



Interprocess Communications in Linux: The Nooks and Crannies

By John Shapley Gray

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Interprocess Communications in Linux explains exactly how to use Linux processes and interprocess communications to build robust, high-performance systems. Coverage includes: named/unnamed pipes, message queues, semaphores, shared memory, RPC and the rpcgen compiler, sockets-based communication, the /proc file system, LinuxThreads POSIX support, multithreading, and much more. Includes detailed exercises, plus dozens of downloadable program examples compiled with GNU C/C++ 2.96 & 3.2 and tested with Red Hat Linux 7.3 & 8.0.

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Editorial Review

From the Back Cover

- The *definitive* guide to Linux processes and IPC for programmers and system administrators
- Pipes, message queues, semaphores, shared memory, RPC, sockets, the /proc filesystem, and much more
- In-depth coverage of multithreading with POSIX compliant LinuxThreads
- Contains dozens of detailed program examples (GNU C/C++ 2.96/Red Hat Linux 7.3 & 8.0)

Raves for Gray's companion UNIX® volume!

"Concepts I only vaguely understood now make complete sense to me! The sample code and exercises are so good, they seem to clamp down on the concepts like a vise grip..."—S. Lee Henry, Johns Hopkins University

The expert, example-rich guide to Linux processes and IPC

Serious Linux software developers need a sophisticated understanding of processes, system level programming and interprocess communication techniques. Now, John Shapley Gray, author of the widely praised *Interprocess Communication in UNIX, Second Edition*, zeroes in on the core techniques Linux uses to manage processes and IPC. With exceptional precision and great clarity, Gray explains what processes are, how they're generated, how they access their environments, how they communicate—and *how to use them to build robust, high-performance systems*.

- Includes extensive coverage of named/unnamed pipes, message queues, semaphores, and shared memory.
- Provides C++ classes for System V IPC facilities.
- Offers an in-depth introduction to socket-based communication.
- Demystifies Linux's /proc file system.
- Illuminates the LinuxThreads POSIX thread implementation and its use in multithreaded applications.
- Provides valuable tips and warnings, plus insight into key differences amongst Linux and Unix implementations.
- Includes problem sets and illustrations designed to reinforce key concepts.

Gray presents dozens of standalone program examples; all compiled with the GNU C/C++ compiler 2.96 & 3.2, and fully tested on PC platforms running Red Hat Linux 7.3 & 8.0.

<http://authors.phptr.com/gray/>

About the Author

JOHN SHAPLEY GRAY is Professor of Computer Science and Chair of the Interactive Information Technology degree program at the University of Hartford, West Hartford, CT, and principal of Gray Software Development. Gray has been actively involved with UNIX and its derivatives for over 20 years; his course on UNIX internals has become legendary amongst students and developers throughout the greater Hartford area. He is author of the best-selling *Interprocess Communications in UNIX, Second Edition*, and co-author of *C++ Programmer's Notebook*.

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Preface

The topic of interprocess communication techniques is broad, challenging and dynamic. All but the most basic operating systems provide methods for processes communication. Early on, UNIX supported a number of rudimentary process communication constructs (such as lock files, signals and pipes). In the early 1980s, facilities such as message queues, semaphores, and shared memory were added to the mix by AT&T with its release of UNIX System V. Somewhat concurrently, the Berkeley Software Distribution added support for Internet protocols (4.3BSD) and the socket interface as a communication construct. By the mid-1990s, threads and multithreaded programming techniques were making significant, permanent inroads into the UNIX mainstream.

Along the way, UNIX spawned innumerable UNIX-like operating systems. One such operating system was MINIX. MINIX, written by Andrew S. Tanenbaum, is a small (about twelve thousand lines) PC version of UNIX. MINIX was presented as a pedagogical tool to permit the user to gain a better understanding of the inner working of a UNIX-like operating system. As all of the operating system source code was provided, the user could tinker with the code and refine its functionality. As a university student, Linus Torvalds' exposure to MINIX led him to develop a more robust UNIX-like operating system called Linux. In brief, Linux is a freely distributed hybrid version of UNIX. Linux system administration is BSD-like while its programming environment has a definite AT&T flavor. A number of commercial versions of Linux populate the market. These versions bundle Linux with a variety of other operating system related utilities and software packages. One of the more widely distributed commercial versions is Red Hat Linux. Red Hat Linux includes Richard Stallman's GNU project C (gcc) and C++ (g++) compilers.

This text explores the intricacies of interprocess communications as supported by Red Hat Linux version 7.3 and 8.0. It is assumed that the reader has a working knowledge of C/C++ programming. It is further assumed that while not being an expert, the reader has worked in a UNIX type environment and is reasonably familiar with generating and editing text using an editor such as vi or pico (available from the University of Washington). This text makes extensive references to specific system calls and predefined library functions. The reader is encouraged to read the manual pages for each system call/library function as it is encountered. As in UNIX, the manual pages in Linux are an unparalleled source of information. Appendix A covers the format and use of manual pages.

All programming references and examples were generated on a PC Pentium-based platform running Red Hat Linux 7.3, using the GNU C/C++ compiler version 2.96. With the release of Red Hat Linux 8.0 and GNU 3.2 the examples were revisited and tweaked where necessary. Many of the examples and most of the exercises have also been compiled and run in a Solaris 2.8 setting using GNU 2.95. Most often, few if any modifications were needed to generate clean, executable code in this alternate environment.

Each example is a complete standalone program. Command line examples, except where noted, are Korn shell based. In any setting, IPC (interprocess communication) support must be available for the user to pursue the materials covered in the chapters on semaphores, message queues, and shared memory. When Linux is installed, usually IPC support is enabled (check the /proc directory for the presence of the sysvipc directory). If it is not present you may need to modify system configuration files and recompile the kernel. There are a number of places that one can peruse for information on how this might be done. One source of information is the Configure.help file that resides in the /usr/src/linuxXXXX/Documentation subdirectory (where XXXX is the version of Linux). However, unless you are the system administrator, you most likely will want to seek help when doing this. To work with threads, a POSIX compliant thread library (such as LinuxThreads) must be available. Fortunately, most new versions of Linux come with thread libraries that are distributed with the GNU compiler (check the /usr/lib directory for files names containing pthread, e.g.,

libpthread.a or libpthread.so).

Users Review

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