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Кафедра вычислительной математики и программирования

Лабораторная работа №1 по курсу

«Операционные системы»

**Приобретение практических навыков диагностики работы
программного обеспечения**

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1. Постановка задачи

При выполнении последующих лабораторных работ необходимо продемонстрировать ключевые системные вызовы, которые в них используются.

Используемые утилиты: strace, ltrace.

2. Описание используемых утилит

Strace — это утилита Linux, отслеживающая системные вызовы, которые представляют собой механизм трансляции, обеспечивающий интерфейс между процессом и операционной системой. Использование данной утилиты позволяет понять, что процесс пытается сделать в данное время. Strace может быть полезен при отладке программ.

Для удобства работы с протоколом утилиты можно использовать следующие ключи:

- -o file – Перенаправить протокол утилиты в файл file
- -e trace=filters – Указать выражения, по которым будут фильтроваться системные вызовы. Например -e trace=write,%process задаёт фильтрацию по системным вызовам write и по группе системных вызовов, связанных с межпроцессорным взаимодействием.
- -f – Отслеживать системные вызовы в дочерних процессах
- -y – Заменить в протоколе все файловые дескрипторы на имена соответствующих им файлов (где возможно).
- -p file – Отслеживать только обращения к файлу file
- -k – Отображать стек вызовов

Ltrace – это утилита Linux, отслеживающая системные вызовы, связанные с динамическими библиотеками. Использование данной утилиты очень похоже на использование strace.

3. Примеры использования утилит

Ниже приведены протоколы strace лабораторных работ. Ключевые строки в протоколе будут выделены красным цветом.

Лабораторная работа 2 – взаимодействие между процессами

```
mosik@LAPTOP-69S778GL:~/os_lab2$ strace -f -e trace="%process,read,write,dup2,pipe" -o
strace_log.txt ./parent
Enter file's name for chiild process 1: first_file
Enter file's name for chiild process 2: second_file
10
20
30

mosik@LAPTOP-69S778GL:~/os_lab2$ cat strace_log.txt
942   execve("./parent", ["./parent"], 0x7fffe903e778 /* 29 vars */) = 0
942   read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000b\0\0\0\0\0\0"...,
832) = 832
942   read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0\0"...,
832) = 832
942   arch_prctl(ARCH_SET_FS, 0x7f10a9780740) = 0
942   write(1, "Enter file's name for chiild pro"..., 40) = 40
942   read(0, "first_file\n", 1024)       = 11
942   write(1, "Enter file's name for chiild pro"..., 40) = 40
942   read(0, "second_file\n", 1024)      = 12
942   pipe([5, 6])                        = 0
942   pipe([7, 8])                        = 0
```

```
942   clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7f10a9780a10) = 951
942   clone( <unfinished ...>
951   dup2(5, 0)                        = 0
951   dup2(3, 1)                        = 1
951   execve("child", [], 0x7fffdb666388 /* 29 vars */ <unfinished ...>
942   <... clone resumed> child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD, child_tidptr=0x7f10a9780a10) =
952
942   read(0, <unfinished ...>
952   dup2(7, 0)                        = 0
952   dup2(4, 1)                        = 1
952   execve("child", [], 0x7fffdb666388 /* 29 vars */ <unfinished ...>
951   <... execve resumed> )            = 0
951   read(6, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0\0"...,
832) = 832
952   <... execve resumed> )            = 0
951   arch_prctl(ARCH_SET_FS, 0x7f0a5d4814c0) = 0
951   read(0, <unfinished ...>
952   read(5, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\260\34\2\0\0\0\0\0"...,
832) = 832
952   arch_prctl(ARCH_SET_FS, 0x7ff4eb5f14c0) = 0
952   read(0, <unfinished ...>
942   <... read resumed> "10\n", 1024)  = 3
942   write(6, "1", 1)                  = 1
951   <... read resumed> "1", 4096)     = 1
942   write(6, "0", 1 <unfinished ...>
951   read(0, <unfinished ...>
942   <... write resumed> )             = 1
951   <... read resumed> "0", 4096)     = 1
942   write(6, "\0", 1 <unfinished ...>
951   read(0, <unfinished ...>
942   <... write resumed> )             = 1
951   <... read resumed> "\0", 4096)    = 1
942   read(0, <unfinished ...>
951   write(1, "01\n", 3)               = 3
951   read(0, <unfinished ...>
942   <... read resumed> "20\n", 1024)  = 3
942   write(8, "2", 1)                  = 1
952   <... read resumed> "2", 4096)     = 1
942   write(8, "0", 1 <unfinished ...>
952   read(0, <unfinished ...>
942   <... write resumed> )             = 1
952   <... read resumed> "0", 4096)     = 1
942   write(8, "\0", 1 <unfinished ...>
952   read(0, <unfinished ...>
942   <... write resumed> )             = 1
952   <... read resumed> "\0", 4096)    = 1
942   read(0, <unfinished ...>
952   write(1, "02\n", 3)               = 3
952   read(0, <unfinished ...>
942   <... read resumed> "30\n", 1024)  = 3
942   write(6, "3", 1)                  = 1
951   <... read resumed> "3", 4096)     = 1
942   write(6, "0", 1)                  = 1
951   read(0, <unfinished ...>
942   write(6, "\0", 1 <unfinished ...>
951   <... read resumed> "0", 4096)     = 1
942   <... write resumed> )             = 1
951   read(0, <unfinished ...>
942   read(0, <unfinished ...>
951   <... read resumed> "\0", 4096)    = 1
951   write(1, "03\n", 3)               = 3
951   read(0, <unfinished ...>
942   <... read resumed> "", 1024)      = 0
942   exit_group(0)                     = ?
```

```
952   <... read resumed> "", 4096)     = 0
951   <... read resumed> "", 4096)     = 0
942   +++ exited with 0 +++
952   exit_group(0)                    = ?
951   exit_group(0)                    = ?
952   +++ exited with 0 +++
951   +++ exited with 0 +++
```

Лабораторная работа 3 – взаимодействие между потоками

```
mosik@LAPTOP-69S778GL:~/os_lab3$ strace -f -e trace="%process,write" -o strace_log.txt
./main 3
Enter a number you want to check: 100
100 is not a prime number
mosik@LAPTOP-69S778GL:~/os_lab3$ cat strace_log.txt
785   execve("./main", ["./main", "3"], 0x7fffc550ab10 /* 30 vars */) = 0
785   arch_prctl(ARCH_SET_FS, 0x7f1970de0740) = 0
785   write(1, "Enter a number you want to check"..., 34) = 34
785   clone(child_stack=0x7f19703cffb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SET
TLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tidptr=0x7f19703d09d0,
tls=0x7f19703d0700, child_tidptr=0x7f19703d09d0) = 795
785   clone(child_stack=0x7f196fbbffb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SET
TLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tidptr=0x7f196fbc09d0,
tls=0x7f196fbc0700, child_tidptr=0x7f196fbc09d0) = 796
785   clone(child_stack=0x7f196f3affb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SET
TLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tidptr=0x7f196f3b09d0,
tls=0x7f196f3b0700, child_tidptr=0x7f196f3b09d0) = 797
795   exit(0)                          = ?
795   +++ exited with 0 +++
796   exit(0 <unfinished ...>
785   clone( <unfinished ...>
796   <... exit resumed>)              = ?
796   +++ exited with 0 +++
785   <... clone resumed> child_stack=0x7f19703cffb0,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SET
TLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tidptr=0x7f19703d09d0,
tls=0x7f19703d0700, child_tidptr=0x7f19703d09d0) = 798
797   exit(0)                          = ?
797   +++ exited with 0 +++
798   exit(0)                          = ?
798   +++ exited with 0 +++
785   write(1, "100 is not a prime number\n", 26) = 26
785   exit_group(0)                    = ?
785   +++ exited with 0 +++
```

Лабораторная работа 4 – отображаемые файлы

```
mosik@LAPTOP-69S778GL:~/os_lab4$ strace -f -e trace="%process,read,write,dup2,mmap" -o
strace_log.txt ./parent
Enter file's name for child process 1: f1
Enter file's name for child process 2: f2
here are
some string
for strace
mosik@LAPTOP-69S778GL:~/os_lab4$ cat f1
era ereh
gnirts emos
mosik@LAPTOP-69S778GL:~/os_lab4$ cat f2
ecarts rof
mosik@LAPTOP-69S778GL:~/os_lab4$ cat strace_log.txt
535   execve("./parent", ["./parent"], 0x7fffee34b5d8 /* 30 vars */) = 0
```

```
535   mmap(NULL, 42756, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7ffea19c4000
535   read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20\35\2\0\0\0\0\0"...,
832) = 832
535   mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7ffea19c0000
535   mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7ffea1200000
535   mmap(0x7ffea15e7000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1e7000) = 0x7ffea15e7000
535   mmap(0x7ffea15ed000, 15072, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7ffea15ed000
535   arch_prctl(ARCH_SET_FS, 0x7ffea19c14c0) = 0
535   write(1, "Enter file's name for child proc"..., 39) = 39
535   read(0, "f1\n", 1024)            = 3
535   write(1, "Enter file's name for child proc"..., 39) = 39
535   read(0, "f2\n", 1024)            = 3
535   write(5, "\1\0\0\0\0\0\0\0", 8)   = 8
535   write(6, "\1\0\0\0\0\0\0\0", 8)   = 8
535   mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 5, 0) = 0x7ffea19b0000
535   mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 6, 0) = 0x7ffea19a0000
535   clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7ffea19c1790) = 536
536   dup2(3, 1 <unfinished ...>
535   clone( <unfinished ...>
536   <... dup2 resumed> )             = 1
536   execve("child", ["1"], 0x7fffeda13568 /* 30 vars */ <unfinished ...>
535   <... clone resumed> child_stack=NULL,
flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD, child_tidptr=0x7ffea19c1790) =
537
537   dup2(4, 1 <unfinished ...>
535   read(0,  <unfinished ...>
537   <... dup2 resumed> )             = 1
537   execve("child", ["2"], 0x7fffeda13568 /* 30 vars */ <unfinished ...>
536   <... execve resumed> )           = 0
536   mmap(NULL, 42756, PROT_READ, MAP_PRIVATE, 7, 0) = 0x7f82f5b9a000
536   read(7,  <unfinished ...>
537   <... execve resumed> )           = 0
536   <... read resumed>
"\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20\35\2\0\0\0\0\0"..., 832) = 832
536   mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f82f5b90000
536   mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 7, 0) =
0x7f82f5400000
536   mmap(0x7f82f57e7000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 7, 0x1e7000) = 0x7f82f57e7000
536   mmap(0x7f82f57ed000, 15072, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0 <unfinished ...>
537   mmap(NULL, 42756, PROT_READ, MAP_PRIVATE, 7, 0 <unfinished ...>
536   <... mmap resumed> )             = 0x7f82f57ed000
537   <... mmap resumed> )             = 0x7f781f8c7000
536   arch_prctl(ARCH_SET_FS, 0x7f82f5b914c0) = 0
537   read(7, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20\35\2\0\0\0\0\0"...,
832) = 832
537   mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f781f8c0000
537   mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 7, 0) =
0x7f781f200000
537   mmap(0x7f781f5e7000, 24576, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 7, 0x1e7000) = 0x7f781f5e7000
537   mmap(0x7f781f5ed000, 15072, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f781f5ed000
537   arch_prctl(ARCH_SET_FS, 0x7f781f8c14c0 <unfinished ...>
536   mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 7, 0 <unfinished ...>
537   <... arch_prctl resumed> )       = 0
536   <... mmap resumed> )             = 0x7f82f5ba0000
537   mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_SHARED, 7, 0) = 0x7f781f8d0000
```

```
535   <... read resumed> "here are\n", 1024) = 9
535   read(0,  <unfinished ...>
536   write(1, "era ereh\n", 9)         = 9
535   <... read resumed> "some string\n", 1024) = 12
535   read(0,  <unfinished ...>
536   write(1, "gnirts emos\n", 12)     = 12
535   <... read resumed> "for strace\n", 1024) = 11
535   read(0,  <unfinished ...>
537   write(1, "ecarts rof\n", 11)      = 11
535   <... read resumed> "", 1024)      = 0
536   exit_group(0 <unfinished ...>
537   exit_group(0 <unfinished ...>
536   <... exit_group resumed>)         = ?
537   <... exit_group resumed>)         = ?
536   +++ exited with 0 +++
537   +++ exited with 0 +++
535   --- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=536, si_uid=1000,
si_status=0, si_utime=0, si_stime=0} ---
535   exit_group(0)                     = ?
535   +++ exited with 0 +++
```

Лабораторная работа 5 – динамические библиотеки

```
mosik@LAPTOP-69S778GL:~/os_lab5$ ltrace -o ltrace.log ./prog2
0 --> change library
1 x --> count 'e' number
2 size_of_array array --> sort array
1
10
Counting 'e' number using second remarkable limit
2.593742
0
Implementation switched
1 10
Counting 'e' number using Taylor series
2.718282
0
Implementation switched
mosik@LAPTOP-69S778GL:~/os_lab5$ cat ltrace.log
puts("0 --> change library")
= 21
puts("1 x --> count 'e' number")
= 25
puts("2 size_of_array array --> sort a"...)
= 37
dlopen("lib1.so", 1)
= 0x7fffd478b6a0
dlsym(0x7fffd478b6a0, "e")
= 0x7f2c775e069a
dlsym(0x7fffd478b6a0, "sort")
= 0x7f2c775e06f0
dlerror()
= nil
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e44, 1, 0)
= 1
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e48, 0x7f2c77bdd8d0, 16)
= 1
printf("%f\n", 2.593742)
= 9
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e44, 0, 0)
= 1
dlclose(0x7fffd478b6a0)
= 0
dlopen("lib2.so", 1)
= 0x7fffd478b6a0
```

```
dlsym(0x7fffd478b6a0, "e")
= 0x7f2c775e067a
dlsym(0x7fffd478b6a0, "sort")
= 0x7f2c775e0839
dlerror()
= nil
puts("Implementation switched")
= 24
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e44, 0x7f2c77bdd8c0, 3)
= 1
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e48, 0x7f2c77bdd8d0, 16)
= 1
printf("%f\n", 2.718282)
= 9
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e44, 0, 0)
= 1
dlclose(0x7fffd478b6a0)
= 0
dlopen("lib1.so", 1)
= 0x7fffd478b6a0
dlsym(0x7fffd478b6a0, "e")
= 0x7f2c775e069a
dlsym(0x7fffd478b6a0, "sort")
= 0x7f2c775e06f0
dlerror()
= nil
puts("Implementation switched")
= 24
__isoc99_scanf(0x7f2c78200e59, 0x7fffdc268e44, 0x7f2c77bdd8c0, 4)
= 0xffffffff
dlclose(0x7fffd478b6a0)
= 0
+++ exited (status 0) +++
```

Лабораторная работа 6 – очереди сообщений

```
mosik@LAPTOP-69S778GL:~/os_lab6$ strace -o strace_log.txt ./control
create 0 -1
OK: 20242
exit
mosik@LAPTOP-69S778GL:~/os_lab6$ cat strace_log.txt
execve("./control", ["./control"], 0x7fffd7c8fb10 /* 19 vars */) = 0
brk(NULL)                               = 0x7fffdb4a2000
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
access("/etc/ld.so.preload", R_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=43552, ...}) = 0
mmap(NULL, 43552, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f71eb6c4000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/libzmq.so.5", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P?\1\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=630464, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f71eb6c0000
mmap(NULL, 2725560, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71eb160000
mprotect(0x7f71eb1f3000, 2097152, PROT_NONE) = 0
mmap(0x7f71eb3f3000, 28672, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x93000) = 0x7f71eb3f3000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/libstdc++.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\220\304\10\0\0\0\0\0"..., 832)
= 832
```

```
fstat(3, {st_mode=S_IFREG|0644, st_size=1594864, ...}) = 0
mmap(NULL, 3702848, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71eadd0000
mprotect(0x7f71eaf49000, 2097152, PROT_NONE) = 0
mmap(0x7f71eb149000, 49152, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x179000) = 0x7f71eb149000
mmap(0x7f71eb155000, 12352, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,
-1, 0) = 0x7f71eb155000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libgcc_s.so.1", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\300*\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=96616, ...}) = 0
mmap(NULL, 2192432, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71eabb0000
mprotect(0x7f71eabc7000, 2093056, PROT_NONE) = 0
mmap(0x7f71eadc6000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x16000) = 0x7f71eadc6000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\20\35\2\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0755, st_size=2030928, ...}) = 0
mmap(NULL, 4131552, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71ea7b0000
mprotect(0x7f71ea997000, 2097152, PROT_NONE) = 0
mmap(0x7f71eab97000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x1e7000) = 0x7f71eab97000
mmap(0x7f71eab9d000, 15072, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,
-1, 0) = 0x7f71eab9d000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/libsodium.so.23", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\340\251\0\0\0\0\0\0"..., 832)
= 832
fstat(3, {st_mode=S_IFREG|0644, st_size=330440, ...}) = 0
mmap(NULL, 2425864, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71ea550000
mprotect(0x7f71ea5a0000, 2093056, PROT_NONE) = 0
mmap(0x7f71ea79f000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x4f000) = 0x7f71ea79f000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/libpgm-5.2.so.0", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000;\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=293784, ...}) = 0
mmap(NULL, 2406448, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71ea300000
mprotect(0x7f71ea347000, 2093056, PROT_NONE) = 0
mmap(0x7f71ea546000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x46000) = 0x7f71ea546000
mmap(0x7f71ea548000, 14384, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,
-1, 0) = 0x7f71ea548000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/libnorm.so.1", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000\374\1\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=522248, ...}) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f71eb6b0000
mmap(NULL, 3340624, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71e9fd0000
mprotect(0x7f71ea04d000, 2097152, PROT_NONE) = 0
```

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mmap(0x7f71ea24d000, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x7d000) = 0x7f71ea24d000
mmap(0x7f71ea250000, 719184, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f71ea250000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/librt.so.1", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\0\"\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0644, st_size=31680, ...}) = 0
mmap(NULL, 2128864, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71e9dc0000
mprotect(0x7f71e9dc7000, 2093056, PROT_NONE) = 0
mmap(0x7f71e9fc6000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x6000) = 0x7f71e9fc6000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libpthread.so.0", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0000b\0\0\0\0\0\0"..., 832) =
832
fstat(3, {st_mode=S_IFREG|0755, st_size=144976, ...}) = 0
mmap(NULL, 2221184, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71e9ba0000
mprotect(0x7f71e9bba000, 2093056, PROT_NONE) = 0
mmap(0x7f71e9db9000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x19000) = 0x7f71e9db9000
mmap(0x7f71e9dbb000, 13440, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,
-1, 0) = 0x7f71e9dbb000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libm.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0\200\272\0\0\0\0\0\0"..., 832)
= 832
fstat(3, {st_mode=S_IFREG|0644, st_size=1700792, ...}) = 0
mmap(NULL, 3789144, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71e9800000
mprotect(0x7f71e999d000, 2093056, PROT_NONE) = 0
mmap(0x7f71e9b9c000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0x19c000) = 0x7f71e9b9c000
close(3)                                = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f71eb6a0000
mmap(NULL, 12288, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f71eb690000
arch_prctl(ARCH_SET_FS, 0x7f71eb690b80) = 0
mprotect(0x7f71eab97000, 16384, PROT_READ) = 0
mprotect(0x7f71e9b9c000, 4096, PROT_READ) = 0
mprotect(0x7f71e9db9000, 4096, PROT_READ) = 0
mprotect(0x7f71e9fc6000, 4096, PROT_READ) = 0
mprotect(0x7f71eadc6000, 4096, PROT_READ) = 0
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x7f71eb680000
mprotect(0x7f71eb149000, 40960, PROT_READ) = 0
mprotect(0x7f71ea24d000, 8192, PROT_READ) = 0
mprotect(0x7f71ea546000, 4096, PROT_READ) = 0
mprotect(0x7f71ea79f000, 4096, PROT_READ) = 0
mprotect(0x7f71eb3f3000, 24576, PROT_READ) = 0
mprotect(0x7f71eba0d000, 4096, PROT_READ) = 0
mprotect(0x7f71eb629000, 4096, PROT_READ) = 0
munmap(0x7f71eb6c4000, 43552)           = 0
set_tid_address(0x7f71eb690e50)         = 20241
set_robust_list(0x7f71eb690e60, 24)     = 0
rt_sigaction(SIGRTMIN, {sa_handler=0x7f71e9ba5cb0, sa_mask=[],
sa_flags=SA_RESTORER|SA_SIGINFO, sa_restorer=0x7f71e9bb2980}, NULL, 8) = 0
rt_sigaction(SIGRT_1, {sa_handler=0x7f71e9ba5d50, sa_mask=[],
sa_flags=SA_RESTORER|SA_RESTART|SA_SIGINFO, sa_restorer=0x7f71e9bb2980}, NULL, 8) = 0
rt_sigprocmask(SIG_UNBLOCK, [RTMIN RT_1], NULL, 8) = 0
```

```
prlimit64(0, RLIMIT_STACK, NULL, {rlim_cur=8192*1024, rlim_max=8192*1024}) = 0
brk(NULL)                               = 0x7fffdb4a2000
brk(0x7fffdb4c3000)                     = 0x7fffdb4c3000
gettimeofday({tv_sec=1609673745, tv_usec=387429}, {tz_minuteswest=0, tz_dsttime=0}) =
0
futex(0x7f71eb15609c, FUTEX_WAKE_PRIVATE, 2147483647) = 0
futex(0x7f71eb1560a8, FUTEX_WAKE_PRIVATE, 2147483647) = 0
time(NULL)                              = 1609673745 (2021-01-03T14:35:45+0300)
openat(AT_FDCWD, "/sys/devices/system/cpu/online", O_RDONLY|O_CLOEXEC) = 3
read(3, "0-7\n", 8192)                  = 4
close(3)                                = 0
openat(AT_FDCWD, "/sys/devices/system/cpu", O_RDONLY|O_NONBLOCK|O_CLOEXEC|O_DIRECTORY)
= 3
fstat(3, {st_mode=S_IFDIR|0755, st_size=0, ...}) = 0
getdents(3, /* 13 entries */, 32768)    = 336
getdents(3, /* 0 entries */, 32768)     = 0
close(3)                                = 0
getpid()                                = 20241
sched_getaffinity(20241, 128, [0, 1, 2, 3, 4, 5, 6, 7]) = 64
openat(AT_FDCWD, "/etc/nsswitch.conf", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=513, ...}) = 0
read(3, "# /etc/nsswitch.conf\n#\n# Example"..., 4096) = 513
read(3, "", 4096)                       = 0
close(3)                                = 0
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=43552, ...}) = 0
mmap(NULL, 43552, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f71eb6c4000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/tls/haswell/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/tls/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such
file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/tls/haswell/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/tls/haswell", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/tls/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/tls/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/tls/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/tls", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/haswell/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file
or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/haswell/libnss_db.so.2", O_RDONLY|O_CLOEXEC) =
-1 ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/haswell", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) =
-1 ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
stat("/lib/x86_64-linux-gnu", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/tls/haswell/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu/tls/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No
such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/tls/haswell/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
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```
stat("/usr/lib/x86_64-linux-gnu/tls/haswell", 0x7fffe3679a70) = -1 ENOENT (No such
file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/tls/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu/tls/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file
or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/tls/libnss_db.so.2", O_RDONLY|O_CLOEXEC) =
-1 ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu/tls", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/haswell/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such
file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/haswell/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu/haswell", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/x86_64/libnss_db.so.2",
O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/usr/lib/x86_64-linux-gnu/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
stat("/usr/lib/x86_64-linux-gnu", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
openat(AT_FDCWD, "/lib/tls/haswell/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
stat("/lib/tls/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/lib/tls/haswell/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)
stat("/lib/tls/haswell", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/tls/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)
stat("/lib/tls/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/tls/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such
file or directory)
stat("/lib/tls", 0x7fffe3679a70)        = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/haswell/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)
stat("/lib/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/haswell/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)
stat("/lib/haswell", 0x7fffe3679a70)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)
stat("/lib/x86_64", 0x7fffe3679a70)     = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such file
or directory)
stat("/lib", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
openat(AT_FDCWD, "/usr/lib/tls/haswell/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -
1 ENOENT (No such file or directory)
stat("/usr/lib/tls/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
openat(AT_FDCWD, "/usr/lib/tls/haswell/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
stat("/usr/lib/tls/haswell", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/tls/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)
stat("/usr/lib/tls/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/tls/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)
stat("/usr/lib/tls", 0x7fffe3679a70)    = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/haswell/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1
ENOENT (No such file or directory)
stat("/usr/lib/haswell/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or
directory)
```

```
openat(AT_FDCWD, "/usr/lib/haswell/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT
(No such file or directory)
stat("/usr/lib/haswell", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/x86_64/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No
such file or directory)
stat("/usr/lib/x86_64", 0x7fffe3679a70) = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/usr/lib/libnss_db.so.2", O_RDONLY|O_CLOEXEC) = -1 ENOENT (No such
file or directory)
stat("/usr/lib", {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
munmap(0x7f71eb6c4000, 43552)           = 0
openat(AT_FDCWD, "/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=43552, ...}) = 0
mmap(NULL, 43552, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f71eb6c4000
close(3)                                = 0
access("/etc/ld.so.nohwcap", F_OK)      = -1 ENOENT (No such file or directory)
openat(AT_FDCWD, "/lib/x86_64-linux-gnu/libnss_files.so.2", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\0\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P#\0\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0644, st_size=47568, ...}) = 0
mmap(NULL, 2168632, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) =
0x7f71e95e0000
mprotect(0x7f71e95eb000, 2093056, PROT_NONE) = 0
mmap(0x7f71e97ea000, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE,
3, 0xa000) = 0x7f71e97ea000
mmap(0x7f71e97ec000, 22328, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,
-1, 0) = 0x7f71e97ec000
close(3)                                = 0
mprotect(0x7f71e97ea000, 4096, PROT_READ) = 0
munmap(0x7f71eb6c4000, 43552)           = 0
openat(AT_FDCWD, "/etc/protocols", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=2932, ...}) = 0
read(3, "# Internet (IP) protocols\n#\n# Up"..., 4096) = 2932
read(3, "", 4096)                       = 0
close(3)                                = 0
gettimeofday({tv_sec=1609673745, tv_usec=399158}, NULL) = 0
eventfd2(0, EFD_CLOEXEC)                 = 3
fcntl(3, F_GETFL)                       = 0x2 (flags O_RDWR)
fcntl(3, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
fcntl(3, F_GETFL)                       = 0x802 (flags O_RDWR|O_NONBLOCK)
fcntl(3, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
getrandom("\x2a\x1c\xa3\x42\xdf\x17\x02\x09\x03\x45\x54\x73\xed\x15\xde\xac", 16, 0) =
16
getrandom("\xf8\x48\x09\xa9\xd0\x1e\x10\xe7\xbb\xac\x48\xcb\xb5\xdb\x18\x37", 16, 0) =
16
fstat(0, {st_mode=S_IFCHR|0660, st_rdev=makedev(4, 1), ...}) = 0
ioctl(0, TCGETS, {B38400 opost isig icanon echo ...}) = 0
read(0, "create 0 -1\n", 4096)          = 12
clone(child_stack=NULL, flags=CLONE_CHILD_CLEARTID|CLONE_CHILD_SETTID|SIGCHLD,
child_tidptr=0x7f71eb690e50) = 20242
eventfd2(0, EFD_CLOEXEC)                 = 4
fcntl(4, F_GETFL)                       = 0x2 (flags O_RDWR)
fcntl(4, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
fcntl(4, F_GETFL)                       = 0x802 (flags O_RDWR|O_NONBLOCK)
fcntl(4, F_SETFL, O_RDWR|O_NONBLOCK)    = 0
clock_gettime(CLOCK_MONOTONIC, {tv_sec=10895, tv_nsec=66665100}) = 0
epoll_create1(EPOLL_CLOEXEC)            = 5
epoll_ctl(5, EPOLL_CTL_ADD, 4, {0, {u32=3679145984, u64=140736872534016}}) = 0
epoll_ctl(5, EPOLL_CTL_MOD, 4, {EPOLLIN, {u32=3679145984, u64=140736872534016}}) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) =
0x7f71e8dd0000
mprotect(0x7f71e8dd1000, 8388608, PROT_READ|PROT_WRITE) = 0
clone(child_stack=0x7f71e95cfb70,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SET
TLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tidptr=0x7f71e95d09d0,
tls=0x7f71e95d0700, child_tidptr=0x7f71e95d09d0) = 20243
openat(AT_FDCWD, "/proc/self/task/20243/comm", O_RDWR) = 6
write(6, "ZMQbg/0", 7)                  = 7
close(6)                                = 0
```

```
eventfd2(0, EFD_CLOEXEC)                 = 6
fcntl(6, F_GETFL)                        = 0x2 (flags O_RDWR)
fcntl(6, F_SETFL, O_RDWR|O_NONBLOCK)     = 0
fcntl(6, F_GETFL)                        = 0x802 (flags O_RDWR|O_NONBLOCK)
fcntl(6, F_SETFL, O_RDWR|O_NONBLOCK)     = 0
clock_gettime(CLOCK_MONOTONIC, {tv_sec=10895, tv_nsec=68580300}) = 0
epoll_create1(EPOLL_CLOEXEC)             = 7
epoll_ctl(7, EPOLL_CTL_ADD, 6, {0, {u32=3679146240, u64=140736872534272}}) = 0
epoll_ctl(7, EPOLL_CTL_MOD, 6, {EPOLLIN, {u32=3679146240, u64=140736872534272}}) = 0
mmap(NULL, 8392704, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS|MAP_STACK, -1, 0) =
0x7f71e85c0000
mprotect(0x7f71e85c1000, 8388608, PROT_READ|PROT_WRITE) = 0
clone(child_stack=0x7f71e8dbfb70,
flags=CLONE_VM|CLONE_FS|CLONE_FILES|CLONE_SIGHAND|CLONE_THREAD|CLONE_SYSVSEM|CLONE_SET
TLS|CLONE_PARENT_SETTID|CLONE_CHILD_CLEARTID, parent_tidptr=0x7f71e8dc09d0,
tls=0x7f71e8dc0700, child_tidptr=0x7f71e8dc09d0) = 20244
openat(AT_FDCWD, "/proc/self/task/20244/comm", O_RDWR) = 8
write(8, "ZMQbg/1", 7)                   = 7
close(8)                                 = 0
clock_gettime(CLOCK_MONOTONIC, {tv_sec=10895, tv_nsec=69505700}) = 0
eventfd2(0, EFD_CLOEXEC)                 = 8
fcntl(8, F_GETFL)                        = 0x2 (flags O_RDWR)
fcntl(8, F_SETFL, O_RDWR|O_NONBLOCK)     = 0
fcntl(8, F_GETFL)                        = 0x802 (flags O_RDWR|O_NONBLOCK)
fcntl(8, F_SETFL, O_RDWR|O_NONBLOCK)     = 0
poll([{fd=8, events=POLLIN}], 1, 0)      = 0 (Timeout)
socket(AF_NETLINK, SOCK_RAW|SOCK_CLOEXEC, NETLINK_ROUTE) = 9
bind(9, {sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000}, 12) = 0
getsockname(9, {sa_family=AF_NETLINK, nl_pid=20241, nl_groups=00000000}, [12]) = 0
time(NULL)                               = 1609673748 (2021-01-03T14:35:48+0300)
sendto(9, "\24\0\0\0\22\0\1\3\24\254\361_\0\0\0\0\0\0\0\0", 20, 0,
{sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000}, 12) = 20
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=80, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x01\x00\x08\x00\x00\x00\x40\x00\x00\x00\x00\x00\x00\x00\x0a\x00\x01\x00\xd8\
xc4\x97\xc2\x6b\x92\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 80
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=80, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x01\x00\x09\x00\x00\x00\x40\x00\x00\x00\x00\x00\x00\x00\x0a\x00\x01\x00\x1c\
x1b\xb5\x88\x10\x48\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 80
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=80, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x01\x00\x13\x00\x00\x00\x43\x10\x00\x00\x00\x00\x00\x0a\x00\x01\x00\x0a\
x00\x27\x00\x00\x13\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 80
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=76, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x04\x03\x01\x00\x00\x00\x49\x00\x00\x00\x00\x00\x00\x00\x0a\x00\x01\x00\x00\
x00\x00\x00\x00\x00\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 76
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=80, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x21\x03\x06\x00\x00\x00\x43\x10\x00\x00\x00\x00\x00\x00\x0a\x00\x01\x00\x1c\
x1b\xb5\x88\x10\x44\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 80
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=80, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x21\x03\x0f\x00\x00\x00\x40\x00\x00\x00\x00\x00\x00\x00\x0a\x00\x01\x00\x1c\
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x1b\xb5\x88\x10\x45\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 80
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=80, type=0x10 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673748, pid=20241},
"\x00\x00\x21\x03\x0c\x00\x00\x00\x40\x00\x00\x00\x00\x00\x00\x00\x0a\x00\x01\x00\x1e\
x1b\xb5\x88\x10\x44\x00\x00\x08\x00\x1b\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 80
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=20, type=NLMSG_DONE, flags=NLM_F_MULTI,
seq=1609673748, pid=20241}, 0}, iov_len=4096}], msg_iovlen=1, msg_controllen=0,
msg_flags=0}, 0) = 20
sendto(9, "\24\0\0\0\26\0\1\3\25\254\361_\0\0\0\0\0\0\0\0", 20, 0,
{sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000}, 12) = 20
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x10\x00\x00\x08\x00\x00\x00\x08\x00\x01\x00\xa9\xfe\x93\xad\x08\x00\x04\x00\xa9\
xfe\xff\xff\x14\x00\x06\x00\xff\xff\xff\xff"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x40\x00\xfd\x08\x00\x00\x00\x14\x00\x01\x00\xfe\x80\x00\x00\x00\x00\x00\x00\x3d\
x05\xea\xe6\x03\x7d\x93\xad\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x10\x00\x00\x09\x00\x00\x00\x08\x00\x01\x00\xa9\xfe\xd9\x3b\x08\x00\x04\x00\xa9\
xfe\xff\xff\x14\x00\x06\x00\xff\xff\xff\xff"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x40\x00\xfd\x09\x00\x00\x00\x14\x00\x01\x00\xfe\x80\x00\x00\x00\x00\x00\x00\xe4\
x8e\x44\xf8\x07\xe3\xd9\x3b\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x18\x00\x00\x13\x00\x00\x00\x08\x00\x01\x00\xc0\xa8\x38\x01\x08\x00\x04\x00\xc0\
xa8\x38\xff\x14\x00\x06\x00\xff\xff\xff\xff"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x40\x00\xfd\x13\x00\x00\x00\x14\x00\x01\x00\xfe\x80\x00\x00\x00\x00\x00\x00\x54\
x5a\x77\xc5\x46\x23\x7e\x74\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x08\x00\x00\x01\x00\x00\x00\x08\x00\x01\x00\x7f\x00\x00\x01\x08\x00\x04\x00\x7f\
xff\xff\xff\x14\x00\x06\x00\xff\xff\xff\xff"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x80\x00\xfe\x01\x00\x00\x00\x14\x00\x01\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\
x00\x00\x00\x00\x00\x01\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x18\x00\x00\x06\x00\x00\x00\x08\x00\x01\x00\xc0\xa8\x00\x25\x08\x00\x04\x00\xc0\

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xa8\x00\xff\x14\x00\x06\x00\x51\x51\x01\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x40\x00\xfd\x06\x00\x00\x00\x14\x00\x01\x00\xfe\x80\x00\x00\x00\x00\x00\x00\xc5\
x1d\xff\x10\x1d\xa5\x8f\x8d\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x10\x00\x00\x0f\x00\x00\x00\x08\x00\x01\x00\xa9\xfe\xfe\x9f\x08\x00\x04\x00\xa9\
xfe\xff\xff\x14\x00\x06\x00\xff\xff\xff\xff"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x40\x00\xfd\x0f\x00\x00\x00\x14\x00\x01\x00\xfe\x80\x00\x00\x00\x00\x00\x00\x91\
xc4\x97\xe8\x18\x2d\xfe\x9f\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=60, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x02\x10\x00\x00\x0c\x00\x00\x00\x08\x00\x01\x00\xa9\xfe\x13\x01\x08\x00\x04\x00\xa9\
xfe\xff\xff\x14\x00\x06\x00\xff\xff\xff\xff"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 60
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=64, type=0x14 /* NLMSG_??? */,
flags=NLM_F_MULTI, seq=1609673749, pid=20241},
"\x0a\x40\x00\xfd\x0c\x00\x00\x00\x14\x00\x01\x00\xfe\x80\x00\x00\x00\x00\x00\x00\xb1\
x56\x78\x65\x03\x84\x13\x01\x14\x00\x06\x00"...}, iov_len=4096}], msg_iovlen=1,
msg_controllen=0, msg_flags=0}, 0) = 64
recvmsg(9, {msg_name={sa_family=AF_NETLINK, nl_pid=0, nl_groups=00000000},
msg_namelen=12, msg_iov=[{iov_base={{len=20, type=NLMSG_DONE, flags=NLM_F_MULTI,
seq=1609673749, pid=20241}, 0}, iov_len=4096}], msg_iovlen=1, msg_controllen=0,
msg_flags=0}, 0) = 20
close(9)                                = 0
socket(AF_INET, SOCK_STREAM|SOCK_CLOEXEC, IPPROTO_TCP) = 9
setsockopt(9, SOL_SOCKET, SO_REUSEADDR, [1], 4) = 0
bind(9, {sa_family=AF_INET, sin_port=htons(4040), sin_addr=inet_addr("127.0.0.1")},
16) = 0
listen(9, 100)                          = 0
getsockname(9, {sa_family=AF_INET, sin_port=htons(4040),
sin_addr=inet_addr("127.0.0.1")}, [128->16]) = 0
write(6, "\1\0\0\0\0\0\0\0", 8)         = 8
write(8, "\1\0\0\0\0\0\0\0", 8)         = 8
poll([{fd=8, events=POLLIN}], 1, 0)     = 1 ([{fd=8, revents=POLLIN}])
read(8, "\1\0\0\0\0\0\0\0", 8)          = 8
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
clock_gettime(CLOCK_MONOTONIC, {tv_sec=10895, tv_nsec=74918500}) = 0
poll([{fd=8, events=POLLIN}], 1, 5000)  = 1 ([{fd=8, revents=POLLIN}])
read(8, "\1\0\0\0\0\0\0\0", 8)          = 8
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
poll([{fd=8, events=POLLIN}], 1, -1)    = 1 ([{fd=8, revents=POLLIN}])
read(8, "\1\0\0\0\0\0\0\0", 8)          = 8
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
poll([{fd=8, events=POLLIN}], 1, -1)    = 1 ([{fd=8, revents=POLLIN}])
read(8, "\1\0\0\0\0\0\0\0", 8)          = 8
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
write(6, "\1\0\0\0\0\0\0\0", 8)         = 8
fstat(1, {st_mode=S_IFCHR|0660, st_rdev=makedev(4, 1), ...}) = 0
ioctl(1, TCGETS, {B38400 opost isig icanon echo ...}) = 0
write(1, "OK: 20242\n", 10)             = 10
read(0, "exit\n", 4096)                 = 5
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
write(6, "\1\0\0\0\0\0\0\0", 8)         = 8
poll([{fd=8, events=POLLIN}], 1, -1)    = 1 ([{fd=8, revents=POLLIN}])
```

```
read(8, "\1\0\0\0\0\0\0\0", 8)          = 8
--- SIGCHLD {si_signo=SIGCHLD, si_code=CLD_EXITED, si_pid=20242, si_uid=1000,
si_status=0, si_utime=0, si_stime=0} ---
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
poll([{fd=8, events=POLLIN}], 1, 0)     = 0 (Timeout)
write(6, "\1\0\0\0\0\0\0\0", 8)         = 8
lseek(0, -1, SEEK_CUR)                  = -1 ESPIPE (Illegal seek)
exit_group(0)                           = ?
+++ exited with 0 +++
```

4. Выводы

Утилиты strace и ltrace – простые и надежные инструменты для отслеживания системных вызовов. Они полезны при отладке и тестировании программ. Несмотря на то, что на первый взгляд протоколы этих утилит кажутся чересчур объёмными и непонятными, при помощи различных ключей можно отфильтровать их «на свой вкус».

Утилита strace позволяет отслеживать большинство системных вызовов. Но если требуется пронаблюдать за более узкими аспектами работы программ, то на помощь придёт ltrace (для отслеживания вызовов динамических библиотек), ftrace (для отслеживания работы операционной системы), perf, SystemTap и многие другие.

Данные утилиты пригодились мне для изучения принципов работы системных вызовов и поиска ошибок в моих лабораторных работах.