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Red Hat Enterprise Linux Release 9.2 Manual Pages on 'signal-safety.7' command

\$ man signal-safety.7

SIGNAL-SAFETY(7) Linux Programmer's Manual SIGNAL-SAFETY(7)

NAME

signal-safety - async-signal-safe functions

DESCRIPTION

An async-signal-safe function is one that can be safely called from within a signal handler. Many functions are not async-signal-safe. In particular, nonreentrant functions are generally unsafe to call from a signal handler.

The kinds of issues that render a function unsafe can be quickly understood when one considers the implementation of the stdio library, all of whose functions are not async-signal-safe.

When performing buffered I/O on a file, the stdio functions must maintain a statically allocated data buffer along with associated counters and indexes (or pointers) that record the amount of data and the current position in the buffer. Suppose that the main program is in the middle of a call to a stdio function such as printf(3) where the buffer and associated variables have been partially updated. If, at that moment, the program is interrupted by a signal handler that also calls printf(3), then the second call to printf(3) will operate on inconsistent data, with unpredictable results.

To avoid problems with unsafe functions, there are two possible choices:

1. Ensure that (a) the signal handler calls only async-signal-safe

functions, and (b) the signal handler itself is reentrant with respect to global variables in the main program.

2. Block signal delivery in the main program when calling functions that are unsafe or operating on global data that is also accessed by the signal handler.

Generally, the second choice is difficult in programs of any complexity, so the first choice is taken.

POSIX.1 specifies a set of functions that an implementation must make async-signal-safe. (An implementation may provide safe implementations of additional functions, but this is not required by the standard and other implementations may not provide the same guarantees.)

In general, a function is async-signal-safe either because it is reentrant or because it is atomic with respect to signals (i.e., its execution can't be interrupted by a signal handler).

The set of functions required to be async-signal-safe by POSIX.1 is shown in the following table. The functions not otherwise noted were required to be async-signal-safe in POSIX.1-2001; the table details changes in the subsequent standards.

Function	Notes
abort(3)	Added in POSIX.1-2001 TC1
accept(2)	
access(2)	
aio_error(3)	
aio_return(3)	
aio_suspend(3)	See notes below
alarm(2)	
bind(2)	
cfgetispeed(3)	
cfgetospeed(3)	
cfsetispeed(3)	
cfsetospeed(3)	
chdir(2)	
chmod(2)	

chown(2)
clock_gettime(2)
close(2)
connect(2)
creat(2)
dup(2)
dup2(2)
execl(3) Added in POSIX.1-2008; see notes below
execle(3) See notes below
execv(3) Added in POSIX.1-2008
execve(2)
_exit(2)
_Exit(2)
faccessat(2) Added in POSIX.1-2008
fchdir(2) Added in POSIX.1-2008 TC1
fchmod(2)
fchmodat(2) Added in POSIX.1-2008
fchown(2)
fchownat(2) Added in POSIX.1-2008
fcntl(2)
fdatasync(2)
fexecve(3) Added in POSIX.1-2008
ffs(3) Added in POSIX.1-2008 TC2
fork(2) See notes below
fstat(2)
fstatat(2) Added in POSIX.1-2008
fsync(2)
ftruncate(2)
futimens(3) Added in POSIX.1-2008
getegid(2)
geteuid(2)
getgid(2)
getgroups(2)

getpeername(2)
getpgrp(2)
getpid(2)
getppid(2)
getsockname(2)
getsockopt(2)
getuid(2)
htonl(3) Added in POSIX.1-2008 TC2
htons(3) Added in POSIX.1-2008 TC2
kill(2)
link(2)
linkat(2) Added in POSIX.1-2008
listen(2)
longjmp(3) Added in POSIX.1-2008 TC2; see notes below
lseek(2)
lstat(2)
memccpy(3) Added in POSIX.1-2008 TC2
memchr(3) Added in POSIX.1-2008 TC2
memcmp(3) Added in POSIX.1-2008 TC2
memcpy(3) Added in POSIX.1-2008 TC2
memmove(3) Added in POSIX.1-2008 TC2
memset(3) Added in POSIX.1-2008 TC2
mkdir(2)
mkdirat(2) Added in POSIX.1-2008
mkfifo(3)
mkfifoat(3) Added in POSIX.1-2008
mknod(2) Added in POSIX.1-2008
mknodat(2) Added in POSIX.1-2008
ntohl(3) Added in POSIX.1-2008 TC2
ntohs(3) Added in POSIX.1-2008 TC2
open(2)
openat(2) Added in POSIX.1-2008
pause(2)

pipe(2)
poll(2)
posix_trace_event(3)
pselect(2)
pthread_kill(3) Added in POSIX.1-2008 TC1
pthread_self(3) Added in POSIX.1-2008 TC1
pthread_sigmask(3) Added in POSIX.1-2008 TC1
raise(3)
read(2)
readlink(2)
readlinkat(2) Added in POSIX.1-2008
recv(2)
recvfrom(2)
recvmsg(2)
rename(2)
renameat(2) Added in POSIX.1-2008
rmdir(2)
select(2)
sem_post(3)
send(2)
sendmsg(2)
sendto(2)
setgid(2)
setpgid(2)
setsid(2)
setsockopt(2)
setuid(2)
shutdown(2)
sigaction(2)
sigaddset(3)
sigdelset(3)
sigemptyset(3)
sigfillset(3)

sigismember(3)
siglongjmp(3) Added in POSIX.1-2008 TC2; see notes below
signal(2)
sigpause(3)
sigpending(2)
sigprocmask(2)
sigqueue(2)
sigset(3)
sigsuspend(2)
sleep(3)
socketatmark(3) Added in POSIX.1-2001 TC2
socket(2)
socketpair(2)
stat(2)
stpcpy(3) Added in POSIX.1-2008 TC2
stpncpy(3) Added in POSIX.1-2008 TC2
strcat(3) Added in POSIX.1-2008 TC2
strchr(3) Added in POSIX.1-2008 TC2
strcmp(3) Added in POSIX.1-2008 TC2
strcpy(3) Added in POSIX.1-2008 TC2
strcspn(3) Added in POSIX.1-2008 TC2
strlen(3) Added in POSIX.1-2008 TC2
strncat(3) Added in POSIX.1-2008 TC2
strncmp(3) Added in POSIX.1-2008 TC2
strncpy(3) Added in POSIX.1-2008 TC2
strnlen(3) Added in POSIX.1-2008 TC2
strpbrk(3) Added in POSIX.1-2008 TC2
strrchr(3) Added in POSIX.1-2008 TC2
strspn(3) Added in POSIX.1-2008 TC2
strstr(3) Added in POSIX.1-2008 TC2
strtok_r(3) Added in POSIX.1-2008 TC2
symlink(2)
symlinkat(2) Added in POSIX.1-2008

tcdrain(3)
tcflow(3)
tcflush(3)
tcgetattr(3)
tcgetpgrp(3)
tcsendbreak(3)
tcsetattr(3)
tcsetpgrp(3)
time(2)
timer_getoverrun(2)
timer_gettime(2)
timer_settime(2)
times(2)
umask(2)
uname(2)
unlink(2)
unlinkat(2) Added in POSIX.1-2008
utime(2)
utimensat(2) Added in POSIX.1-2008
utimes(2) Added in POSIX.1-2008
wait(2)
waitpid(2)
wcpncpy(3) Added in POSIX.1-2008 TC2
wcpncpy(3) Added in POSIX.1-2008 TC2
wcscat(3) Added in POSIX.1-2008 TC2
wcschr(3) Added in POSIX.1-2008 TC2
wcscmp(3) Added in POSIX.1-2008 TC2
wcscpy(3) Added in POSIX.1-2008 TC2
wcscspn(3) Added in POSIX.1-2008 TC2
wcslen(3) Added in POSIX.1-2008 TC2
wcsncat(3) Added in POSIX.1-2008 TC2
wcsncmp(3) Added in POSIX.1-2008 TC2
wcsncpy(3) Added in POSIX.1-2008 TC2

wcsnlen(3) Added in POSIX.1-2008 TC2
 wcsprk(3) Added in POSIX.1-2008 TC2
 wcsrchr(3) Added in POSIX.1-2008 TC2
 wcssp(3) Added in POSIX.1-2008 TC2
 wcsstr(3) Added in POSIX.1-2008 TC2
 wcstok(3) Added in POSIX.1-2008 TC2
 wmemchr(3) Added in POSIX.1-2008 TC2
 wmemcmp(3) Added in POSIX.1-2008 TC2
 wmemcpy(3) Added in POSIX.1-2008 TC2
 wmemmove(3) Added in POSIX.1-2008 TC2
 wmemset(3) Added in POSIX.1-2008 TC2
 write(2)

Notes:

- * POSIX.1-2001 and POSIX.1-2001 TC2 required the functions fpathconf(3), pathconf(3), and sysconf(3) to be async-signal-safe, but this requirement was removed in POSIX.1-2008.
- * If a signal handler interrupts the execution of an unsafe function, and the handler terminates via a call to longjmp(3) or siglongjmp(3) and the program subsequently calls an unsafe function, then the behavior of the program is undefined.
- * POSIX.1-2001 TC1 clarified that if an application calls fork(2) from a signal handler and any of the fork handlers registered by pthread_atfork(3) calls a function that is not async-signal-safe, the behavior is undefined. A future revision of the standard is likely to remove fork(2) from the list of async-signal-safe functions.
- * Asynchronous signal handlers that call functions which are cancellation points and nest over regions of deferred cancellation may trigger cancellation whose behavior is as if asynchronous cancellation had occurred and may cause application state to become inconsistent.

errno

Fetching and setting the value of errno is async-signal-safe provided that the signal handler saves errno on entry and restores its value before returning.

fore returning.

Deviations in the GNU C library

The following known deviations from the standard occur in the GNU C library:

- * Before glibc 2.24, `execl(3)` and `execle(3)` employed `realloc(3)` internally and were consequently not `async-signal-safe`. This was fixed in glibc 2.24.
- * The glibc implementation of `aio_suspend(3)` is not `async-signal-safe` because it uses `pthread_mutex_lock(3)` internally.

SEE ALSO

`sigaction(2)`, `signal(7)`, `standards(7)`

COLOPHON

This page is part of release 5.10 of the Linux man-pages project. A description of the project, information about reporting bugs, and the latest version of this page, can be found at <https://www.kernel.org/doc/man-pages/>.

Linux 2020-12-21 SIGNAL-SAFETY(7)