in the **INIT ACK** chunk. If you disable this

feature (`--without sctp-hmac-md5`), the MD5 HMAC will be unavailable for use with SCTP. This option defaults to `'enabled'`.

`--with sctp-adler32`

Enable Adler32 checksum. This provides the ability to use the older RFC 2960 Adler32 checksum. If `CONFIG_SCTP_CRC_32` below is not selected, the Adler32 checksum is always provided. This option defaults to `'disabled'`.

`--without sctp-crc32c`

Disable CRC-32C checksum. This provides the ability to use the newer CRC-32c checksum as described in RFC 3309. When this is selected and `CONFIG_SCTP_ADLER_32` is not selected above, then the only checksum that will be used is the CRC-32c checksum. This option defaults to `'enabled'`.

`--with sctp-throttle-passiveopens`

Enable throttling of passive opens. Special feature of Linux SCTP not mentioned in RFC 2960. When secure algorithms are used for signing cookies, the implementation becomes vulnerable to INIT and COOKIE-ECHO flooding. If you enable this feature (`--with sctp-throttle-passiveopens`), SCTP will only allow one INIT and one COOKIE-ECHO to be processed in each interval corresponding to the `sysctl sctp_throttle_itvl`. Setting `sctp_throttle_itvl` to 0 defeats this function. If you disable this feature (`--without sctp-throttle-passiveopens`), each INIT and COOKIE-ECHO will be processed. This option defaults to `'disabled'`.

`--with sctp-ecn`

Enable explicit congestion notification. This enables support for Explicit Congestion Notification (ECN) chunks in SCTP messages as defined in RFC 2960 and RFC 3168. It also adds `sysctl (/proc/net/ipv4/sctp-ecn)` which allows ECN for SCTP to be disabled at runtime. This option defaults to `'disabled'`.

`--with sctp-lifetimes`

Enable SCTP message lifetimes. This enables support for message lifetimes as described in RFC 2960. When enabled, message lifetimes can be set on messages. See `sctp(7)`. This feature is always enabled when Partial Reliability Support is set. This option defaults to `'disabled'`.

`--with sctp-add-ip`

Enable ADD-IP. This enables support for ADD-IP as described in `draft-ietf-tsvwg-addip-sctp-07.txt`. This allows the addition and removal of IP addresses from existing connections. This is experimental stuff. This option defaults to `'disabled'`.

`--with sctp-adaptation-layer-info`

Enable ALI. This enables support for the Adaptation Layer Information parameter described in `draft-ietf-tsvwg-addip-sctp-07.txt` for communicating application layer information bits at initialization. This is experimental stuff. This option defaults to `'disabled'`.

`--with sctp-partial-reliability`

Enable SCTP Partial Reliability (PR-SCTP). This enables support for PR-SCTP as described in `draft-stewart-tsvwg-prsctp-03.txt`. This allows for partial

reliability of message delivery on a "timed reliability" basis. This is experimental stuff. This option defaults to 'disabled'.

**--without sctp-error-generator**

Disable the SCTP error generator. This provides an internal error generator that can be accessed with socket options for testing SCTP operation under packet loss. You will need this option to run some of the test programs distributed with the SCTP module. This option defaults to 'enabled'.

**--without tcp-compatible**

Disables support for SOCK\_STREAM type TCP compatible sockets in addition to the normal SCTP SOCK\_SEQPACKET sockets. These work well and are normally enabled. This option defaults to 'enabled'.

**--with udp-compatible**

Enables support for SOCK\_RDM type RUDP compatible sockets in addition to the normal SCTP SOCK\_SEQPACKET sockets. These have not been tested. This is experimental stuff. This option defaults to 'disabled'.

In general, the default values of these options are sufficient for most purposes and no options need be provided when rebuilding the Source RPMs.

## Build

To build from the source RPM, See [Section 6.4.1 \[Building from the Source RPM\]](#), page 106.

### 6.3.4 Configuring the Debian DSC

The Debian DSC can be configured by passing options in the environment variable *BUILD\_DEBOPTIONS*. The options placed in this variable take the same form as those passed to the 'configure' script, See [Section 6.3.5 \[Configuring the Tar Ball\]](#), page 93. For an example, See [Section 6.4.2 \[Building from the Debian DSC\]](#), page 106.

## Build

To build from the Debian DSC, See [Section 6.4.2 \[Building from the Debian DSC\]](#), page 106.

### 6.3.5 Configuring the Tar Ball

All of the normal GNU **autoconf(1)** configuration options and environment variables apply. Additional options and environment variables are provided to tailor or customize the build and are described below.

#### 6.3.5.1 Configure Options

This is a generic description of common 'configure' options that are in addition to those provided by **autoconf(1)**, **automake(1)**, **libtool(1)** and **gettext(1)**.

Not all 'configure' options are applicable to all release packages. Options that are kernel module specific are only applicable to release packages that build kernel modules. *STREAMS* options are only applicable to release packages that provide or require *STREAMS*.

Following are the additional 'configure' options, their meaning and use:



`--enable-checks`

`--disable-checks`

Enable or disable preinstall checks. Each release package supports a number of preinstall checks that can be performed by invoking the ‘`check`’ target with `make(1)`. These currently consist of checking each kernel module for unresolved kernel symbols, checking for documentation for exported kernel module symbols, checking for documentation for exported library symbols, checking for standard options for build and installable programs, checking for documentation for built and installable programs. Normally these checks are only run in maintainer mode, but can be enabled and disabled with this option.

`--enable-autotest`

`--disable-autotest`

Enable or disable pre- and post-installation testing. Each release package supports a number of `autotest` test suites that can be performed by invoking the ‘`installcheck`’ target with `make(1)`. These currently consist of running installed modules, commands and binaries against a number of specific test cases. Normally these checks are only run in maintainer mode, but can be enabled and disabled with this option.

`--disable-compress-manpages`

Compress manual pages with ‘`gzip -9`’ or ‘`bzip2 -9`’ or leave them uncompressed. The default is to compress manual pages with ‘`gzip -9`’ or ‘`bzip2 -9`’ if a single compressed manual page exists in the target installation directory (‘`--mandir`’). This disables automatic compression.

`--disable-public`

Disable public release. This option is not usable on public releases and only has a usable effect on OpenSS7 Linux Native SCTP when the package is acquired from CVS. In particular, the *STREAMS SS7/VoIP/ISDN/SIGTRAN Stacks* (`strss7-0.9a.8`) release package has a large number of non-public components. Specifying this option will cause the package to build and install all private release components in addition to the public release components. This option affects all release packages. Most release packages do not have private release components.

`--disable-initscripts`

Disables the installation of `init` scripts. The default is to configure and install `init` scripts and their associated configuration files.

Although the default is to install `init` scripts, installation attempts to detect a System V `init` script configuration, and if one is not found, the `init` scripts are installed into the appropriate directories, but the symbolic links to the run level script directories are not generated and the script is not invoked. Therefore, it is safe to leave this option unchanged, even on distributions that do not support System V `init` script layout.

`--disable-32bit-libs`

Disables the build and install of 32-bit compatibility libraries and test binaries on 64-bit systems that support 32-bit compatibility. The default is to build and install 32-bit compatibility libraries and test binaries. This option can



be useful when configuring for an embedded target where only native shared libraries and binaries are desired.

#### `--disable-devel`

Disables the installation of development environment components such as header files, static libraries, manual pages and `texinfo(1)` documentation. The default is to install development environment components. This option can be useful when configuring for an embedded target where only the runtime components are desired, or when performing a edit-compile-test cycle.

#### `--disable-docs`

Disables the build and installation of major documentation such manual pages and `texinfo(1)` documentation. The default is to build and install documentation. This option can be useful when building for an embedded target where only the runtime and static compile components are desired, but not major documentation. This option does not override the setting of ‘`--disable-devel`’.

#### `--enable-tools`

Specifies whether user space programs and libraries are to be built and installed. The default is to build and install user space programs and libraries. This option can be useful when rebuilding for multiple architectures and target kernels, particularly under `rpm(1)` or `dpkg(1)`. The ‘rebuild’ `automake(1)` target uses this feature when rebuilding RPMs for all available architectures and kernels, to rebuild user packages once per architecture instead of once per kernel.

#### `--enable-modules`

Specifies whether kernel modules are to be built and installed. The default is to build and install kernel modules. This option can be useful when rebuilding for multiple architectures and target kernels, particularly under `rpm(1)` or `dpkg(1)`. The ‘rebuild’ `automake(1)` target uses this feature to rebuild for all available architectures and kernels. This option has no effect for release packages that do not provide kernel modules.

#### `--enable-arch`

Specifies whether architectural dependent package components are to be built and installed. This option can be useful when rebuilding for multiple architectures and target kernels, particularly under `dpkg(1)`. The default is to configure, build and install architecture dependent package components. This option has no effect for release packages that do not provide architecture dependent components.

#### `--enable-indep`

Specifies whether architecture independent package components are to be built and installed. This option can be useful when rebuilding for multiple architectures and target kernels, particularly under `dpkg(1)`. The default is to configure, build and install architecture independent package components. This options has no effect for release packages that do not provide architecture independent components.

**--enable-k-inline**

Enable kernel inline functions. Most Linux kernels build without ‘**-finline-functions**’. This option adds the ‘**-finline-functions**’ and ‘**-Winline**’ flags to the compilation of kernel modules. Use with care. This option has no effect for release packages that do not provide kernel modules.

**--enable-k-safe**

Enable kernel module run-time safety checks. Specifies whether kernel safety is to be performed. This option is mutually exclusive with ‘**--enable-k-test**’ and ‘**--enable-k-debug**’ below. This has the effect of invoking some more pedantic assertion macros in the code. The default is not to apply kernel safety. This option has no effect for release packages that have are no kernel modules.

**--enable-k-test**

Enable kernel module run-time testing. Specifies whether kernel testing is to be performed. This option is mutually exclusive with ‘**--enable-k-safe**’ above and ‘**--enable-k-debug**’ below. This has the effect of remove **static** and **inline** attributes from functions and invoking most non-performance affecting debugging macros in the code. The default is not to perform kernel testing. This option has no effect for release packages that do not provide kernel modules.

**--enable-k-debug**

Enable kernel module run-time debugging. Specifies whether kernel debugging is to be performed. This option is mutually exclusive with ‘**--enable-k-safe**’ and ‘**--enable-k-test**’ above. This has the effect of removing **static** and **inline** attributes from functions and invoking all debugging macros in the code (including performance-affecting debug macros). The default is to not perform kernel debugging. This option has no effect for release packages that do not provide kernel modules.

**--disable-k-modversions**

Disable module versions on SCTP symbols. Specifies whether kernel symbol versions are to be used on symbols exported from built SCTP modules. The default is to provide kernel symbol versions on all exported symbols. This option has no effect for release packages that do not provide kernel modules.

**--enable-devfs****--disable-devfs**

Specifies whether the build is for a device file system daemon enabled system with autoloading, or not. The default is to build for **devfsd(8)** autoloading when **CONFIG\_DEVFS\_FS** is defined in the target kernel. The ‘**reuild automake(1)**’ target uses this option to signal to the RPM spec file that the ‘**dev**’ subpackage need not be built. This option has no effect for release packages that do not provide devices.

**--with-gpg-user=GNUPGUSER**

Specify the **gpg(1)** ‘**GNUPGUSER**’ for signing RPMs and tarballs. The default is the content of the environment variable **GNUPGUSER**. If unspecified, the **gpg(1)** program will normally use the user name of the account invoking the **gpg(1)** program. For building source RPMs, the RPM macro ‘**\_gpg\_name**’ will override this setting.

`--with-gpg-home=GNUPGHOME`

Specify the ‘GNUPGHOME’ directory for signing RPMs and tarballs. The default is the user’s ‘`~/.gpg`’ directory. For building source RPMs, the RPM macro ‘`_gpg_path`’ will override this setting.

`--with-pkg-epoch=EPOCH`

Specifies the epoch for the package. This is neither used for `rpm(1)` nor `dpkg(1)` packages, it applies to the tarball release as a whole. The default is the contents of the ‘`.pkgePOCH`’ file in the release package source directory or, if that file does not exist, zero (0).

`--with-pkg-release=RELEASE`

Specifies the release for the package. This is neither used for `rpm(1)` nor `dpkg(1)` packages, it applies to the tarball release as a whole. The default is the contents of the ‘`.pkgrelease`’ file in the release package source directory or, if that file does not exist, one (1). This is the number after the last point in the package version number.

`--with-pkg-distdir=DIR`

Specifies the distribution directory for the package. This is used by the maintainer for building distributions of tarballs. This is the directory into which archives are copied for distribution. The default is the top build directory.

`--with-cooked-manpages`

Convert manual pages to remove macro dependencies and `grefer(1)` references. Some systems do not like `grefer(1)` references in manual pages.<sup>33</sup> This option will cook `soelim(1)`, `refer(1)`, `tbl(1)` and `pic(1)` commands from the manual pages and also strip `groff(1)` comments. The default is to leave manual pages uncooked (they are actually smaller that way).

`--with-rpm-epoch=PACKAGE_EPOCH`

Specify the ‘`PACKAGE_EPOCH`’ for the RPM spec file. The default is to use the RPM epoch contained in the release package file ‘`.rpmepoch`’.

`--with-rpm-release=PACKAGE_RPMRELEASE`

Specify the ‘`PACKAGE_RPMRELEASE`’ for the RPM ‘`spec`’ file. The default is to use the RPM release contained in the release package file ‘`.rpmrelease`’.

`--with-rpm-extra=PACKAGE_RPMEXTRA`

Specify the ‘`PACKAGE_RPMEXTRA`’ extra release information for the RPM spec file. The default is to use the RPM extra release information contained in the release package file ‘`.rpmextra`’. Otherwise, this value will be determined from automatic detection of the RPM distribution.

`--with-rpm-topdir=PACKAGE_RPMTOPDIR`

Specify the ‘`PACKAGE_RPMTOPDIR`’ top directory for RPMs. If specified with a null ‘`PACKAGE_RPMTOPDIR`’, the default directory for the RPM distribution will be used. If this option is not provided on the command line, the top build directory will be used as the RPM top directory as well.

<sup>33</sup> In particular, some *Debian* or *Ubuntu* systems do not load the `groff(1)` extensions package and do not have `grefer(1)` installed. Although this is an oversight on the configuration of the particular *Debian* or *Ubuntu* system, we accomodate such misconfiguration with this feature.

**--with-deb-epoch=EPOCH**

Specify the 'PACKAGE\_DEBEPOCH' for the DEB control file. The default is to use the DEB epoch contained in the release package file '.debepoch'.

**--with-deb-release=RELEASE**

Specify the 'PACKAGE\_DEBRELEASE' for the DEB control file. The default is to use the DEB release contained in the release package file '.debrelease'.

**--with-deb-topdir=DIR**

Specify the 'PACKAGE\_DEBTOPDIR' top directory for DEBs. If specified with a null 'PACKAGE\_DEBTOPDIR', the default directory for the DEB distribution will be used. If this option is not provided on the command line, the top build directory will be used as the DEB top directory as well.

**--with-k-release=PACKAGE\_KRELEASE**

Specify the 'PACKAGE\_KRELEASE' release of the Linux kernel for which the build is targeted. When not cross compiling, if this option is not set, the build will be targeted at the kernel running in the build environment (e.g., 'uname -r'). When cross-compiling this option must be specified or the configure script will generate an error and terminate.

**--with-k-linkage=PACKAGE\_KLINKAGE**

Specify the 'PACKAGE\_KLINKAGE' for kernel module linkage. This can be one of the following:

- 'loadable' – loadable kernel modules
- 'linkable' – linkable kernel objects

The default is to build loadable kernel modules.

**--with-k-modules=K-MODULES-DIR**

Specify the 'K-MODULES-DIR' directory to which kernel modules will be installed. The default is based on the option '--with-k-release', '--with-k-prefix' and '--with-k-rootdir'. The default is 'DESTDIR'/'K-MODULES-DIR' which is typically 'DESTDIR/lib/modules/PACKAGE\_KRELEASE/'. This directory is normally located by the 'configure' script and need only be provided for special cross-build environments or when requested by a 'configure' script error message.

**--with-k-build=K-BUILD-DIR**

Specify the 'K-BUILD-DIR' base kernel build directory in which configured kernel source resides. The default is 'DESTDIR/K-MODULES-DIR/build'. This directory is normally located by the 'configure' script and need only be provided for special cross-build environments or when requested by a 'configure' script error message.

**--with-k-source=K-SOURCE-DIR**

Specify the 'K-SOURCE-DIR' base kernel build directory in which configured kernel source resides. The default is 'DESTDIR/K-MODULES-DIR/source'. This directory is normally located by the 'configure' script and need only be provided for special cross-build environments or when requested by a 'configure' script error message.

`--with-k-modver=K-MODVER-FILE`

Specify the ‘K-MODVER-FILE’ kernel module versions file. The default is ‘*K-BUILD-DIR/Module.symvers*’. This file is normally located by the ‘`configure`’ script and need only be provided for special cross-build environments or when requested by a ‘`configure`’ script error message.

`--with-k-sysmap=K-SYSMAP-FILE`

Specify the ‘K-SYSMAP-FILE’ kernel system map file. The default is ‘*K-BUILD-DIR/System.map*’. This file is normally located by the ‘`configure`’ script and need only be provided for special cross-build environments or when requested by a ‘`configure`’ script error message.

`--with-k-archdir=K-ARCHDIR`

Specify the ‘K-ARCHDIR’ kernel source architecture specific directory. The default is ‘*DESTDIR/K-SOURCE-DIR/arch*’. This directory is normally located by the ‘`configure`’ script and need only be provided for special cross-build environments or when requested by a ‘`configure`’ script error message.

`--with-k-machdir=K-MACHDIR`

Specify the ‘K-MACHDIR’ kernel source machine specific directory. The default is ‘*DESTDIR/K-SOURCE-DIR/target\_cpu*’. This directory is normally located by the ‘`configure`’ script and need only be provided for special cross-build environments or when requested by a ‘`configure`’ script error message.

`--with-k-config=K-CONFIG`

Specify the ‘K-CONFIG’ kernel configuration file. The default is ‘*BOOT/config-K-RELEASE*’. This configuration file is normally located by the ‘`configure`’ script and need only be provided for special cross-build environments or when requested by a ‘`configure`’ script error message.

`--with-k-optimize=HOW`

`--without-k-optimize`

Specify ‘HOW’ optimization, *normal*, *size*, *speed* or *quick*. *size* compiles kernel modules `-Os`, *speed* compiles kernel modules `-O3`, and *quick* compiles kernel modules `-O0`. The default is *normal*. Use with care. The most common use of this option is to specify ‘`--with-k-optimize=speed --disable-k-safe`’ to compile for maximum performance. Nevertheless, even these setting are *ricing* and the resulting kernel modules will only be about 5% faster.

`--with-lis[=LIS-DIR]`

`--without-lis`

Specify the ‘LIS-DIR’ directory in which to find *LiS* headers. Also specifies that the build is to be made against Linux *STREAMS*. The default is ‘*/usr/include/LiS*’ if it exists, ‘*no*’ otherwise. This directory is normally located by the ‘`configure`’ script and need only be provided for special cross-build environments or when requested by a ‘`configure`’ script error message. This option has no effect on release packages that do not use the *STREAMS* subsystem.

`--with-lfs[=LFS-DIR]`

`--without-lfs`

Specify the 'LFS-DIR' directory in which to find *Lfs* headers. Also specifies that the build is to be made against Linux Fast-STREAMS. The default is '/usr/include/streams' if it exists, 'no' otherwise. This directory is normally located by the 'configure' script and need only be provided for special cross-build environments or when requested by a 'configure' script error message. This option has no effect on release packages that do not use the *STREAMS* subsystem.

`--with-strconf-master=STRCONF_CONFIG`

Specify the 'STRCONF\_CONFIG' file name to which the configuration master file is written. The default is 'Config.master'. This option has no effect on release packages that do not use the *STREAMS* subsystem and the strconf scripts. This option should not be specified when configuring the master package as the setting for all add-on packages will conflict.

`--with-base-major=STRCONF_MAJBASE`

Start numbering for major devices at 'STRCONF\_MAJBASE'. The default is '230'. This option has no effect on release packages that do not use the *STREAMS* subsystem and the strconf scripts. This option should not be specified when configuring the master package as the setting for all add-on packages will conflict.

In addition, the following `configure` options, specific to the OpenSS7 Linux Native SCTP package are available:

`--enable-sctp-slow-verification`

Enable slow verification of addresses and tags. When a message comes from an SCTP endpoint with the correct verification tag, it is not necessary to check whether it is from a correct source address to identify the SCTP association to which it belongs. When you disable this feature (`--disable-sctp-slow-verification`), source addresses are not checked and it is up to firewall implementations to thwart attackers of the verification tag. When you enable this feature (`--enable-sctp-slow-verification`), you get RFC 2960 compliant operation, but at great cost to SCTP performance. This option defaults to 'disabled'.

`--enable-sctp-throttle-heartbeats`

Enable heartbeat throttling. Special feature of OpenSS7 Linux Native SCTP that is not mentioned in RFC 2960. When you enable this feature (`--enable-sctp-throttle-heartbeats`), OpenSS7 Linux Native SCTP will throttle the rate at which it responds to heartbeats to the system control *heartbeat\_interval*. This makes SCTP more resilient to implementations which flood heartbeat messages. For RFC 2960 compliant operation, disable this feature (`--disable-sctp-throttle-heartbeats`). This option defaults to 'disabled'.

`--enable-sctp-discard-otb`

Enable discard of out-of-the-blue packets. RFC 2960 requires the implementation to send ABORT to some OTB packets (packets for which no SCTP



association exists). Sending ABORT chunks to unverified source addresses with the T bit set opens SCTP to blind masquerade attacks. Not sending them may lead to delays at the peer endpoint aborting associations where our ABORT has been lost and the socket is already closed or if we have restarted and the peer still has open associations to us. If you enable this feature (`--enable-sctp-discard-ootb`), SCTP will discard all OOTB packets. This is necessary if another SCTP stack is being run on the same machine. Therefore, if the OpenSS7 Linux Native SCTP package is included on an OpenSS7 SCTP kernel, this feature is automatically enabled. For RFC 2960 compliant operation, disable this feature (`--disable-sctp-discard-ootb`). This option defaults to 'disabled' for non-OpenSS7 SCTP kernels, and 'enabled' for OpenSS7 SCTP kernels.

**`--enable-sctp-extended-ip-support`**

Enable extended IP support for SCTP. This provides extended IP support for SCTP for things like IP Transparent Proxy and IP Masquerading. This is experimental stuff. If in doubt, disable this feature (`--disable-sctp-extended-ip-support`). This option defaults to 'disabled'.

**`--enable-sctp-hmac-sha1`**

Disable SHA-1 HMAC. This provides the ability to use the FIPS 180-1 (SHA-1) message authentication code in SCTP cookies. If you enable this feature (`--enable-sctp-hmac-sha1`), when the appropriate sysctl is set, SCTP will use the SHA-1 HMAC when signing cookies in the INIT-ACK chunk. If disable this feature (`--disable-sctp-hmac-sha1`), the SHA-1 HMAC will be unavailable for use with SCTP. This option defaults to 'enabled'.

**`--enable-sctp-hmac-md5`**

Disable MD5 HMAC. This provides the ability to use the MD5 (RFC 1321) message authentication code in SCTP cookies. If you enable this feature (`--enable-sctp-hmac-md5`), when the appropriate sysctl is set, SCTP will use the MD5 HMAC when signing cookies in the INIT ACK chunk. If you disable this feature (`--disable-sctp-hmac-md5`), the MD5 HMAC will be unavailable for use with SCTP. This option defaults to 'enabled'.

**`--enable-sctp-adler32`**

Enable Adler32 checksum. This provides the ability to use the older RFC 2960 Adler32 checksum. If CONFIG\_SCTP\_CRC\_32 below is not selected, the Adler32 checksum is always provided. This option defaults to 'disabled'.

**`--disable-sctp-crc32c`**

Disable CRC-32C checksum. This provides the ability to use the newer CRC-32c checksum as described in RFC 3309. When this is selected and CONFIG\_SCTP\_ADLER\_32 is not selected above, then the only checksum that will be used is the CRC-32c checksum. This option defaults to 'enabled'.

**`--enable-sctp-throttle-passiveopens`**

Enable throttling of passive opens. Special feature of Linux SCTP not mentioned in RFC 2960. When secure algorithms are used for signing cookies, the implementation becomes vulnerable to INIT and COOKIE-ECHO flooding.

If you enable this feature (`--enable-sctp-throttle-passiveopens`), SCTP will only allow one INIT and one COOKIE-ECHO to be processed in each interval corresponding to the `sysctl sctp.throttle_itvl`. Setting `sctp.throttle_itvl` to 0 defeats this function. If you disable this feature (`--disable-sctp-throttle-passiveopens`), each INIT and COOKIE-ECHO will be processed. This option defaults to 'disabled'.

`--enable-sctp-ecn`

Enable explicit congestion notification. This enables support for Explicit Congestion Notification (ECN) chunks in SCTP messages as defined in RFC 2960 and RFC 3168. It also adds `sysctl (/proc/net/ipv4/sctp-ecn)` which allows ECN for SCTP to be disabled at runtime. This option defaults to 'disabled'.

`--enable-sctp-lifetimes`

Enable SCTP message lifetimes. This enables support for message lifetimes as described in RFC 2960. When enabled, message lifetimes can be set on messages. See `sctp(7)`. This feature is always enabled when Partial Reliability Support is set. This option defaults to 'disabled'.

`--enable-sctp-add-ip`

Enable ADD-IP. This enables support for ADD-IP as described in `draft-ietf-tsvwg-addip-sctp-07.txt`. This allows the addition and removal of IP addresses from existing connections. This is experimental stuff. This option defaults to 'disabled'.

`--enable-sctp-adaptation-layer-info`

Enable ALI. This enables support for the Adaptation Layer Information parameter described in `draft-ietf-tsvwg-addip-sctp-07.txt` for communicating application layer information bits at initialization. This is experimental stuff. This option defaults to 'disabled'.

`--enable-sctp-partial-reliability`

Enable SCTP Partial Reliability (PR-SCTP). This enables support for PR-SCTP as described in `draft-stewart-tsvwg-prsctp-03.txt`. This allows for partial reliability of message delivery on a "timed reliability" basis. This is experimental stuff. This option defaults to 'disabled'.

`--disable-sctp-error-generator`

Disable the SCTP error generator. This provides an internal error generator that can be accessed with socket options for testing SCTP operation under packet loss. You will need this option to run some of the test programs distributed with the SCTP module. This option defaults to 'enabled'.

`--disable-tcp-compatible`

Disables support for SOCK\_STREAM type TCP compatible sockets in addition to the normal SCTP SOCK\_SEQPACKET sockets. These work well and are normally enabled. This option defaults to 'enabled'.

`--enable-udp-compatible`

Enables support for SOCK\_RDM type RUDP compatible sockets in addition to the normal SCTP SOCK\_SEQPACKET sockets. These have not been tested. This is experimental stuff. This option defaults to 'disabled'.



### 6.3.5.2 Environment Variables

Following are additional environment variables to ‘`configure`’, their meaning and use:

**GPG** GPG signature command. This is used for signing distributions by the maintainer. By default, ‘`configure`’ will search for this tool.

**GNUPGUSER**

GPG user name. This is used for signing distributions by the maintainer.

**GNUPGHOME**

GPG home directory. This is used for signing distributions by the maintainer.

**GPGPASSWD**

GPG password for signing. This is used for signing distributions by the maintainer. This environment variable is not maintained by the ‘`configure`’ script and should only be used on an isolated system.

**SOELIM** Roff source elimination command, `soelim(1)`. This is only necessary when the option ‘`--with-cooked-manpages`’ has been specified and ‘`configure`’ cannot find the proper `soelim(1)` command. By default, ‘`configure`’ will search for this tool.

**REFER** Roff references command, `refer(1)`. This is only necessary when the option ‘`--with-cooked-manpages`’ has been specified and ‘`configure`’ cannot find the proper `refer(1)` command. By default, ‘`configure`’ will search for this tool.

**TBL** Roff table command, `tbl(1)`. This is only necessary when the option ‘`--with-cooked-manpages`’ has been specified and ‘`configure`’ cannot find the proper `tbl(1)` command. By default, ‘`configure`’ will search for this tool.

**PIC** Roff picture command, `pic(1)`. This is only necessary when the option ‘`--with-cooked-manpages`’ has been specified and ‘`configure`’ cannot find the proper `pic(1)` command. By default, ‘`configure`’ will search for this tool.

**GZIP** Default compression options provided to `GZIP_CMD`.

**GZIP\_CMD**

Manpages (and kernel modules) compression commands, `gzip(1)`. This is only necessary when the option ‘`--without-compressed-manpages`’ has *not* been specified and ‘`configure`’ cannot find the proper `gzip(1)` command. By default, ‘`configure`’ will search for this tool.

**BZIP2** Default compression options provided to `BZIP2_CMD`

**BZIP2\_CMD**

Manpages compression commands, `bzip2(1)`. This is only necessary when the option ‘`--without-compressed-manpages`’ has *not* been specified and ‘`configure`’ cannot find the proper `bzip2(1)` command. By default, ‘`configure`’ will search for this tool.

**MAKEWHATIS**

Manpages apropos database rebuild command, `makewhatis(8)`. By default, ‘`configure`’ will search for this tool. By default, ‘`configure`’ will search for this tool.

*CHKCONFIG*

Chkconfig command, `chkconfig(8)`. This was used for installation of `init` scripts. All packages now come with `init_install(8)` and `init_remove(8)` scripts used to install and remove `init` scripts on both RPM and Debian systems.

*RPM* Rpm command, `rpm(1)`. This is only necessary for RPM builds. By default, 'configure' will search for this tool.

*RPMBUILD*

Build RPM command, `rpmbuild(1)`. This is only necessary for RPM builds. By default, 'configure' will search for this tool. `rpm(1)` will be used instead of `rpmbuild(1)` only if `rpmbuild(1)` cannot be found.

*DPKG* Dpkg command, `dpkg(1)`. This command is used for building Debian packages. By default, 'configure' will search for this tool.

*DPKG\_SOURCE*

Dpkg-source command, `dpkg-source(1)`. This command is used for building Debian dsc packages. By default, 'configure' will search for this tool.

*DPKG\_BUILDPACKAGE*

Dpkg-buildpackage command, `dpkg-buildpackage(1)`. This command is used for building Debian deb packages. By default, 'configure' will search for this tool.

*DEB\_BUILD\_ARCH*

Debian build architecture. This variable is used for building Debian packages. The default is the autoconf build architecture.

*DEB\_BUILD\_GNU\_CPU*

Debian build cpu. This variable is used for building Debian packages. The default is the autoconf build cpu.

*DEB\_BUILD\_GNU\_SYSTEM*

Debian build os. This variable is used for building Debian packages. The default is the autoconf build os.

*DEB\_BUILD\_GNU\_TYPE*

Debian build alias. This variable is used for building Debian packages. The default is the autoconf build alias.

*DEB\_HOST\_ARCH*

Debian host architecture. This variable is used for building Debian packages. The default is the autoconf host architecture.

*DEB\_HOST\_GNU\_CPU*

Debian host cpu. This variable is used for building Debian packages. The default is the autoconf host cpu.

*DEB\_HOST\_GNU\_SYSTEM*

Debian host os. This variable is used for building Debian packages. The default is the autoconf host os.

*DEB\_HOST\_GNU\_TYPE*

Debian host alias. This variable is used for building Debian packages. The default is the autoconf host alias.

*LDCONFIG*

Configure loader command, `ldconfig(8)`. Command used to configure the loader when libraries are installed. By default, ‘`configure`’ will search for this tool.

*DESTDIR* Cross build root directory. Specifies the root directory for build and installation.

*DEPMOD*

Build kernel module dependencies command, `depmod(8)`. This is used during installation of kernel modules to a running kernel to rebuild the modules dependency database. By default, ‘`configure`’ will search for this tool.

*MODPROBE*

Probe kernel module dependencies command, `modprobe(8)`. This is used during installation of kernel modules to a running kernel to remove old modules. By default, ‘`configure`’ will search for this tool.

*LSMOD*

List kernel modules command, `lsmod(8)`. This is used during installation of kernel modules to a running kernel to detect old modules for removal. By default, ‘`configure`’ will search for this tool.

*LSOF*

List open files command, `lsof(1)`. This is used during installation of kernel modules to a running kernel to detect old modules for removal. Processes owning the old kernel modules will be killed and the module removed. If the process restarts, the new module will be demand loaded. By default, ‘`configure`’ will search for this tool.

*GENKSYMS*

Generate kernel symbols command, `genksyms(8)`. This is used for generating module symbol versions during build. By default, ‘`configure`’ will search for this tool.

*KGENKSYMS*

Linux 2.6 generate kernel symbols command, `genksyms(8)`. This is used for generating module symbol version during build. By default, ‘`configure`’ will search for this tool.

*OBJDUMP*

Object dumping command, `objdump(1)`. This is used for listing information about object files. By default, ‘`configure`’ will search for this tool.

*NM*

Object symbol listing command, `nm(1)`. This is used for listing information about object files. By default, ‘`configure`’ will search for this tool.

*MODPOST\_CACHE*

Cache file for `modpost(1)`. The version of the `modpost.sh` script that ships with each package can cache information to a cache file to speed multiple builds. This environment variable is used to specify a cache file.

**AUTOM4TE**

Autom4te command, **autom4te(1)**. This is the executable used by **autotest** for pre- and post-installation checks. By default, ‘**configure**’ will search for this tool.

**AUTOTEST**

Autotest macro build command, **autom4te(1)**. This is the executable used by **autotest** for pre- and post-installation checks. By default, ‘**configure**’ will search for this tool.

**6.3.5.3 Build**

To build from the tar ball, See [Section 6.4.3 \[Building from the Tar Ball\]](#), page 107.

**6.4 Building****6.4.1 Building from the Source RPM**

If you have downloaded the necessary source RPM (see [Section 6.2.5 \[Downloading the Source RPM\]](#), page 81), then the following instructions will rebuild the binary RPMs on your system. Once the binary RPMs are rebuilt, you may install them as described above (see [Section 6.5.1 \[Installing the Binary RPM\]](#), page 108).

The source RPM is rebuilt to binary RPMs as follows:

```
% wget http://www.openss7.org/rpms/SRPMS/sctp-0.2.27-1.src.rpm
% rpmbuild --rebuild -vv sctp-0.2.27-1.src.rpm
```

The rebuild process can also recognize a number of options that can be used to tweak the resulting binaries, See [Section 6.3.3 \[Configuring the Source RPM\]](#), page 87. These options are provided on the **rpm(1)** command line. For example:

```
% rpmbuild --rebuild -vv --target athlon-redhat-linux \
--define "_kversion 2.4.20-28.7" \
--with lfs -- sctp-0.2.27-1.src.rpm
```

will rebuild binary RPM for the ‘2.4.20-28.7’ kernel for the ‘athlon’ architecture against the *Linux Fast-STREAMS STREAMS* package.<sup>34</sup>

**Installation**

To install the resulting binary RPM, See [Section 6.5.1 \[Installing the Binary RPM\]](#), page 108.

**6.4.2 Building from the Debian DSC**

If you have downloaded the necessary Debian DSC (see [Section 6.2.6 \[Downloading the Debian DSC\]](#), page 81), then the following instructions will rebuild the binary DEBs on your system. Once the binary DEBs are rebuilt, you may install them as described above (see [Section 6.5.2 \[Installing the Debian DEB\]](#), page 109).

<sup>34</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

The Debian DSC is rebuilt to binary DEBs as follows:

```
% wget http://www.openss7.org/debian/sctp_0.2.27-0.dsc
% wget http://www.openss7.org/debian/sctp_0.2.27-0.tar.gz
% dpkg-buildpackage -v sctp_0.2.27-0.dsc
```

The rebuild process can also recognize a number of options that can be used to tweak the resulting binaries, See [Section 6.3.4 \[Configuring the Debian DSC\]](#), page 93. These options are provided in the environment variable *BUILD\_DPKGOPTIONS* and have the same form as the options to ‘configure’, See [Section 6.3.5 \[Configuring the Tar Ball\]](#), page 93. For example:

```
% BUILD_DEBOPTIONS='
    --with-lfs
    --with-k-release=2.4.20-28.7
    --host=athlon-debian-linux-gnu'
dpkg-buildpackage -v \
sctp_0.2.27-0.dsc
```

will rebuild binary DEB for the ‘2.4.20-28.7’ kernel for the ‘athlon’ architecture against the *Linux Fast-STREAMS STREAMS* package.<sup>35</sup>

## Installation

To install the resulting binary DEB, See [Section 6.5.2 \[Installing the Debian DEB\]](#), page 109.

### 6.4.3 Building from the Tar Ball

If you have downloaded the tar ball (see [Section 6.2.7 \[Downloading the Tar Ball\]](#), page 82), then the following instructions will rebuild the package on your system. (Note that the build process does not required *root* privilege.)

#### 6.4.3.1 Native Build

Following is an example of a native build against the running kernel:

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
% tar -xjvf sctp-0.2.27.tar.bz2
% pushd sctp-0.2.27
% ./configure
% make
% popd
```

---

<sup>35</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

### 6.4.3.2 Cross-Build

Following is an example for a cross-build. The kernel release version must always be specified for a cross-build.<sup>36</sup> If you are cross-building, specify the root for the build with environment variable *DESTDIR*. The cross-compile host must also be specified if different from the build host. Either the compiler and other tools must be in the usual places where GNU *autoconf*(1) can find them, or they must be specified with declarations such as ‘*CC=/usr/lib/ppc-linux/gcc*’ on the ‘*configure*’ command line.

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
% tar -xjvf sctp-0.2.27.tar.bz2
% pushd sctp-0.2.27
% ./configure DESTDIR="/some/other/root" \
--with-k-release=2.4.18 --host sparc-linux
% make
% popd
```

## 6.5 Installing

### 6.5.1 Installing the Binary RPM

If you have downloaded the necessary binary RPMs (see [Section 6.2.3 \[Downloading the Binary RPM\]](#), page 75), or have rebuilt binary RPMs using the source RPM (see [Section 6.4.1 \[Building from the Source RPM\]](#), page 106), then the following instructions will install the RPMs on your system. For additional information on *rpm*(1), see *rpm*(8).

```
% pushd RPMS/i686
% rpm -ihv sctp-*-0.2.27-1.7.2.i686.rpm
```

You must have the correct binary RPMs downloaded or built for this to be successful.

Some of the packages are relocatable and can have final installation directories altered with the ‘*--relocate*’ option to *rpm*(1), see *rpm*(8). For example, the following will relocate the documentation and info directories:

```
% pushd RPMS/i686
% rpm -ihv \
    --relocate '/usr/share/doc=/usr/local/share/doc' \
    --relocate '/usr/share/info=/usr/local/share/info' \
    -- sctp-doc-0.2.27-1.7.2.i686.rpm
```

The previous example will install the ‘*sctp-doc*’ package by will relocate the documentation an info directory contents to the ‘*/usr/local*’ version.

<sup>36</sup> Because it *is* a cross-build, the kernel version on the build machine is unlikely to be the kernel version of the target machine, except by coincidence.

### 6.5.2 Installing the Debian DEB

If you have downloaded the necessary Debian DEBs (see [Section 6.2.4 \[Downloading the Debian DEB\]](#), page 78), or have rebuild binary DEBs using the Debian DSC (see [Section 6.4.2 \[Building from the Debian DSC\]](#), page 106), then the following instructions will install the DEBs on your system. For additional information see [dpkg\(8\)](#).

```
% pushd debian
% dpkg -iv sctp-*_0.2.27-0_*.deb
```

You must have the correct ‘.deb’ files downloaded or build for this to be successful.

### 6.5.3 Installing the Tar Ball

After the build process (see [Section 6.4.3 \[Building from the Tar Ball\]](#), page 107), installation only requires execution of one of two [automake\(1\)](#) targets:

‘make install’

The ‘install’ [automake\(1\)](#) target will install all the components of the package. Root privilege is required to successfully invoke this target.

‘make install-strip’

The ‘install-strip’ [automake\(1\)](#) target will install all the components of the package, but will strip unnecessary information out of the objects and compress manual pages. Root privilege is required to successfully invoke this target.

## 6.6 Removing

### 6.6.1 Removing the Binary RPM

To remove an installed version of the binary RPMs (whether obtained from the OpenSS7 binary RPM releases, or whether created by the source RPM), execute the following command:

```
% rpm -evv 'rpm -qa | grep '^sctp-'
```

For more information see [rpm\(1\)](#).

### 6.6.2 Removing the Debian DEB

To remove an installed version of the Debian DEB (whether obtained from the OpenSS7 binary DEB releases, or whether created by the Debian DSC), execute the following command:

```
% dpkg -ev 'dpkg -l | grep '^sctp-'
```

For more information see [dpkg\(8\)](#).

### 6.6.3 Removing the Source RPM

To remove all the installed binary RPM build from the source RPM, see [Section 6.6.1 \[Removing the Binary RPM\]](#), page 109. Then simply remove the binary RPM package files and source RPM file. A command such as:

```
% find / -name 'sctp-*.rpm' -type f -print0 | xargs --null rm -f
```

should remove all ‘SCTP’ RPMs from your system.

### 6.6.4 Removing the Debian DSC

To remove all the installed binary DEB build from the Debian DSC, see [Section 6.6.2 \[Removing the Debian DEB\]](#), page 109. Then simply remove the binary DEB package files and Debian DSC file. A command such as:

```
% find / \( -name 'sctp-*.deb' \  
-o -name 'sctp-*.dsc' \  
-o -name 'sctp-*.tar.*' \  
\) -type f -print0 | xargs --null rm -f
```

should remove all ‘SCTP’ DEBs, DSCs and TARs from your system.

### 6.6.5 Removing the Tar Ball

To remove a version installed from tar ball, change to the build directory where the package was built and use the ‘uninstall’ [automake\(1\)](#) target as follows:

```
% cd /usr/src/sctp  
% make uninstall  
% cd ..  
% rm -fr sctp-0.2.27  
% rm -f sctp-0.2.27.tar.gz  
% rm -f sctp-0.2.27.tar.bz2
```

If you have inadvertently removed the build directory and, therefore, no longer have a configured directory from which to execute ‘make uninstall’, then perform all of the steps for configuration and installation (see [Section 6.5.3 \[Installing the Tar Ball\]](#), page 109) except the final installation and then perform the steps above.

## 6.7 Loading

### 6.7.1 Normal Module Loading

When OpenSS7 Linux Native Sctp installs, modules and drivers belonging to release packages are normally configured for demand loading. The ‘install’ and ‘install-strip’ [automake\(1\)](#) targets will make the necessary changes to the ‘/etc/modules.conf’ file and place the modules in an appropriate place in ‘/lib/modules/2.4.20-28.7/sctp’. The



‘make install’ process should have copied the kernel module files ‘streams-\*.o’ to the directory ‘/lib/modules/2.4.20-28.7/sctp’. This means that to load any of these modules, you can simply execute, for example, ‘modprobe stream-somedriver’.<sup>37</sup>

### 6.7.1.1 Linux Fast-STREAMS Module Loading

The ‘sctp’ demand load system supports both the old `kernelld` and the new `kmod` mechanisms for demand loading kernel modules.

The convention for ‘sctp’ kernel loadable object files is:

- Their name start with "streams-".
- They are placed in ‘/lib/modules/2.4.20-28.7/streams/’, where ‘2.4.20-28.7’ is an example kernel version.

If your kernel has been built using the ‘kernelld’ daemon, then ‘SCTP’ kernel modules will automatically load as soon as the *STREAMS* module is pushed or the driver is opened. The ‘make install’ process makes the necessary changes to the ‘/etc/modules.conf’ file. After the install, you will see lines like the following added to your ‘/etc/modules.conf’ file:

```
prune modules.sctp
if -f /lib/modules/`uname -r`/modules.sctp
include /lib/modules/`uname -r`/modules.sctp
endif
```

which will provide for demand loading of the modules if they have been built and installed for the running kernel. The ‘/lib/modules/`uname -r`/modules.sctp’ file looks like this:

```
alias char-major-245 streams-some_driver
alias char-major-246 streams-other_driver
```

Note that *STREAMS* modules are not listed in this file, but will be loaded by name using ‘kernelld’ if available.

*Linux Fast-STREAMS* has a wider range of kernel module loading mechanisms than is provided by the deprecated *LiS*. For mechanisms used for kernel module loading under *Linux Fast-STREAMS*, See [Section “Top” in \*Linux Fast-STREAMS Reference Manual\*](#).

### 6.7.1.2 Linux STREAMS Module Loading

*LiS* is deprecated and this section has been deleted.

## 6.8 Maintenance

### 6.8.1 Makefile Targets

`automake(1)` has many targets, not all of which are obvious to the casual user. In addition, *OpenSS7 automake(1)* files have additional rules added to make maintaining and releasing a package somewhat easier. This list of targets provides some help with what targets can be invoked, what they do, and what they hope to achieve. The available targets are as follows:

<sup>37</sup> Note that the ‘\_kversion’ of ‘2.4.20-28.7’ is only an example.

### 6.8.1.1 User Targets

The following are normal targets intended to be invoked by installers of the package. They are concerned with compiling, checking the compile, installing, checking the installation, and removing the package.

**‘[all]’** This is also the default target. It compiles the package and all release packages selected by **‘configure’**. This is performed after configuring the source with **‘configure’**. A **‘Makefile’** stub is provided so that if the package has not had **autoreconf(1)** run (such as when checked out from CVS, the package will attempt to run **‘autoreconf -fiv’**.

All *OpenSS7 Project* packages are configured without maintainer mode and without dependency tracking by default. This speeds compilation of the package for one-time builds. This also means that if you are developing using the source package (edit-compile-test cycle), changes made to source files will not cause the automatic rebuilding due to dependencies. There are two ways to enable dependency tracking: specify **‘--enable-maintainer-mode’** to **‘configure’**; or, specify **‘--enable-dependency-tracking’** to **‘configure’**. I use the former during my edit-compile-test cycle.

This is a standard GNU **automake(1)** makefile target. This target does not require root privilege.

**‘check’** All *OpenSS7 Project* release packages provide check scripts for the check target. This step is performed after compiling the package and will run all of the **‘check’** programs against the compiled binaries. Which checks are performed depends on whether **‘--enable-maintainer-mode’** was specified to **‘configure’**. If in maintainer mode, checks that assist with the release of the package will be run (such as checking that all manual pages load properly and that they have required sections.) We recommend running the check stage before installing, because it catches problems that might keep the installed package from functioning properly.

Another way to enable the greater set of checks, without invoking maintainer mode, is to specify **‘--enable-checks’** to **‘configure’**. For more information, see [Section 7.1.1 \[Pre-installation Checks\]](#), page 123.

This is a standard GNU **automake(1)** makefile target, although the functions performed are customized for the *OpenSS7 Project*. This target does not require root privilege.

**‘install’**

**‘install-strip’**

The **‘install’** target installs the package by installing each release package. This target also performs some actions similar to the pre- and post-install scripts used by packaging tools such as **rpm(1)** or **dpkg(1)**. The **‘install-strip’** target strips unnecessary symbols from executables and kernel modules before installing.

This is a standard GNU **automake(1)** makefile target. This target requires root privilege.

**‘installcheck’**

All *OpenSS7 Project* packages provide test scripts for the ‘installcheck’ target. Test scripts are created and run using `autotest` (part of the `autoconf(1)` package). Which test suites are run and how extensive they are depends on whether ‘--enable-maintainer-mode’ was specified to ‘configure’. When in maintainer mode, all test suites will be run. When not in maintainer mode, only a few post-install checks will be performed, but the test suites themselves will be installed in ‘/usr/libexec/sctp’<sup>38</sup> for later use.

This is a standard GNU `automake(1)` makefile target. This target might require root privilege. Tests requiring root privilege will be skipped when run as a regular user. Tests requiring regular account privileges will be skipped when run as root.

**‘retest’**

To complement the ‘installcheck’ target above, all *OpenSS7 Project* packages provide the ‘retest’ target as a means to rerun failed conformance test suite test cases. The ‘retest’ target is provided because some test cases in the test suites have delicate timing considerations that allow them to fail sporadically. Invoking this target will retest the failed cases until no cases that are not expected failures remain.

This is an *OpenSS7 Project* specific makefile target. As with ‘installcheck’, this target might require root privilege. Tests requiring root privilege will be skipped when run as a regular user. Tests requiring regular account privileges will be skipped when run as root.

**‘uninstall’**

This target will reverse the steps taken to install the package. This target also performs pre- and post- erase scripts used by packaging tools such as *rpm* or *dpkg*. You need to have a configured build directory from which to execute this target, however, you do not need to have compiled any of the files in that build directory.<sup>39</sup>

The ‘uninstall’ target unfortunately removes add-on packages in the same order in which they were installed. This is not good for the *OpenSS7 Master Package*, where the ‘remove’ target should be used instead.

This is a standard GNU `automake(1)` makefile target. This target requires root privilege.

**‘remove’**

This target is like ‘uninstall’ with the exception that it removes add-on packages in the reverse order that installation was performed.<sup>40</sup>

This is an *OpenSS7 Project* specific makefile target. This target requires root privilege.

<sup>38</sup> ‘/usr/libexec/sctp’ is just an example, the actual location is ‘\${libexecdir}/\${PACKAGE}’, which varies from distribution to distribution (as some distributions such as Mandriva do not have a libexec directory).

<sup>39</sup> Therefore, it is possible to download the package, configure it, and then uninstall it. This is handy if you do not have the sources used to build and install the package immediately available.

<sup>40</sup> This is useful from the *OpenSS7 Master Package*.

### 6.8.1.2 Maintainer Targets

The following targets are targets intended for use by maintainers of the package, or those responsible for release and packaging of a derivative work of the package. Some of these targets are only effective when maintainer mode has been invoked (`--enable-maintainer-mode` specified to `'configure'`.)

**'dist'** Creates a distribution package (tarball) in the top level build directory. *OpenSS7 Project* packages distribute two archives: a `'gzip tar'` archive and a `'bzip tar'` archive. These archives will have the name `'sctp-0.2.27.tar.gz'` and `'sctp-0.2.27.tar.bz2'`.

This is a standard GNU `automake(1)` makefile target. This target does not require root privilege.

**'distcheck'**

This target is intended for use when releasing the package. It creates the `tar(1)` archives above and then unpacks the tarball in a source directory, configures in a separate build directory, compiles the package, installs the package in a separate install directory, tests the install package to ensure that some components work, and, finally, uses the unpacked source tree to build another tarball. If you have added or removed files from the package, this is a good way to ensure that everything is still stable for release.

This is a standard GNU `automake(1)` makefile target. This target does not require root privilege.

### 6.8.1.3 Clean Targets

**'mostlyclean'**

Cleans out most of the files from the compile stage. This target is helpful if you have not enabled dependency tracking and need to recompile with changes.

This is a standard GNU `automake(1)` makefile target. This target does not require root privilege.

**'clean'**

Cleans all the files from the build directory generated during the `'make [all]'` phase. It does not, however, remove files from the directory left there from the `'configure'` run. Use the `'distclean'` target to remove those too.

This is a standard GNU `automake(1)` makefile target. This target might require root privilege if the `'installcheck'` target or the `testsuite` was invoked with root privilege (leaving files belonging to root).

**'distclean'**

This target cleans out the directories left behind by `'distcheck'` and removes all the `'configure'` and generated files from the build directory. This will effectively remove all the files in the build directory, with the except of files that belong to you or some other process.

This is a standard GNU `automake(1)` makefile target. This target might require root privilege if the `'installcheck'` target or the `testsuite` was invoked with root privilege (leaving files belonging to root).

**‘maintainer-clean’**

This target not only removes files from the build directory, it removes generated files from the source directory as well. Care should be taken when invoking this target, because it removes files generated by the maintainer and distributed with the archive that might require special tools to regenerate. These special tools might only be available to the maintainer.<sup>41</sup> It also means that you probably need a full blown Linux system to rebuild the package. For more information, see [Section 6.2.8 \[Downloading from CVS\], page 82](#).

This is a standard GNU `automake(1)` makefile target. This target might require root privilege if the ‘installcheck’ target or the `testsuite` was invoked with root privilege (leaving files belonging to root).

**‘check-clean’**

This target removes log files left behind by the ‘check’ target. By default, the check scripts append to log files in the top level build directory. This target can be used to clean out those log files before the next run.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

### 6.8.1.4 Manual Page Targets

The following targets are used to build, install and uninstall just the manual pages from the distribution. These targets are good for creating a distribution of just the manual pages. When building atop multiple packages, these targets recurse down through each package.

**‘mans’** Build all of the manual pages. This involves performing parameter substitution on manual pages and optionally cooking the manual pages if ‘--with-cooked-manpages’ was requested during configuration.

**‘install-mans’**

Installs the manual pages under *DESTDIR*. Specify *DESTDIR* to place the manual pages wherever you see fit. If *DESTDIR* is not specified on the command line, the manual pages will be installed in the normal installation directory.

**‘uninstall-mans’**

Uninstalls the manual pages from *DESTDIR*. Specify *DESTDIR* to indicate where to remove the manual pages from. If *DESTDIR* is not specified on the command line, the manual pages will be removed from the normal installation directory.

### 6.8.1.5 Release Targets

The following are targets used to generate complete releases into the package distribution directory. These are good for unattended and NFS builds, which is what I use them for. Also, when building from atop multiple packages, these targets also recurse down through each package.

<sup>41</sup> Theoretically this is true, however, the *OpenSS7 Project* does not use any maintainer programs that are not generally available (i.e. open source).

**‘release’** Build all of the things necessary to generate a release. On an **rpm(1)** system this is the distribution archives, the source rpm, and the architecture dependent and architecture independent binary rpms. All items are placed in the package distribution directory that can be specified with the **‘--with-pkg-distdir=DIR’** option to **‘configure’**.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘forced-release’**

The **‘release’** target will not regenerate any files that already exist in the package distribution directory. This forced target will.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘release-sign’**

You will be prompted for a password, unless to specify it to make with the **GNUPGPASS** variable. For unattended or non-interactive builds with signing, you can do that as: **‘make GNUPGPASS=mypasswd release-sign’**

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘forced-release-sign’**

The **‘release-sign’** target will not regenerate any files that already exist in the package distribution directory. This forced target will.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘release-clean’**

This target will remove all distribution files for the current package from the package distribution directory.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

### 6.8.1.6 Logging Targets

For convenience, to log the output of a number of targets to a file, log targets are defined. The log file itself is used as the target to make, but make invokes the target minus a **‘.log’** suffix. So, for example, to log the results of target **‘foo’**, invoke the target **‘foo.log’**. The only target that this does not apply to is **‘compile.log’**. When you invoke the target **‘compile.log’** a simple **automake(1)** is invoked and logged to the file **‘compile.log’**. The **‘foo.log’** rule applies to all other targets. This does not work for all targets, just a selected few.<sup>42</sup> Following are the logging targets:

### Common Logging Targets

Common logging targets correspond to normal user **automake(1)** makefile targets as follows:

<sup>42</sup> Note that because logging targets invoke a pipe, **automake(1)** does not return the correct return status (always returns success if the **tee(1)** operation is successful). Therefore, these targets should not be invoked by scripts that need to use the return value from **automake(1)**.

- `'compile.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'[all]'`.
- `'check.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'check'`.
- `'install.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'install'`.
- `'installcheck.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'installcheck'`.
- `'uninstall.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'uninstall'`.
- `'remove.log'`  
This is an *OpenSS7 Project* specific makefile target, that invokes the *OpenSS7 Project* `'remove'` target.

## Maintainer Logging Targets

Maintainer logging targets correspond to maintainer mode `automake(1)` makefile targets as follows:

- `'dist.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'dist'`.
- `'distcheck.log'`  
This is an *OpenSS7 Project* specific makefile target, but it invokes the standard GNU `automake(1)` makefile target `'distcheck'`.
- `'srpm.log'`  
This is an *OpenSS7 Project* specific makefile target, that invokes the *OpenSS7 Project* `'srpm'` target.
- `'rebuild.log'`  
This is an *OpenSS7 Project* specific makefile target, that invokes the *OpenSS7 Project* `'rebuild'` target.
- `'resign.log'`  
This is an *OpenSS7 Project* specific makefile target, that invokes the *OpenSS7 Project* `'resign'` target.
- `'release.log'`  
This is an *OpenSS7 Project* specific makefile target, that invokes the *OpenSS7 Project* `'release'` target.
- `'release-sign.log'`  
This is an *OpenSS7 Project* specific makefile target, that invokes the *OpenSS7 Project* `'release-sign'` target.



If you want to add one, simply add it to *LOGGING\_TARGETS* in *'Makefile.am'*.

### 6.8.1.7 Problem Report Targets

To ease problem report generation, all logging targets will automatically generate a problem report suitable for mailing in the file *'target.pr'* for target *'target.log'*. This problem report file is in the form of an email and can be sent using the included *send-pr* script or by invoking the *'send-pr'* makefile target.

There are two additional problem report targets:

**'pr'** The *'pr'* target is for independently generating a problem report outside of the build or installation process. The target will automatically generate a problem report skeleton suitable for editing and mailing in the file *'problem.pr'*. This problem report file is in the form of an email and can be edited and sent directly, or sent using the included *send-pr* script or by invoking the *'send-pr'* target. This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**'send-pr'** The *'send-pr'* target is for finalizing and mailing a problem report generated either inside or outside the build and installation process. The target will automatically finalize and mail the *'problem.pr'* problem report if it has changed since the last time that *'send-pr'* was invoked.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege (unless the problem report file was generated as root).

### 6.8.1.8 Release Archive Targets

The following targets are used to generate and clean distribution archive and signature files. Whereas the *'dist'* target affects archives in the top build directory, the *'release-archive'* targets affects archives in the package distribution directory (either the top build directory or that specified with *'--with-pkg-distdir=DIR'* to *'configure'*).

You can change the directory to which packages are distributed by using the *'--with-pkg-distdir=DIR'* option to *'configure'*. The default directory is the top build directory.

**'release-archives'**

This target creates the distribution archive files if they have not already been created. This not only runs the *'dist'* target, but also copies the files to the distribution directory, which, by default is the top build directory.

The files generated are named:

*'sctp-0.2.27.tar.gz'* and *'sctp-0.2.27.tar.bz2'*

You can change this distribution directory with the *'--with-pkg-distdir'* option to *'configure'*. See *'./configure --help'* for more details on options.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**'release-sign-archives'**

This target is like *'release-archives'*, except that it also signs the archives using a *GPG* detached signature. You will be prompted for a password unless



you pass the *GNUPGPASS* variable to make. For automated or unattended builds, pass the *GNUPGPASS* variable like so:

```
'make GNUPGPASS=mypasswd release-sign-archives'
```

Signature files will be named:

```
'sctp-0.2.27.tar.gz.asc' and 'sctp-0.2.27.tar.bz2.asc'
```

These files will be moved to the package distribution directory with the plain text archives.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**'release-clean-archives'**

This target will clean the release archives and signature files from the package distribution directory.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

### 6.8.1.9 RPM Build Targets

On **rpm(1)** systems, or systems sporting rpm packaging tools, the following targets are used to generate **rpm(1)** release packages. The epoch and release number can be controlled by the contents of the `.rpmepoch` and `.rpmrelease` files, or with the `--with-rpm-epoch=EPOCH` and `--with-rpm-release=RELEASE` options to `configure`. See `configure --help` for more information on options. We always use release number '1'. You can use release numbers above '1'.

**'srpm'** This target generates the source rpm for the package (without signing the source rpm). The source rpm will be named: `'sctp-0.2.27-1.srpm'`.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**'rpms'** This target is responsible for generating all of the package binary rpms for the architecture. The binary rpms will be named:

```
'sctp*-0.2.27-1.*.rpm'
```

where the stars indicate the subpackage and the architecture. Both the architecture specific subpackages (binary objects) and the architecture independent (`.noarch`) subpackages will be built unless the former was disabled with the option `--disable-arch`, or the later with the option `--disable-indep`, passed to `configure`.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**'sign'**

**'srpm-sign'**

These two targets are the same. When invoked, they will add a signature to the source rpm file, provided that the file does not already have a signature. You will be prompted for a password if a signature is required. Automated or unattended builds can be achieved by using the `emake` expect script, included in `'${srcdir}/scripts/emake'`.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘rebuild’** This target accepts searches out a list of kernel names from the ‘`${DESTDIR}/lib/modules`’ directory and builds rpms for those kernels and for each of a set of architectures given in the *AM\_RPMTARGETS* variable to make. This is convenience target for building a group of rpms on a given build machine.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘resign’** This target will search out and sign, with a *GPG* signature, the source rpm, and all of the binary rpms for this package that can be found in the package distribution directory. This target will prompt for a *GPG* password. Automated or unattended builds can be achieved with the *emake* expect script located here: ‘`${srcdir}/scripts/emake`’.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

### 6.8.1.10 Debian Build Targets

On Debian systems, or systems sporting Debian packaging tools, the following targets are used to generate Debian release packages. The release number can be controlled by the contents of the ‘`.debrelease`’ file, or with the ‘`--with-debrelease=RELEASENUMBER`’ option to ‘`configure`’. See ‘`configure --help`’ for more information on options.

**‘dsc’** This target will build the Debian source change package (‘`.dsc`’ file). We use release number ‘0’ so that the entire tarball is included in the ‘`dsc`’ file. You can use release number ‘1’ for the same purposes. Release numbers above ‘1’ will not include the entire tarball. The ‘`.dsc`’ file will be named: ‘`sctp_0.2.27-0.dsc`’.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘sigs’** This target signs the ‘`.deb`’ files. You will be prompted for a password, unless to specify it to make with the *GNUPGPASS* variable.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘debs’** This target will build the Debian binary package (‘`.deb`’ file) from the ‘`.dsc`’ created above. (This target will also create the ‘`.dsc`’ if it has not been created already.) The subpackage ‘`.deb`’ files will be named: ‘`sctp-*_0.2.27-0_*.deb`’, where the stars indicate the subpackage and the architecture.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

**‘csig’** This target signs the ‘`.dsc`’ file. You will be prompted for a password, unless to specify it to make with the *GNUPGPASS* variable.

This is an *OpenSS7 Project* specific makefile target. This target does not require root privilege.

### 6.8.1.11 Documentation Targets

On systems that have `doxygen(1)` documentation tool, the following targets are used to generate doxygen html documentation:

`'doxy'`      This target generates `doxygen(1)` documentation from suitably marked sources. File containing the necessary documentation marks are discovered automatically by `configure`. Doxygen documentation can be generated but is not distributed. Documentation is created in the subdirectory `'doc/html'`.



## 7 Troubleshooting

### 7.1 Test Suites

#### 7.1.1 Pre-installation Checks

Most *OpenSS7* packages, including the *OpenSS7 Linux Native SCTP* package, ship with pre-installation checks integral to the build system. Pre-installation checks include check scripts that are shipped in the ‘scripts’ subdirectory as well as specialized `make` targets that perform the checks.

When building and installing the package from *RPM* or *DEB* source packages (see [Section 6.4.1 \[Building from the Source RPM\]](#), page 106; and [Section 6.4.2 \[Building from the Debian DSC\]](#), page 106), a fundamental set of post-compile, pre-installation checks are performed prior to building binary packages. This is performed automatically and does not require any special actions on the part of the user creating binary packages from source packages.

When building and installing the package from *tarball* (see [Section 6.4.3 \[Building from the Tar Ball\]](#), page 107; and [Section 6.5.3 \[Installing the Tar Ball\]](#), page 109), however, pre-installation checks are only performed if specifically invoked by the builder of the package. Pre-installation checks are invoked after building the package and before installing the package. Pre-installation checks are performed by invoking the ‘check’ or ‘check.log’ target to `make` when building the package, as shown in [Example 7.1](#).

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
% tar -xjvf sctp-0.2.27.tar.bz2
% pushd sctp-0.2.27
% ./configure
% make
% make check # <----- invoke pre-installation checks
% popd
```

Example 7.1: *Invoking Pre-Installation Checks*

Pre-installation checks fall into two categories: *System Checks* and *Maintenance Checks*.

##### 7.1.1.1 Pre-Installation System Checks

*System Checks* are post-compilation checks that can be performed before installing the package that check to ensure that the compiled objects function and will be successfully installed. When the ‘--enable-maintainer-mode’ option has not been passed to `configure`, only *System Checks* will be performed.

For example, the steps shown in [Example 7.2](#) will perform *System* checks.

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
% tar -xjvf sctp-0.2.27.tar.bz2
% pushd sctp-0.2.27
% ./configure
% make
% make check # <----- invokes System pre-installation checks
% popd
```

Example 7.2: *Invoking System Checks*

### 7.1.1.2 Pre-Installation Maintenance Checks

*Maintenance Checks* include all *System Checks*, but also checks to ensure that the kernel modules, applications programs, header files, development tools, test programs, documentation, and manual pages conform to *OpenSS7* standards. When the ‘*--enable-maintainer-mode*’ option has been passed to *configure*, *Maintenance Checks* will be performed.

For example, the steps shown in [Example 7.3](#) will perform *Maintenance* checks.

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
% tar -xjvf sctp-0.2.27.tar.bz2
% pushd sctp-0.2.27
% ./configure --enable-maintainer-mode
% make
% make check # <----- invokes Maintenance pre-installation checks
% popd
```

Example 7.3: *Invoking Maintenance Checks*

### 7.1.1.3 Specific Pre-Installation Checks

A number of check scripts are provided in the ‘*scripts*’ subdirectory of the distribution that perform both *System* and *Maintenance* checks. These are as follows:

#### *check\_commands*

This check performs both *System* and *Maintenance* checks.

When performing *System* tests, the following tests are performed:

Unless cross-compiling, or unless a program is included in *AM\_INSTALLCHECK\_STD\_OPTIONS\_EXEMPT* every program in *bin\_PROGRAMS*, *sbin\_PROGRAMS*, and *libexec\_PROGRAMS* is tested to ensure that the ‘*--help*’, ‘*--version*’, and ‘*--copying*’ options are accepted. When cross-compiling is not possible to execute cross-compiled binaries, and these checks are skipped in that case.

Script executables, on the other hand, can be executed on the build host, so, unless listed in *AM\_INSTALLCHECK\_STD\_OPTIONS\_EXEMPT*, every program in *dist\_bit\_SCRIPTS*, *dist\_sbin\_SCRIPTS*, and *pkglibexec\_SCRIPTS* are tested to ensure that the ‘*--help*’, ‘*--version*’, and ‘*--copying*’ options are accepted.

When performing *Maintenance* tests, *check\_commands* also checks to ensure that a manual page exists in section 1 for every executable binary or script

that will be installed from `bin_PROGRAMS` and `dist_bin_SCRIPTS`. It also checks to ensure that a manual page exists in section 8 for every executable binary or script that will be installed from `sbin_PROGRAMS`, `dist_sbin_SCRIPTS`, `libexec_PROGRAMS`, and `pkglibexec_SCRIPTS`.

#### `check_decls`

This check only performs *Maintenance* checks.

It collects the results from the `check_libs`, `check_modules` and `check_headers` check scripts and tests to ensure every declaration of a function prototype or external variable contained in installed header files has a corresponding exported symbol from either a to be installed shared object library or a to be installed kernel module. Declarations are exempted from this requirement if their identifiers have been explicitly added to the `EXPOSED_SYMBOL` variable. If `WARN_EXCESS` is set to 'yes', then the check script will only warn when excess declarations exist (without a corresponding exported symbol); otherwise, the check script will generate an error and the check will fail.

#### `check_headers`

This check only performs *Maintenance* checks.

When performing *Maintenance* tests, it identifies all of the declarations included in to be installed header files. It then checks to ensure that a manual page exists in sections 2, 3, 7 or 9, as appropriate, for the type of declaration. It also checks to see if a manual page source file exists in the source directory for a declaration that has not been included in the distribution. Function or prototype declarations that do not have a manual page in sections 2, 3, or 9 will cause the check to fail. Other declarations ('variable', 'externvar', 'macro', 'enumerate', 'enum', 'struct', 'union', 'typedef', 'member', etc.) will only warn if a manual page does not exist, but will not fail the check.

#### `check_libs`

This check only performs *Maintenance* checks.

When performing *Maintenance* tests, it checks that each exported symbol in each to be installed shared object library has a manual page in section 3. It also checks that each exported symbol has a 'function', 'prototype' or 'externvar' declaration in the to be installed header files. A missing declaration or manual page will cause this check to fail.

#### `check_mans`

This check only performs *Maintenance* checks.

When performing *Maintenance* tests, it checks that to be install manual pages can be formatted for display without any errors or warnings from the build host `man` program. It also checks that required headings exist for manual pages according to the section in which the manual page will be installed. It warns if recommended headings are not included in the manual pages. Because some *RPM* distributions have manual pages that might conflict with the package manual pages, this check script also checks for conflicts with installed manual pages on the build host. This check script also checks to ensure that all to be

installed manual pages are used in some fashion, that is, they have a declaration, or exported symbol, or are the name of a kernel module or STREAMS module or driver, possibly capitalized.

Note that checking for conflicts with the build host should probably be included in the *System* checks (because *System* checks are performed before the source *RPM %install* scriptlet).

#### `check_modules`

This check performs both *System* and *Maintenance* checks.

When performing *System* tests, it checks each to be installed kernel module to ensure that all undefined symbols can be resolved to either the kernel or another module. It also checks whether an exported or externally declared symbol conflicts with an exported or externally declared symbol present in the kernel or another module.<sup>1</sup>

When performing *Maintenance* tests, this check script tests that each to be installed kernel module has a manual page in section 9 and that each exported symbol that does not begin with an underscore, and that belongs to an exported function or exported variable, has a manual page in section 9. It also checks to ensure that each exported symbol that does not begin with an underscore, and that belongs to an exported function or exported variable, has a ‘`function`’, ‘`prototype`’ or ‘`externvar`’ declaration in the to be installed header files.

#### `check_streams`

This check performs only *Maintenance* checks.

When performing *Maintenance* tests, it checks that for each configured *STREAMS* module or driver, or device node, that a manual page exists in section 4 or section 7 as appropriate.

The output of the pre-installation tests are fairly self explanatory. Each check script saves some output to ‘`name.log`’, where *name* is the name of the check script as listed above. A summary of the results of the test are display to standard output and can also be captured to the ‘`check.log`’ file if the ‘`check.log`’ target is used instead of the ‘`check`’ target to `make`.

Because the check scripts proliferate ‘`name.log`’ files throughout the build directory, a ‘`make check-clean`’ `make` target has be provided to clean them out. ‘`make check-clean`’ should be run before each successive run of ‘`make check`’.

### 7.1.2 Post-installation Checks

Most OpenSS7 packages ship with a compatibility and conformance test suite built using the ‘`autotest`’ capabilities of ‘`autoconf`’. These test suites act as a wrapper for the compatibility and conformance test programs that are shipped with the package.

Unlike the pre-installation checks, the post-installation checks are always run complete. The only check that post-installation test scripts perform is to test whether they have been invoked with root privileges or not. When invoked as root, or as a plain user, some tests might be skipped that require root privileges, or that require plain user privileges, to complete successfully.

<sup>1</sup> This particular check has caught some name space pollution that has occurred in the 2.6.11 kernel.



### 7.1.2.1 Running Test Suites

There are several ways of invoking the conformance test suites:

1. The test suites can be run after installation of the package by invoking the `‘make installcheck’` or `‘make installcheck.log’` target. Some packages require that root privileges be acquired before invoking the package.
2. The test suites can be run from the distribution subdirectory after installation of the package by invoking the `testsuite` shell script directly.
3. The test suites can be run standalone from the `‘libexec’` (`‘/usr/libexec’`) installation directory by invoking the `testsuite` shell script directly.

Typical steps for invoking the test suites directly from `make` are shown in [Example 7.4](#).

```
% wget http://www.openss7.org/sctp-0.2.27.tar.bz2
% tar -xjvf sctp-0.2.27.tar.bz2
% pushd sctp-0.2.27
% ./configure
% make
% make check # <----- invokes System pre-installation checks
% make install
% sudo make installcheck # <----- invokes post-installation tests
% popd
```

Example 7.4: *Invoking System Checks*

When performing post-installation checks for the purposes of generating a problem report, the checks should always be performed from the build directory, either with `‘make installcheck’` or by invoking `testsuite` directly from the `‘tests’` subdirectory of the build directory. This ensures that all of the information known to `configure` and pertinent to the configuration of the system for which a test case failed, will be collected in the resulting `‘testsuite.log’` file deposited upon test suite failure in the `‘tests’` directory. This `‘testsuite.log’` file can then be attached as part of the problem report and provides rich details to maintainers of the package. See also [Section 7.2 \[Problem Reports\]](#), page 127, below.

Typical steps for invoking and installed `testsuite` standalone are shown in [Example 7.5](#).

```
% [sudo] /usr/libexec/sctp/testsuite
```

Example 7.5: *Invoking testsuite Directly*

When invoked directly, `testsuite` will generate a `‘testsuite.log’` file in the current directory, and a `‘testsuite.dir’` directory of failed tests cases and debugging scripts. For generating a problem report for failed test cases, see [Section 7.2.4 \[Stand Alone Problem Reports\]](#), page 130.

## 7.2 Problem Reports

### 7.2.1 Problem Report Guidelines

Problem reports in the following categories should include a log file as indicated in the table below:

`‘./configure’`

A problem with the configuration process occurs that causes the `‘./configure’` command to fail. The problem report must include the `‘config.log’` file that was generated by `configure`.

`‘make compile.log’`

A problem with the build process occurs that causes the `‘make’` command to fail. Perform `‘make clean’` and then `‘make compile.log’` and attach the `‘config.log’` and `‘compile.log’` files to the problem report.

`‘make check.log’`

A problem occurs with the `‘make check’` target that causes it to fail. Perform `‘make check-clean check.log’` and attach the `‘config.log’`, `‘compile.log’` and `‘check.log’` files to the problem report.

`‘sudo make install.log’`

A problem occurs with `‘sudo make install’` that causes it to fail. Perform `‘sudo make uninstall’` and `‘sudo make install.log’` and attach the `‘config.log’`, `‘compile.log’`, `‘check.log’`, and `‘install.log’` files to the problem report.

`‘[sudo] make installcheck.log’`

A problem occurs with the `‘make installcheck’` target that causes the test suite to fail. Attach the resulting `‘tests/testsuite.log’` and `‘installcheck.log’` file to the problem report. There is no need to attach the other files as they are included in `‘tests/testsuite.log’`.

`‘[sudo] make uninstall.log’`

A problem occurs with the `‘make uninstall’` target that causes the test suite to fail. Perform `‘sudo make uninstall.log’` and attach the `‘config.log’`, `‘compile.log’`, `‘check.log’`, `‘install.log’`, `‘installcheck.log’`, `‘tests/testsuite.log’` and `‘uninstall.log’` file to the problem report.

`‘[sudo] make remove.log’`

A problem occurs with the `‘make remove’` target that causes the test suite to fail. Perform `‘sudo make remove.log’` and attach the `‘config.log’`, `‘compile.log’`, `‘check.log’`, `‘install.log’`, `‘installcheck.log’`, `‘tests/testsuite.log’` and `‘remove.log’` file to the problem report.

For other problems that occur during the use of the *OpenSS7 Linux Native SCTP* package, please write a test case for the test suite that recreates the problem if one does not yet exist and provide a test program patch with the problem report. Also include whatever log files are generated by the kernel (`cmn_err(9)`) or by the `strerr(8)` or `strace(1)` facilities (`strlog(9)`).

### 7.2.2 Generating Problem Reports

The *OpenSS7 Project* uses the *GNU GNATS* system for problem reporting. Although the `‘send-pr’` tool from the *GNU GNATS* package can be used for bug reporting to the project’s

*GNATS* database using electronic mail, it is not always convenient to download and install the *GNATS* system to gain access to the ‘*send-pr*’ tool.

Therefore, the *OpenSS7 Linux Native SCTP* package provides the ‘*send-pr*’ shell script that can be used for problem reporting. The ‘*send-pr*’ shell script can be invoked directly and is a work-alike for the *GNU* ‘*send-pr*’ tool.

The ‘*send-pr*’ tool takes the same flags and can be used in the same fashion, however, whereas ‘*send-pr*’ is an interactive tool<sup>2</sup>, ‘*send-pr*’ is also able to perform batch processing. Whereas ‘*send-pr*’ takes its field information from local databases or from using the ‘*query-pr*’ C-language program to query a remote database, the ‘*send-pr*’ tool has the field database internal to the tool.

Problem reports can be generated using *make*, See [Section 6.8.1.7 \[Problem Report Targets\]](#), [page 118](#). An example of how simple it is to generate a problem report is illustrated in [Example 7.6](#).

```
% make pr
SEND-PR:
SEND-PR: send-pr:  send-pr was invoked to generate an external report.  An
SEND-PR: automated problem report has been created in the file named
SEND-PR: 'problem.pr' in the current directory.  This problem report can
SEND-PR: be sent to bugs@openss7.org by calling this script as
SEND-PR: '/home/brian/os7/scripts/send-pr --file="problem.pr"'.
SEND-PR:
SEND-PR: It is possible to edit some of the fields before sending on the
SEND-PR: problem report.  Please remember that there is NO WARRANTY.  See
SEND-PR: the file 'COPYING' in the top level directory.
SEND-PR:
SEND-PR: Please do not send confidential information to the bug report
SEND-PR: address.  Inspect the file 'problem.pr' for confidential
SEND-PR: information before mailing.
SEND-PR:
% vim problem.pr # <--- follow instructions at head of file
% make send-pr
```

Example 7.6: *Invoking Problem Report Generation*

Using the ‘*make pr*’ target to generate a problem report has the advantages that it will assemble any available ‘\*.log’ files in the build directory and attach them to the problem report.

### 7.2.3 Automatic Problem Reports

The *OpenSS7 Linux Native SCTP* package also provides a feature for automatic problem report generation that meets the problem report submission guidelines detailed in the preceding sections.

Whenever a logging makefile target (see [Section 6.8.1.6 \[Logging Targets\]](#), [page 116](#)) is invoked, if the primary target fails, the *send-pr* shell script is invoked to automatically

<sup>2</sup> ‘*send-pr*’ launches the user’s *EDITOR* to edit the problem report before submitting it.

generate a problem report file suitable for the corresponding target (as described above under see [Section 7.2.1 \[Problem Report Guidelines\]](#), page 128). An example is shown in [Example 7.7](#).

```
% make compile.log
...
...
make[5]: *** [libXNSdrvs_a-ip.o] Error 1
make[5]: Leaving directory '/u6/buildel4/strxns'
make[4]: *** [all-recursive] Error 1
make[4]: Leaving directory '/u6/buildel4/strxns'
make[3]: *** [all] Error 2
make[3]: Leaving directory '/u6/buildel4/strxns'
make[2]: *** [all-recursive] Error 1
make[2]: Leaving directory '/u6/buildel4'
make[1]: *** [all] Error 2
make[1]: Leaving directory '/u6/buildel4'
SEND-PR:
SEND-PR: send-pr: Make target compile.log failed in the compile stage. An
SEND-PR: automated problem report has been created in the file named
SEND-PR: 'problem.pr' in the current directory. This problem report can
SEND-PR: be sent to bugs@openss7.org by calling 'make send-pr'.
SEND-PR:
SEND-PR: It is possible to edit some of the fields before sending on the
SEND-PR: problem report. Please remember that there is NO WARRANTY. See
SEND-PR: the file 'COPYING' in the top level directory.
SEND-PR:
SEND-PR: Please do not send confidential information to the bug report
SEND-PR: address. Inspect the file 'problem.pr' for confidential
SEND-PR: information before mailing.
SEND-PR:
% vim problem.pr # <--- follow instructions at head of file
% make send-pr
```

Example 7.7: *Problem Report from Failed Logging Target*

## 7.2.4 Stand Alone Problem Reports

The *OpenSS7 Linux Native SCTP* package installs the `send-pr` script and its configuration file '`send-pr.config`' in '`${libexecdir}/sctp`' along with the validation `testsuite`, see [Section 7.1 \[Test Suites\]](#), page 123. As with the `testsuite`, this allows the `send-pr` script to be used for problem report generation on an installed system that does not have a build directory.

An example of invoking the package `testsuite` and then generating a problem report for failed cases is shown in [Example 7.8](#).

```
% [sudo] /usr/libexec/sctp/testsuite
% # test cases failed...
% /usr/libexec/sctp/send-pr
SEND-PR:
SEND-PR: send-pr: send-pr was invoked to generate an external report. An
SEND-PR: automated problem report has been created in the file named
SEND-PR: 'problem.pr' in the current directory. This problem report can
SEND-PR: be sent to bugs@openss7.org by calling this script as
SEND-PR: '/usr/libexec/sctp/send-pr --file problem.pr'.
SEND-PR:
SEND-PR: It is possible to edit some of the fields before sending on the
SEND-PR: problem report. Please remember that there is NO WARRANTY. See
SEND-PR: the file 'COPYING' in the top level directory.
SEND-PR:
SEND-PR: Please do not send confidential information to the bug report
SEND-PR: address. Inspect the file 'problem.pr' for confidential
SEND-PR: information before mailing.
SEND-PR:
% vim problem.pr # <--- follow instructions at head of file
% /usr/libexec/sctp/send-pr --file problem.pr
```

Example 7.8: *Invoking send-pr Directly*

The advantage of the approach shown in the example is that the `send-pr` script is capable of collecting the `'testsuite.log'` file and the failed test cases and debugging scripts from the `'testsuite.dir'` directory and including them in the problem report, as well as all package pertinent information from the installed `'send-pr.config'`.

## 7.3 Known Problems

*The OpenSS7 Project* does not ship software with known bugs. All bugs are unknown.

Verified behaviour is that behaviour that has been verified by conformance test suites that are shipped with the *OpenSS7 Linux Native SCTP* package.

Unverified behaviour may contain unknown bugs.

Please remember that there is **NO WARRANTY**.

See also [Section 5.5 \[Bugs\]](#), [page 65](#), or file `'BUGS'` in the release directory.



## Licenses

## GNU Affero General Public License

The GNU Affero General Public License.

Version 3, 19 November 2007

Copyright © 2007 Free Software Foundation, Inc. <http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

### Preamble

The GNU Affero General Public License is a free, copyleft license for software and other kinds of works, specifically designed to ensure cooperation with the community in the case of network server software.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, our General Public Licenses are intended to guarantee your freedom to share and change all versions of a program—to make sure it remains free software for all its users.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

Developers that use our General Public Licenses protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License which gives you legal permission to copy, distribute and/or modify the software.

A secondary benefit of defending all users' freedom is that improvements made in alternate versions of the program, if they receive widespread use, become available for other developers to incorporate. Many developers of free software are heartened and encouraged by the resulting cooperation. However, in the case of software used on network servers, this result may fail to come about. The GNU General Public License permits making a modified version and letting the public access it on a server without ever releasing its source code to the public.

The GNU Affero General Public License is designed specifically to ensure that, in such cases, the modified source code becomes available to the community. It requires the operator of a network server to provide the source code of the modified version running there to the users of that server. Therefore, public use of a modified version, on a publicly accessible server, gives the public access to the source code of the modified version.

An older license, called the Affero General Public License and published by Affero, was designed to accomplish similar goals. This is a different license, not a version of the Affero GPL, but Affero has released a new version of the Affero GPL which permits relicensing under this license.

The precise terms and conditions for copying, distribution and modification follow.



## Terms and Conditions

### 0. Definitions.

“This License” refers to version 3 of the GNU Affero General Public License.

“Copyright” also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

“The Program” refers to any copyrightable work licensed under this License. Each licensee is addressed as “you”. “Licensees” and “recipients” may be individuals or organizations.

To “modify” a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a “modified version” of the earlier work or a work “based on” the earlier work.

A “covered work” means either the unmodified Program or a work based on the Program.

To “propagate” a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To “convey” a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays “Appropriate Legal Notices” to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

### 1. Source Code.

The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work.

A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The “System Libraries” of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A “Major Component”, in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The “Corresponding Source” for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work’s System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

## 2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

## 3. Protecting Users’ Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work’s users, your or third parties’ legal rights to forbid circumvention of technological measures.

## 4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program’s source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an

appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

- a. The work must carry prominent notices stating that you modified it, and giving a relevant date.
- b. The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to “keep intact all notices”.
- c. You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.
- d. If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an “aggregate” if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation’s users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

- a. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.
- b. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange,

for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.

- c. Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.
- d. Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.
- e. Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A “User Product” is either (1) a “consumer product”, which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, “normally used” refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

“Installation Information” for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any

third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

#### 7. Additional Terms.

“Additional permissions” are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

- a. Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or
- b. Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or
- c. Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or
- d. Limiting the use for publicity purposes of names of licensors or authors of the material; or
- e. Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or
- f. Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered “further restrictions” within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

#### 8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

#### 9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

#### 10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.



An “entity transaction” is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party’s predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

#### 11. Patents.

A “contributor” is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor’s “contributor version”.

A contributor’s “essential patent claims” are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, “control” includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor’s essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a “patent license” is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To “grant” such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. “Knowingly relying” means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient’s use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.

If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license

to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is “discriminatory” if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.

12. No Surrender of Others’ Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Remote Network Interaction; Use with the GNU General Public License.

Notwithstanding any other provision of this License, if you modify the Program, your modified version must prominently offer all users interacting with it remotely through a network (if your version supports such interaction) an opportunity to receive the Corresponding Source of your version by providing access to the Corresponding Source from a network server at no charge, through some standard or customary means of facilitating copying of software. This Corresponding Source shall include the Corresponding Source for any work covered by version 3 of the GNU General Public License that is incorporated pursuant to the following paragraph.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the work with which it is combined will remain governed by version 3 of the GNU General Public License.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU Affero General Public License from time to time. Such new versions will be similar



in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU Affero General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU Affero General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU Affero General Public License can be used, that proxy’s public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

**THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.**

16. Limitation of Liability.

**IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.**

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

**END OF TERMS AND CONDITIONS**

## How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the “copyright” line and a pointer to where the full notice is found.

```
one line to give the program's name and a brief idea of what it does.
Copyright (C) year name of author
```

```
This program is free software: you can redistribute it and/or modify
it under the terms of the GNU Affero General Public License as published by
the Free Software Foundation, either version 3 of the License, or (at
your option) any later version.
```

```
This program is distributed in the hope that it will be useful, but
WITHOUT ANY WARRANTY; without even the implied warranty of
MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU
Affero General Public License for more details.
```

```
You should have received a copy of the GNU Affero General Public License
along with this program. If not, see http://www.gnu.org/licenses/.
```

Also add information on how to contact you by electronic and paper mail.

If your software can interact with users remotely through a network, you should also make sure that it provides a way for users to get its source. For example, if your program is a web application, its interface could display a “Source” link that leads users to an archive of the code. There are many ways you could offer source, and different solutions will be better for different programs; see section 13 for the specific requirements.

You should also get your employer (if you work as a programmer) or school, if any, to sign a “copyright disclaimer” for the program, if necessary. For more information on this, and how to apply and follow the GNU AGPL, see <http://www.gnu.org/licenses/>.

## GNU General Public License

### GNU GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. <http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

### Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program—to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other

domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

## Terms and Conditions

### 0. Definitions.

“This License” refers to version 3 of the GNU General Public License.

“Copyright” also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

“The Program” refers to any copyrightable work licensed under this License. Each licensee is addressed as “you”. “Licensees” and “recipients” may be individuals or organizations.

To “modify” a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a “modified version” of the earlier work or a work “based on” the earlier work.

A “covered work” means either the unmodified Program or a work based on the Program.

To “propagate” a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To “convey” a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays “Appropriate Legal Notices” to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

### 1. Source Code.

The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work.

A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular

programming language, one that is widely used among developers working in that language.

The “System Libraries” of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A “Major Component”, in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The “Corresponding Source” for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work’s System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

## 2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

## 3. Protecting Users’ Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty

adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.

#### 4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

#### 5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

- a. The work must carry prominent notices stating that you modified it, and giving a relevant date.
- b. The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to "keep intact all notices".
- c. You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.
- d. If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an "aggregate" if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

#### 6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

- a. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.
- b. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.
- c. Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.
- d. Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.
- e. Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A “User Product” is either (1) a “consumer product”, which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, “normally used” refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.



“Installation Information” for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

## 7. Additional Terms.

“Additional permissions” are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

- a. Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or
- b. Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or



- c. Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or
- d. Limiting the use for publicity purposes of names of licensors or authors of the material; or
- e. Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or
- f. Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered “further restrictions” within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

## 8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.

An “entity transaction” is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party’s predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

11. Patents.

A “contributor” is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor’s “contributor version”.

A contributor’s “essential patent claims” are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, “control” includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor’s essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a “patent license” is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To “grant” such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. “Knowingly relying” means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient’s use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.

If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is “discriminatory” if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.

12. No Surrender of Others’ Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work,

but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy’s public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

**THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.**

16. Limitation of Liability.

**IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.**

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with

the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

**END OF TERMS AND CONDITIONS**

## How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the “copyright” line and a pointer to where the full notice is found.

```
one line to give the program's name and a brief idea of what it does.
Copyright (C) year name of author
```

```
This program is free software: you can redistribute it and/or modify
it under the terms of the GNU General Public License as published by
the Free Software Foundation, either version 3 of the License, or (at
your option) any later version.
```

```
This program is distributed in the hope that it will be useful, but
WITHOUT ANY WARRANTY; without even the implied warranty of
MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU
General Public License for more details.
```

```
You should have received a copy of the GNU General Public License
along with this program. If not, see http://www.gnu.org/licenses/.
```

Also add information on how to contact you by electronic and paper mail.

If the program does terminal interaction, make it output a short notice like this when it starts in an interactive mode:

```
program Copyright (C) year name of author
This program comes with ABSOLUTELY NO WARRANTY; for details type 'show w'.
This is free software, and you are welcome to redistribute it
under certain conditions; type 'show c' for details.
```

The hypothetical commands ‘show w’ and ‘show c’ should show the appropriate parts of the General Public License. Of course, your program’s commands might be different; for a GUI interface, you would use an “about box”.

You should also get your employer (if you work as a programmer) or school, if any, to sign a “copyright disclaimer” for the program, if necessary. For more information on this, and how to apply and follow the GNU GPL, see <http://www.gnu.org/licenses/>.

The GNU General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License. But first, please read <http://www.gnu.org/philosophy/why-not-lgpl.html>.

## GNU Lesser General Public License

### GNU LESSER GENERAL PUBLIC LICENSE

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. <http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

### Terms and Conditions

This version of the GNU Lesser General Public License incorporates the terms and conditions of version 3 of the GNU General Public License, supplemented by the additional permissions listed below.

#### 0. Additional Definitions.

As used herein, “this License” refers to version 3 of the GNU Lesser General Public License, and the “GNU GPL” refers to version 3 of the GNU General Public License.

“The Library” refers to a covered work governed by this License, other than an Application or a Combined Work as defined below.

An “Application” is any work that makes use of an interface provided by the Library, but which is not otherwise based on the Library. Defining a subclass of a class defined by the Library is deemed a mode of using an interface provided by the Library.

A “Combined Work” is a work produced by combining or linking an Application with the Library. The particular version of the Library with which the Combined Work was made is also called the “Linked Version”.

The “Minimal Corresponding Source” for a Combined Work means the Corresponding Source for the Combined Work, excluding any source code for portions of the Combined Work that, considered in isolation, are based on the Application, and not on the Linked Version.

The “Corresponding Application Code” for a Combined Work means the object code and/or source code for the Application, including any data and utility programs needed for reproducing the Combined Work from the Application, but excluding the System Libraries of the Combined Work.

#### 1. Exception to Section 3 of the GNU GPL.

You may convey a covered work under sections 3 and 4 of this License without being bound by section 3 of the GNU GPL.

#### 2. Conveying Modified Versions.

If you modify a copy of the Library, and, in your modifications, a facility refers to a function or data to be supplied by an Application that uses the facility (other than as an argument passed when the facility is invoked), then you may convey a copy of the modified version:

- a. under this License, provided that you make a good faith effort to ensure that, in the event an Application does not supply the function or data, the facility still operates, and performs whatever part of its purpose remains meaningful, or



- b. under the GNU GPL, with none of the additional permissions of this License applicable to that copy.
3. Object Code Incorporating Material from Library Header Files.

The object code form of an Application may incorporate material from a header file that is part of the Library. You may convey such object code under terms of your choice, provided that, if the incorporated material is not limited to numerical parameters, data structure layouts and accessors, or small macros, inline functions and templates (ten or fewer lines in length), you do both of the following:

- a. Give prominent notice with each copy of the object code that the Library is used in it and that the Library and its use are covered by this License.
  - b. Accompany the object code with a copy of the GNU GPL and this license document.
4. Combined Works.

You may convey a Combined Work under terms of your choice that, taken together, effectively do not restrict modification of the portions of the Library contained in the Combined Work and reverse engineering for debugging such modifications, if you also do each of the following:

- a. Give prominent notice with each copy of the Combined Work that the Library is used in it and that the Library and its use are covered by this License.
- b. Accompany the Combined Work with a copy of the GNU GPL and this license document.
- c. For a Combined Work that displays copyright notices during execution, include the copyright notice for the Library among these notices, as well as a reference directing the user to the copies of the GNU GPL and this license document.
- d. Do one of the following:
  - 0. Convey the Minimal Corresponding Source under the terms of this License, and the Corresponding Application Code in a form suitable for, and under terms that permit, the user to recombine or relink the Application with a modified version of the Linked Version to produce a modified Combined Work, in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.
  - 1. Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (a) uses at run time a copy of the Library already present on the user's computer system, and (b) will operate properly with a modified version of the Library that is interface-compatible with the Linked Version.
- e. Provide Installation Information, but only if you would otherwise be required to provide such information under section 6 of the GNU GPL, and only to the extent that such information is necessary to install and execute a modified version of the Combined Work produced by recombining or relinking the Application with a modified version of the Linked Version. (If you use option 4d0, the Installation Information must accompany the Minimal Corresponding Source and Corresponding Application Code. If you use option 4d1, you must provide the Installation Information in the manner specified by section 6 of the GNU GPL for conveying Corresponding Source.)



5. Combined Libraries.

You may place library facilities that are a work based on the Library side by side in a single library together with other library facilities that are not Applications and are not covered by this License, and convey such a combined library under terms of your choice, if you do both of the following:

- a. Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities, conveyed under the terms of this License.
- b. Give prominent notice with the combined library that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

6. Revised Versions of the GNU Lesser General Public License.

The Free Software Foundation may publish revised and/or new versions of the GNU Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library as you received it specifies that a certain numbered version of the GNU Lesser General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that published version or of any later version published by the Free Software Foundation. If the Library as you received it does not specify a version number of the GNU Lesser General Public License, you may choose any version of the GNU Lesser General Public License ever published by the Free Software Foundation.

If the Library as you received it specifies that a proxy can decide whether future versions of the GNU Lesser General Public License shall apply, that proxy’s public statement of acceptance of any version is permanent authorization for you to choose that version for the Library.

**END OF TERMS AND CONDITIONS**

## GNU Free Documentation License

### GNU FREE DOCUMENTATION LICENSE

Version 1.1, March 2000

Copyright © 2000 Free Software Foundation, Inc.  
59 Temple Place, Suite 330, Boston, MA 02111-1307, USA

Everyone is permitted to copy and distribute verbatim copies  
of this license document, but changing it is not allowed.

### Preamble

The purpose of this License is to make a manual, textbook, or other written document *free* in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of “copyleft”, which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

## Terms and Conditions for Copying, Distribution and Modification

### 1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. The “Document”, below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as “you”.

A “Modified Version” of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A “Secondary Section” is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document’s overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (For example, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The “Invariant Sections” are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License.

The “Cover Texts” are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License.

A “Transparent” copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, whose contents can be viewed and edited directly and straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup has been designed to thwart or discourage subsequent modification by readers is not Transparent. A copy that is not “Transparent” is called “Opaque”.

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML designed for human modification. Opaque formats include PostScript, PDF, proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML produced by some word processors for output purposes only.

The “Title Page” means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, “Title Page” means the text near the most prominent appearance of the work’s title, preceding the beginning of the body of the text.

## 2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

## 3. COPYING IN QUANTITY

If you publish printed copies of the Document numbering more than 100, and the Document’s license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other

material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a publicly-accessible computer-network location containing a complete Transparent copy of the Document, free of added material, which the general network-using public has access to download anonymously at no charge using public-standard network protocols. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

#### 4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

- A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
- B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has less than five).
- C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
- D. Preserve all the copyright notices of the Document.
- E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
- F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
- G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
- H. Include an unaltered copy of this License.

- I. Preserve the section entitled “History”, and its title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section entitled “History” in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
- J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the “History” section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
- K. In any section entitled “Acknowledgments” or “Dedications”, preserve the section’s title, and preserve in the section all the substance and tone of each of the contributor acknowledgments and/or dedications given therein.
- L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
- M. Delete any section entitled “Endorsements”. Such a section may not be included in the Modified Version.
- N. Do not retitle any existing section as “Endorsements” or to conflict in title with any Invariant Section.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version’s license notice. These titles must be distinct from any other section titles.

You may add a section entitled “Endorsements”, provided it contains nothing but endorsements of your Modified Version by various parties—for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

## 5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you

include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections entitled “History” in the various original documents, forming one section entitled “History”; likewise combine any sections entitled “Acknowledgments”, and any sections entitled “Dedications”. You must delete all sections entitled “Endorsements.”

## 6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

## 7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, does not as a whole count as a Modified Version of the Document, provided no compilation copyright is claimed for the compilation. Such a compilation is called an “aggregate”, and this License does not apply to the other self-contained works thus compiled with the Document, on account of their being thus compiled, if they are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one quarter of the entire aggregate, the Document’s Cover Texts may be placed on covers that surround only the Document within the aggregate. Otherwise they must appear on covers around the whole aggregate.

## 8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License provided that you also include the original English version of this License. In case of a disagreement between the translation and the original English version of this License, the original English version will prevail.

## 9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

## 10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See <http://www.gnu.org/copyleft/>.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License “or any later version” applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

**END OF TERMS AND CONDITIONS**

## How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

```
Copyright (C)  year  your name.
Permission is granted to copy, distribute and/or modify this document
under the terms of the GNU Free Documentation License, Version 1.1
or any later version published by the Free Software Foundation;
with the Invariant Sections being list their titles, with the
Front-Cover Texts being list, and with the Back-Cover Texts being list.
A copy of the license is included in the section entitled ‘‘GNU
Free Documentation License’’.
```

If you have no Invariant Sections, write “with no Invariant Sections” instead of saying which ones are invariant. If you have no Front-Cover Texts, write “no Front-Cover Texts” instead of “Front-Cover Texts being *list*”; likewise for Back-Cover Texts.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.



# Indices

## Index of Concepts

### A

apt ..... 72, 75  
 Architectures ..... 60  
 authors ..... 5

### B

binary deps ..... 78, 87, 109  
 binary rpms ..... 75, 85, 108, 109  
 bug reports, automatic generation ..... 129  
 bug reports, generating ..... 128  
 bug reports, stand along generation ..... 130  
 bugs ..... 65  
 bugs, history ..... 65  
 bugs, known ..... 65  
 bugs, reporting ..... 127  
 building ..... 106  
 building, source dscs ..... 106  
 building, source srpm ..... 106  
 building, tar ball ..... 107

### C

checkout, cvs ..... 82  
 compatibility ..... 57  
 configuration ..... 85  
 configure environment variables ..... 103  
 configure options ..... 93  
 configuring, binary deps ..... 87  
 configuring, binary rpms ..... 85  
 configuring, source dscs ..... 93  
 configuring, source srpm ..... 87  
 configuring, tar ball ..... 93  
 conformance ..... 55  
 contributors ..... 5  
 conventions ..... 13  
 credits ..... 4  
 cvs ..... 82

### D

definitions ..... 13  
 developing ..... 21  
 downloading ..... 73  
 downloading, apt ..... 75  
 downloading, binary rpms ..... 75  
 downloading, debian deps ..... 78  
 downloading, debian dscs ..... 81  
 downloading, source srpm ..... 81  
 downloading, tar ball ..... 82  
 downloading, yum ..... 73

### G

generating bug reports ..... 128, 130  
 generating bug reports automatically ..... 129  
 generating problem reports ..... 128  
 generating problem reports automatically ..... 129  
 generating problem reports stand alone ..... 130  
 GNU/Linux Distributions ..... 57

### H

headers ..... 17  
 history ..... 69  
 history bugs ..... 65

### I

indices ..... 167  
 installation ..... 71  
 installing ..... 108  
 installing, binary deps ..... 109  
 installing, binary rpms ..... 108  
 installing, tar ball ..... 109  
 introduction ..... 13

### K

Kernel ..... 59  
 kernel modules ..... 20  
 known bugs ..... 65  
 known problems ..... 131

### L

libraries ..... 20  
 license, AGPL ..... 134  
 license, FDL ..... 160  
 license, GNU Affero General Public License ... 134  
 license, GNU Free Documentation License .... 160  
 license, GNU General Public License ..... 145  
 license, GPL ..... 145  
 license, Lesser General Public License ..... 157  
 license, LGPL ..... 157  
 licenses ..... 133  
 licensing ..... 1  
 loading ..... 110

### M

maintainer ..... 5  
 manual abstract ..... 1

|                         |    |
|-------------------------|----|
| manual audience .....   | 1  |
| manual disclaimer ..... | 3  |
| manual intent .....     | 1  |
| manual notice .....     | 1  |
| manual objective .....  | 1  |
| manual revisions .....  | 2  |
| maturity .....          | 63 |

## O

|                    |    |
|--------------------|----|
| objective .....    | 15 |
| organization ..... | 13 |
| overview .....     | 13 |

## P

|                                |     |
|--------------------------------|-----|
| post-installation checks ..... | 126 |
| pre-installation checks .....  | 123 |
| prerequisites .....            | 57  |
| problem reports .....          | 127 |
| problems, known .....          | 131 |

## Q

|                         |   |
|-------------------------|---|
| quick start guide ..... | 9 |
|-------------------------|---|

## R

|                             |     |
|-----------------------------|-----|
| reference .....             | 17  |
| release notes .....         | 60  |
| release sctp-0.2.20-1 ..... | 63  |
| release sctp-0.2.21 .....   | 63  |
| release sctp-0.2.22 .....   | 63  |
| release sctp-0.2.23 .....   | 63  |
| release sctp-0.2.24 .....   | 62  |
| release sctp-0.2.25 .....   | 61  |
| release sctp-0.2.26 .....   | 61  |
| release sctp-0.2.27 .....   | 60  |
| releases .....              | 57  |
| removing .....              | 109 |
| removing, binary deps ..... | 109 |
| removing, binary rpms ..... | 109 |
| removing, source dscs ..... | 110 |
| removing, source srpm ..... | 110 |
| removing, tar ball .....    | 110 |

|                         |     |
|-------------------------|-----|
| reporting bugs .....    | 127 |
| repositories .....      | 71  |
| repositories, apt ..... | 72  |
| repositories, yum ..... | 71  |

## S

|                                                     |                  |
|-----------------------------------------------------|------------------|
| schedule .....                                      | 65               |
| SCTP Reference Page .....                           | 21               |
| sctp-dev-0.2.27-1.7.2.i686.rpm .....                | 86               |
| sctp-devel-0.2.27-1.7.2.i686.rpm .....              | 86               |
| sctp-doc-0.2.27-1.7.2.i686.rpm .....                | 86               |
| sctp-LiS-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm ..  | 85               |
| sctp-LiS-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm ..  | 86               |
| sctp-LiS-lib-0.2.27-1.7.2.i686.rpm .....            | 86               |
| sctp-LiS-util-0.2.27-1.7.2.i686.rpm .....           | 86               |
| sctp-source-0.2.27-1.7.2.i686.rpm .....             | 86               |
| sctp-streams-core-2.4.20-28.7-0.2.27-1.7.2.i686.rpm |                  |
| .....                                               | 85               |
| sctp-streams-info-2.4.20-28.7-0.2.27-1.7.2.i686.rpm |                  |
| .....                                               | 86               |
| sctp-streams-lib-0.2.27-1.7.2.i686.rpm .....        | 86               |
| sctp-streams-util-0.2.27-1.7.2.i686.rpm .....       | 86               |
| source dscs .....                                   | 81, 93, 106, 110 |
| source rpms .....                                   | 81, 87, 106, 110 |
| sponsors .....                                      | 4                |

## T

|                            |                       |
|----------------------------|-----------------------|
| tar ball .....             | 82, 93, 107, 109, 110 |
| test suites .....          | 123                   |
| test suites, running ..... | 127                   |
| troubleshooting .....      | 123                   |

## U

|                 |    |
|-----------------|----|
| utilities ..... | 20 |
|-----------------|----|

## W

|                     |   |
|---------------------|---|
| web resources ..... | 5 |
|---------------------|---|

## Y

|           |        |
|-----------|--------|
| yum ..... | 71, 73 |
|-----------|--------|

Index of Data Types

A

apt-get(8) ..... 60

Y

yum(8) ..... 60

## Index of Functions and Macros

(Index is nonexistent)

## Index of Variables and Constants

### A

AUTOM4TE..... 106  
AUTOTEST..... 106

### B

BZIP2..... 103  
BZIP2\_CMD..... 103

### C

CHKCONFIG..... 104

### D

DEB\_BUILD\_ARCH..... 104  
DEB\_BUILD\_GNU\_CPU..... 104  
DEB\_BUILD\_GNU\_SYSTEM..... 104  
DEB\_BUILD\_GNU\_TYPE..... 104  
DEB\_HOST\_ARCH..... 104  
DEB\_HOST\_GNU\_CPU..... 104  
DEB\_HOST\_GNU\_SYSTEM..... 104  
DEB\_HOST\_GNU\_TYPE..... 105  
DEPMOD..... 105  
DESTDIR..... 105  
DPKG..... 104  
DPKG\_BUILDPACKAGE..... 104  
DPKG\_SOURCE..... 104

### G

GENKSYMS..... 105  
GNUPGHOME..... 103  
GNUPGUSER..... 103  
GPG..... 103  
GPGPASSWD..... 103  
GZIP..... 103  
GZIP\_CMD..... 103

### K

KGENKSYMS..... 105

### L

LDCONFIG..... 105  
LSMOD..... 105  
LSOF..... 105

### M

MAKEWHATIS..... 103  
MODPOST\_CACHE..... 105  
MODPROBE..... 105  
MODULE\_VERSION..... 60

### N

NM..... 105

### O

OBJDUMP..... 105

### P

PACKAGE\_KVERSION..... 88  
PIC..... 103

### R

REFER..... 103  
RPM..... 104  
RPMBUILD..... 104

### S

SOELIM..... 103

### T

TBL..... 103

## Index of Files and Programs

/lib/modules/2.4.20-28.7/streams/..... 111

## Index of Configuration Options

### 3

32bit-libs..... 94

### A

arch..... 95  
autotest..... 94

### B

base-major..... 100

### C

checks..... 88, 94  
compress-manpages..... 94  
cooked-manpages..... 88, 97

### D

deb-epoch..... 98  
deb-release..... 98  
deb-topdir..... 98  
devel..... 90, 95  
devfs..... 96  
docs..... 90, 95

### G

gpg-home..... 97  
gpg-user..... 96

### I

indep..... 95  
initscripts..... 94

### K

k-archdir..... 99  
k-build..... 98  
k-config..... 99  
k-debug..... 89, 96  
k-inline..... 89, 96  
k-linkage..... 98  
k-machdir..... 99  
k-modules..... 98  
k-modversions..... 89, 96  
k-optimize..... 88, 99  
k-release..... 88, 98  
k-safe..... 89, 96  
k-sysmap..... 99

k-test..... 89, 96

### L

lfs..... 90, 100  
lis..... 90, 99

### M

modules..... 90, 95

### P

pkg-distdir..... 97  
pkg-epoch..... 97  
pkg-release..... 97  
public..... 89, 94

### R

rpm-epoch..... 97  
rpm-extra..... 97  
rpm-release..... 97  
rpm-topdir..... 97

### S

sctp-adaptation-layer-info..... 92, 102  
sctp-add-ip..... 92, 102  
sctp-adler32..... 92, 101  
sctp-crc32c..... 92, 101  
sctp-discard-ootb..... 91, 100  
sctp-ecn..... 92, 102  
sctp-error-generator..... 93, 102  
sctp-extended-ip-support..... 91, 101  
sctp-hmac-md5..... 91, 101  
sctp-hmac-sha1..... 91, 101  
sctp-lifetimes..... 92, 102  
sctp-partial-reliability..... 92, 102  
sctp-slow-verification..... 90, 100  
sctp-throttle-heartbeats..... 91, 100  
sctp-throttle-passiveopens..... 92, 101  
strconf-master..... 100

### T

tcp-compatible..... 93, 102  
tools..... 90, 95

### U

udp-compatible..... 93, 102

## Index of Makefile Targets

### A

all..... 110, 112

### C

check..... 112  
 check-clean..... 115  
 check.log..... 117  
 clean..... 114  
 compile.log..... 117  
 csig..... 120

### D

debs..... 120  
 dist..... 114  
 dist.log..... 117  
 distcheck..... 114  
 distcheck.log..... 117  
 distclean..... 114  
 doxy..... 121  
 dsc..... 120

### F

forced-release..... 116  
 forced-release-sign..... 116

### I

install..... 110, 112  
 install-mans..... 115  
 install-strip..... 110, 112  
 install.log..... 117  
 installcheck..... 113  
 installcheck.log..... 117

### M

maintainer-clean..... 115

mans..... 115  
 mostlyclean..... 114

### P

pr..... 118, 129

### R

rebuild..... 120  
 rebuild.log..... 117  
 release..... 116  
 release-archives..... 118  
 release-clean..... 116  
 release-clean-archives..... 119  
 release-sign..... 116  
 release-sign-archives..... 118  
 release-sign.log..... 117  
 release.log..... 117  
 remove..... 113  
 remove.log..... 117  
 resign..... 120  
 resign.log..... 117  
 retest..... 113  
 rpms..... 119

### S

send-pr..... 118  
 sign..... 119  
 sigs..... 120  
 srpm..... 119  
 srpm-sign..... 119  
 srpm.log..... 117

### U

uninstall..... 113  
 uninstall-mans..... 115  
 uninstall.log..... 117



Index of Authors

Bidulock, Brian..... 5

## Index of Manual Pages Referenced

### A

accept(2) ..... 22, 24, 25, 31, 32, 34, 35, 51  
 apt(8) ..... 9, 71, 75  
 autoconf(1) .... 9, 75, 79, 82, 83, 85, 93, 108, 113  
 autom4te(1) ..... 106  
 automake(1) .. 83, 88, 90, 93, 95, 96, 109, 110, 111,  
 112, 113, 114, 115, 116, 117  
 autoreconf(1) ..... 112

### B

bind(2) ..... 22, 24, 25  
 bzip2(1) ..... 103

### C

chkconfig(8) ..... 104  
 close(2) ..... 23, 28  
 connect(2) .. 22, 24, 25, 31, 32, 34, 35, 40, 41, 42,  
 43, 44, 51  
 cvs(1) ..... 9, 83

### D

depmod(8) ..... 105  
 devfsd(1) ..... 89  
 devfsd(8) ..... 96  
 doxygen(1) ..... 121  
 dpkg(1) ..... 71, 73, 82, 84, 95, 97, 104, 112  
 dpkg(8) ..... 109  
 dpkg-buildpackage(1) ..... 104  
 dpkg-source(1) ..... 104

### E

exit(2) ..... 28

### G

gcc(1) ..... 10  
 genksyms(8) ..... 84, 105  
 getpeername(2) ..... 24, 25, 40, 42, 48  
 getsockname(2) ..... 24  
 getsockopt(2) ..... 35, 37  
 gettext(1) ..... 93  
 git(1) ..... 9  
 gpg(1) ..... 96  
 grefer(1) ..... 84, 88, 97  
 groff(1) ..... 84, 88, 89, 97  
 gzip(1) ..... 103

### I

ifconfig(8) ..... 47, 48

init\_install(8) ..... 104  
 init\_remove(8) ..... 104  
 ioctl(2) ..... 49  
 ip(7) ..... 21, 22, 23, 24, 29, 35, 36, 37, 38, 50

### L

ldconfig(8) ..... 105  
 libtool(1) ..... 93  
 listen(2) .... 22, 25, 30, 31, 32, 40, 41, 42, 43, 44  
 lsmod(8) ..... 105  
 lsof(1) ..... 105

### M

make(1) ..... 85, 94  
 makewhatis(8) ..... 103  
 modpost(1) ..... 105  
 modprobe(8) ..... 105

### N

netstat(8) ..... 50, 52  
 nm(1) ..... 105

### O

objdump(1) ..... 105

### P

pic(1) ..... 88, 97, 103  
 proc(5) ..... 50

### R

read(2) ..... 23, 26  
 recv(2) ..... 23, 26, 27, 45, 46, 47  
 recvfrom(2) ..... 23, 26, 27, 45, 46, 47  
 recvmsg(2) ... 23, 26, 27, 37, 38, 39, 40, 45, 46, 47  
 refer(1) ..... 88, 97, 103  
 rpm(1) .... 71, 73, 75, 82, 84, 95, 97, 104, 106, 108,  
 109, 112, 116, 119  
 rpm(8) ..... 87, 108  
 rpmbuild(1) ..... 88, 104

### S

send(2) ..... 22, 23, 27, 36, 45, 47, 53, 54  
 sendfile(2) ..... 39  
 sendmsg(2) .. 22, 23, 27, 36, 37, 38, 39, 45, 47, 53,  
 54  
 sendpage(2) ..... 54  
 sendto(2) ..... 22, 23, 27, 36, 45, 47, 53, 54

setsockopt(2) ..... 22, 35, 37, 40, 42  
 shutdown(2) ..... 28  
 socket(7) ..... 22, 25, 29, 33, 35, 36, 49, 50  
 soelim(1) ..... 88, 97, 103  
 STREAMS(9) ..... 1  
 sysctl(2) ..... 29  
 sysctl(8) ..... 29

## T

tar(1) ..... 82, 114  
 tbl(1) ..... 88, 97, 103  
 tcp(7) ... 22, 23, 24, 25, 26, 28, 36, 38, 39, 43, 49,  
 50, 53, 54  
 tee(1) ..... 116  
 test-sctp-dc(8) ..... 20  
 test-sctp-ds(8) ..... 20  
 test-sctp-sc(8) ..... 20  
 test-sctp-ss(8) ..... 20  
 test-sctp-tc(8) ..... 20  
 test-sctp-ts(8) ..... 20  
 test-sctpc(8) ..... 20  
 test-sctps(8) ..... 20  
 test-tcp-dc(8) ..... 20  
 test-tcp-ds(8) ..... 20

test-tcp-tc(8) ..... 20  
 test-tcp-ts(8) ..... 21  
 test-tcpc(8) ..... 21  
 test-tcps(8) ..... 21  
 test-udpc(8) ..... 21  
 test-udps(8) ..... 21  
 texinfo(1) ..... 90, 95

## U

udp(7) ..... 22, 25, 28, 37

## W

wget(1) ..... 71, 82  
 write(2) ..... 22, 27, 53

## Y

yast(8) ..... 71  
 yum(8) ..... 9, 71, 73, 74

## Z

zypper(8) ..... 71, 73

