Syscall Tracing für libiotrace

Gerrit Klein - HPC Projekt (Prof. Keller)

Gliederung

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1. Vorstellung libiotrace

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2. Filename Resolution

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3. Motivation - Syscall Tracing

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5. Todo: Integration

Vorstellung libiotrace

Motivation

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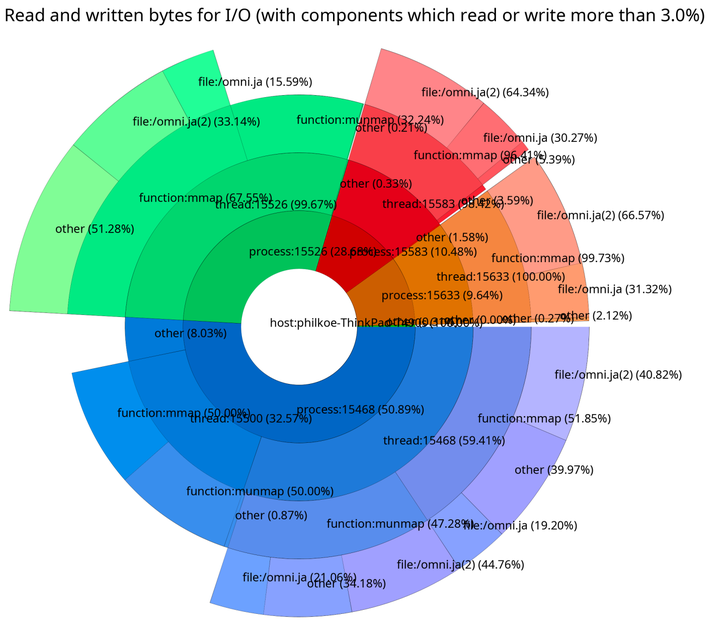
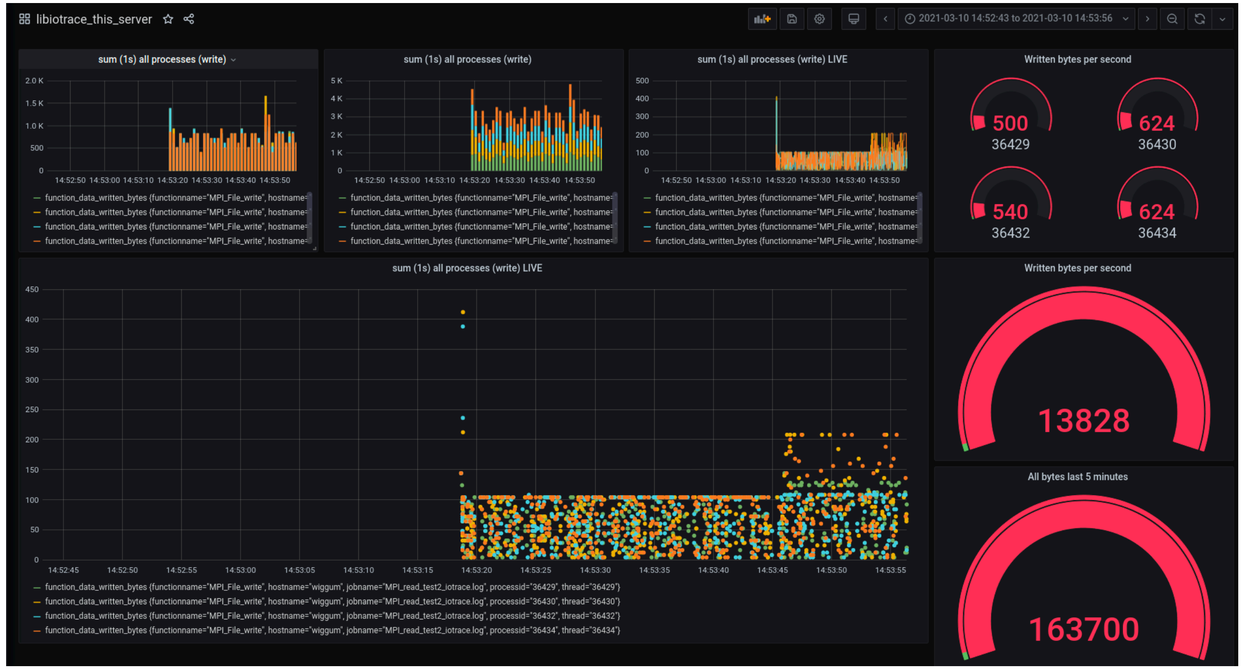
  - **Auswertung**: Java Tool (Post mortem) / Grafana (Live Tracing)



Quelle: GitHub



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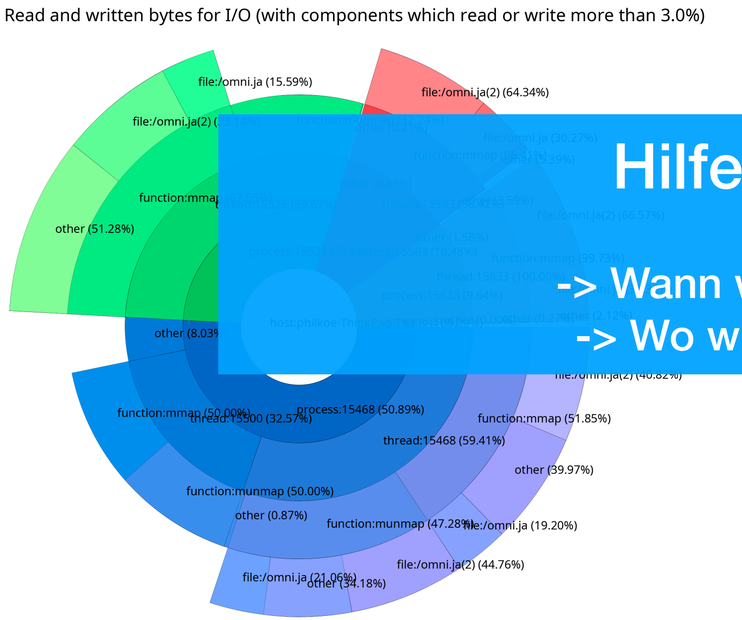

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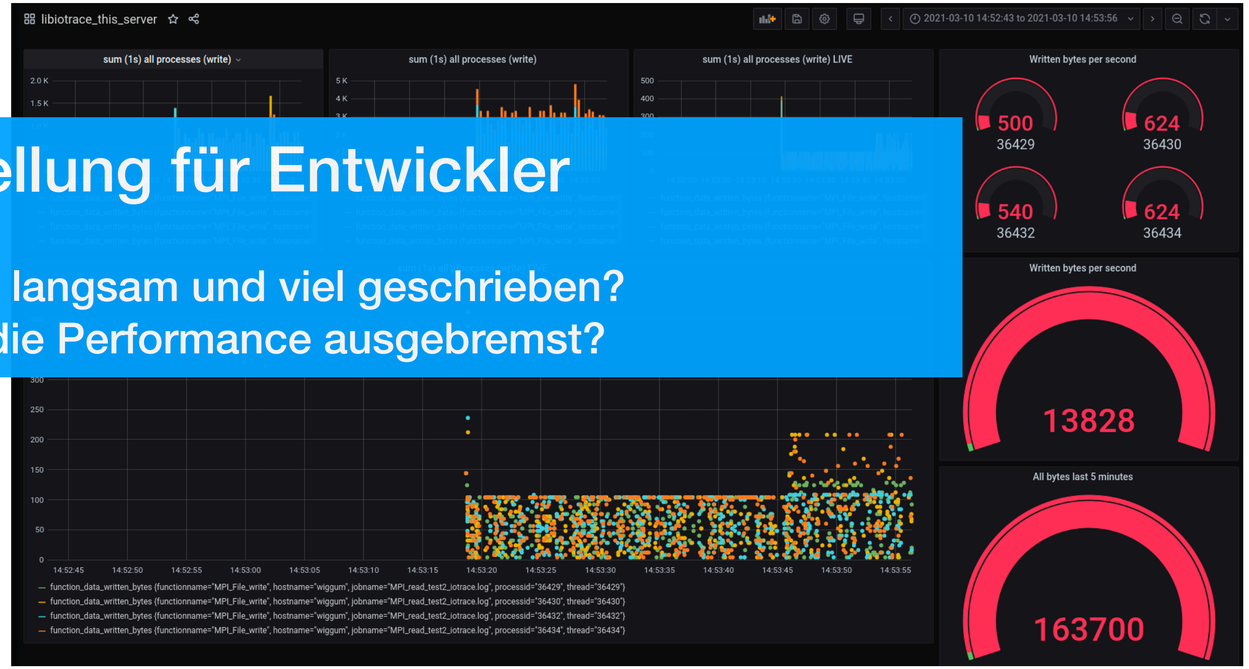

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Hilfestellung für Entwickler

-> Wann wird langsam und viel geschrieben?
-> Wo wird die Performance ausgebremst?

Funktionsweise

```
➜  ~ LD_PRELOAD=path/to/libiotrace_shared.so ./path/to/exec
```

Funktionsweise

```
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User
space

Funktionsweise

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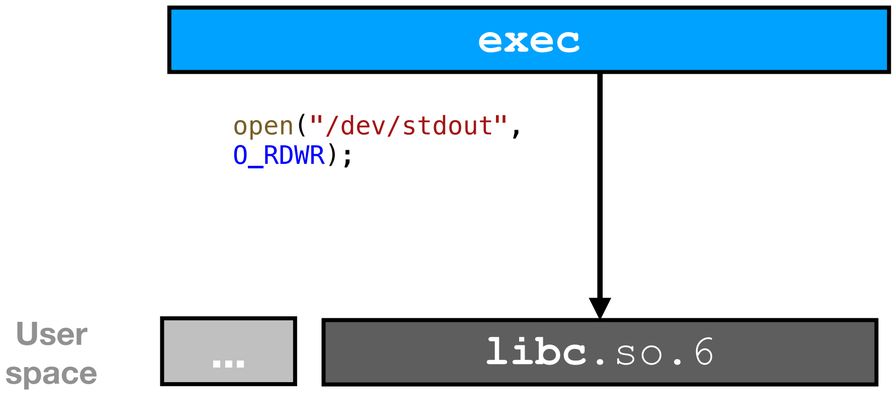

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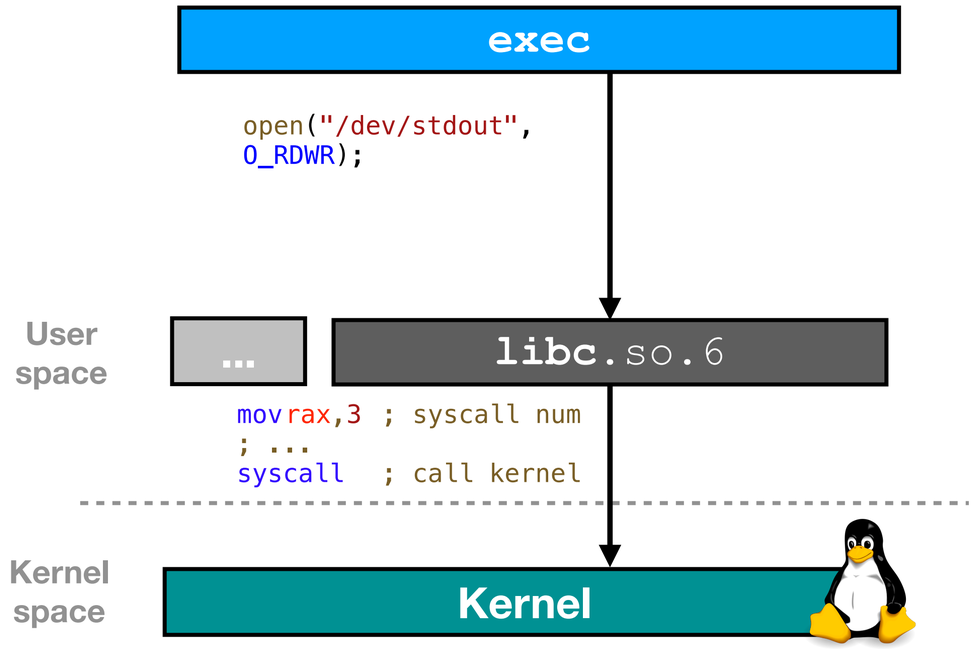

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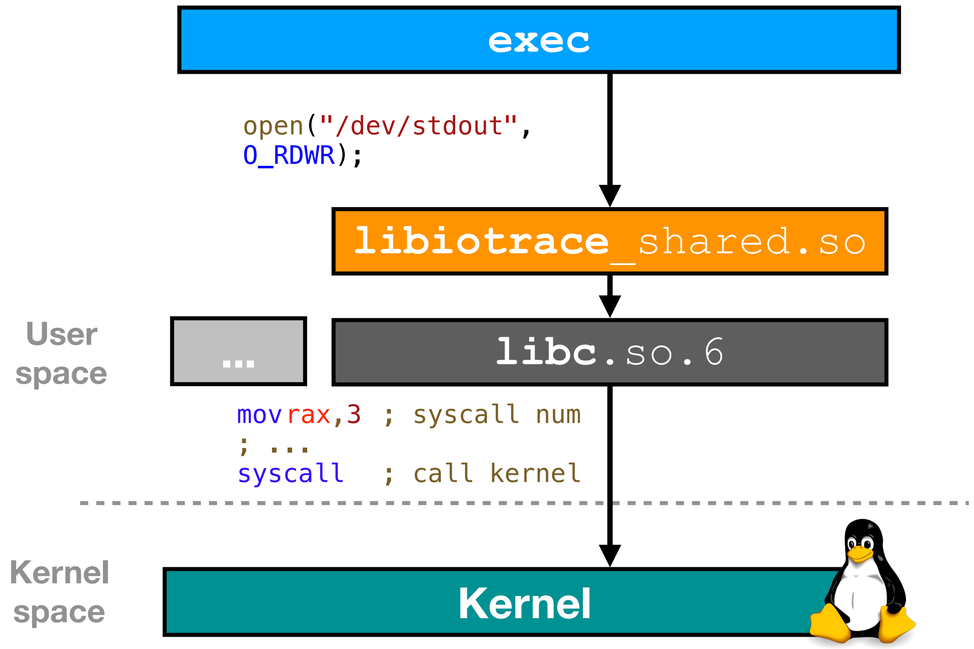

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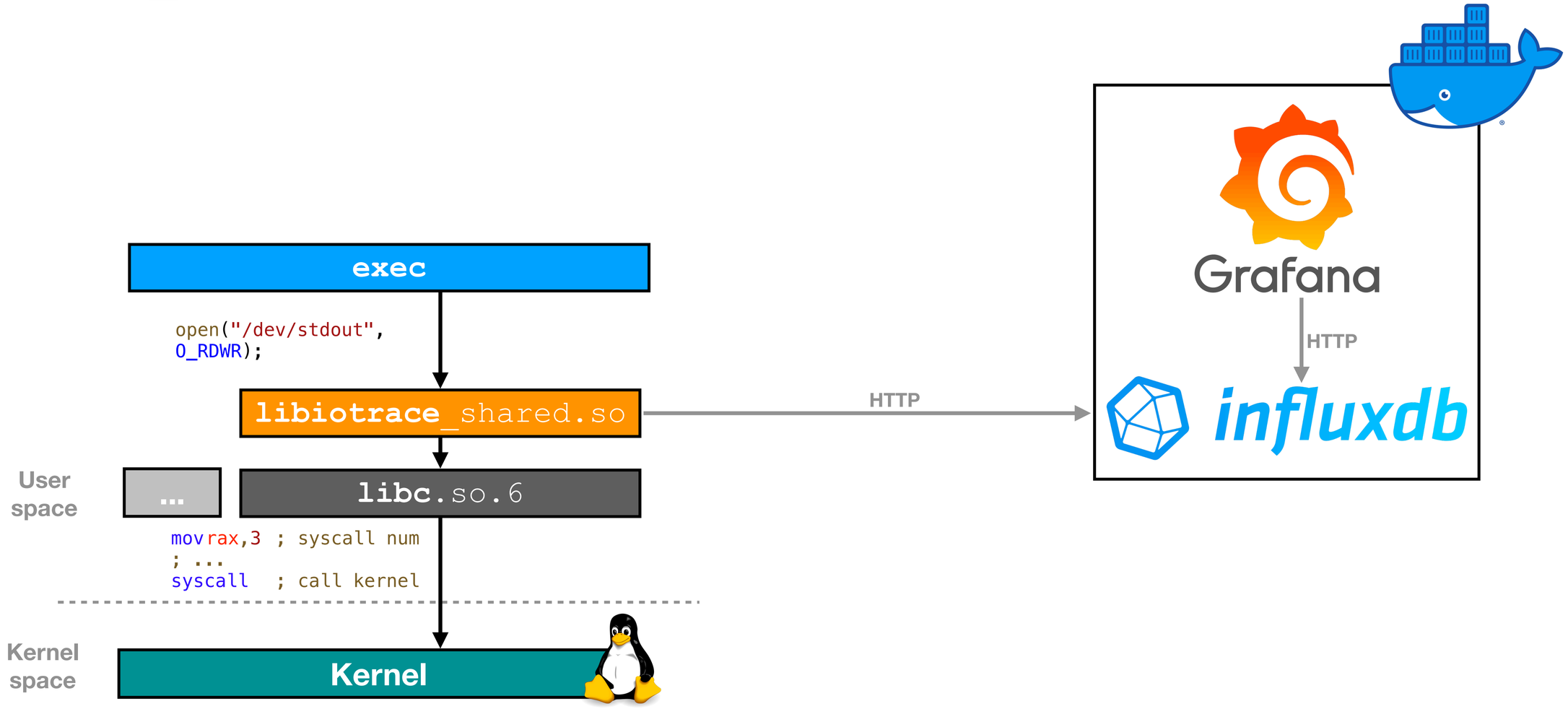

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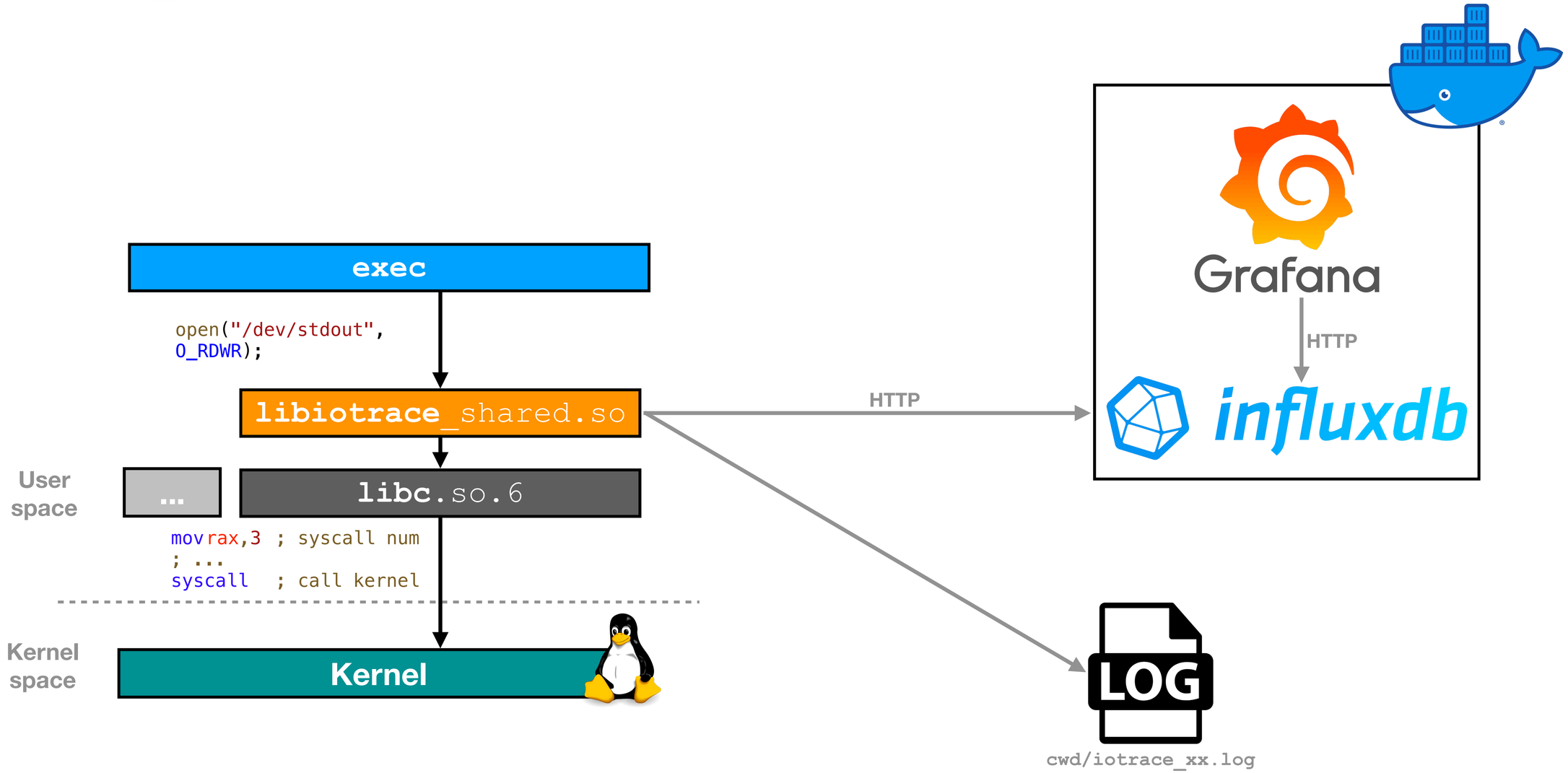

Filename Resolution

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  - Initiales öffnen: **Filename**

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O_RDONLY);
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  - Folgende Operationen: **Handles**

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Funktionsweise

Handle	Filename
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"Filename Map"
Handle -> Filename

Funktionsweise


```
{... "function_name":"open","file_type":
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{... ,"function_name":"mmap","file_type":
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Integration: Modul `fnres`

BEFORE:

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struct basic b;

traced_filename: NULL
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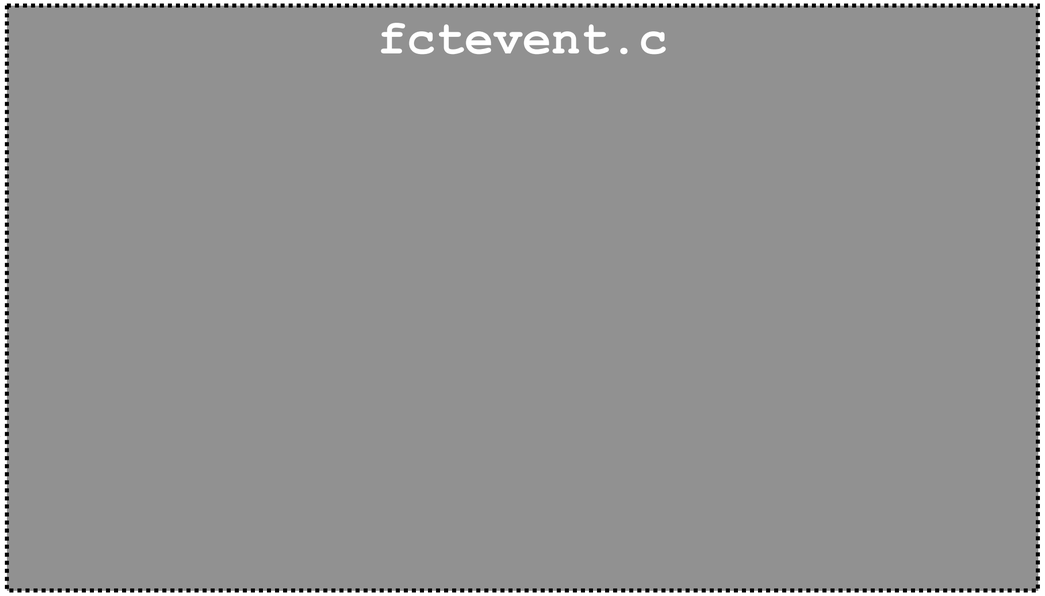

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fctevent.c

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- `atomic_hash`: Lock-free, C
  - Map: Hashed `fnmap_key` -> `char* filename`

Motivation - Syscall Tracing

Limitierungen `fnres`

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```
filename":"_ NOT FOUND _","hostname":"fpj-vm","process_id":16215,"thread_id":16215,"function_name":"mmap",'
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```
[pid 35846] openat(AT_FDCWD, "/dev/shm/UC8GnG", O_RDWR|O_CREAT|O_EXCL, 0644) = 17
    /lib/x86_64-linux-gnu/libpthread-2.31.so(__open64+0xd4) [0x14ad4]
    /lib/x86_64-linux-gnu/libpthread-2.31.so(sem_open+0x2b5) [0x12df5]
    ...
    /home/philkoe/git/fsprj2/libiotrace/build/src/libiotrace_shared.so(MPI_File_open+0x20a) [0xa8899]
    /home/philkoe/git/fsprj2/libiotrace/build/test/MPI_read(main+0xc8) [0x1391]
    /lib/x86_64-linux-gnu/libc-2.31.so(__libc_start_main+0xf3) [0x270b3]
    /home/philkoe/git/fsprj2/libiotrace/build/test/MPI_read(_start+0x2e) [0x120e]
...
[pid 35846] mmap(NULL, 32, PROT_READ|PROT_WRITE, MAP_SHARED, 17, 0) = 0x7f57ac8ee000
    /lib/x86_64-linux-gnu/libc-2.31.so(mmap64+0x26) [0x11ba46]
    /home/philkoe/git/fsprj2/libiotrace/build/src/libiotrace_shared.so(mmap+0x197) [0x943d7]
    /lib/x86_64-linux-gnu/libpthread-2.31.so(sem_open+0x41e) [0x12f5e]
    ...
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    /lib/x86_64-linux-gnu/libpthread-2.31.so(sem_open+0x2b5) [0x12df5]
    ...
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<- Kein "libc call" = Kein libiotrace wrapper

Limitierungen `fnres`

```
filename":"_ NOT FOUND _","hostname":"fpj-vm","process_id":16215,"thread_id":16215,"function_name":"mmap",'
filename":"_ NOT FOUND _","hostname":"fpj-vm","process_id":16215,"thread_id":16215,"function_name":"close",
```

- Fortified functions `open` -> `__open_2`
- Kein libc call ?!

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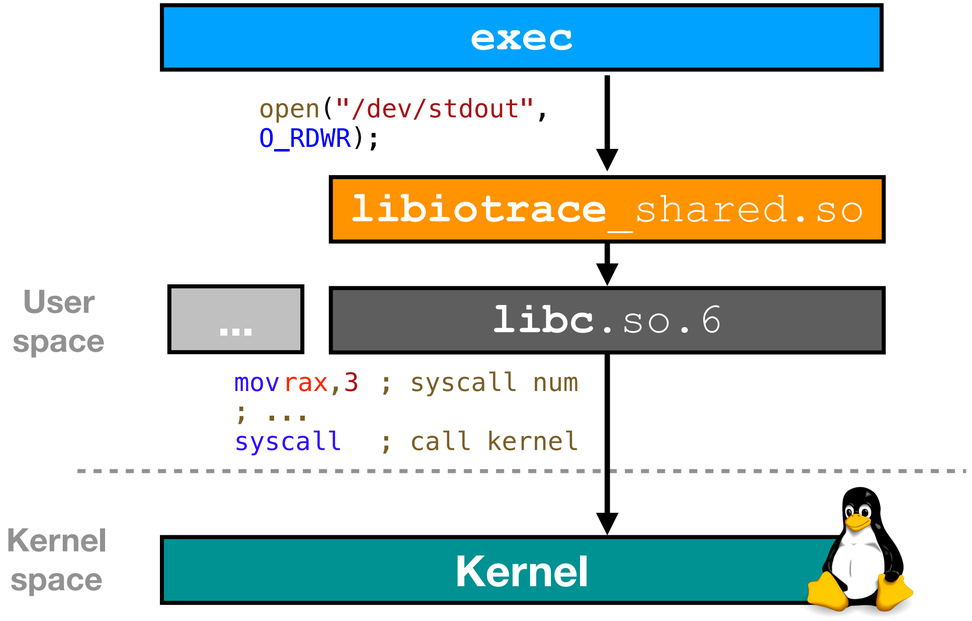
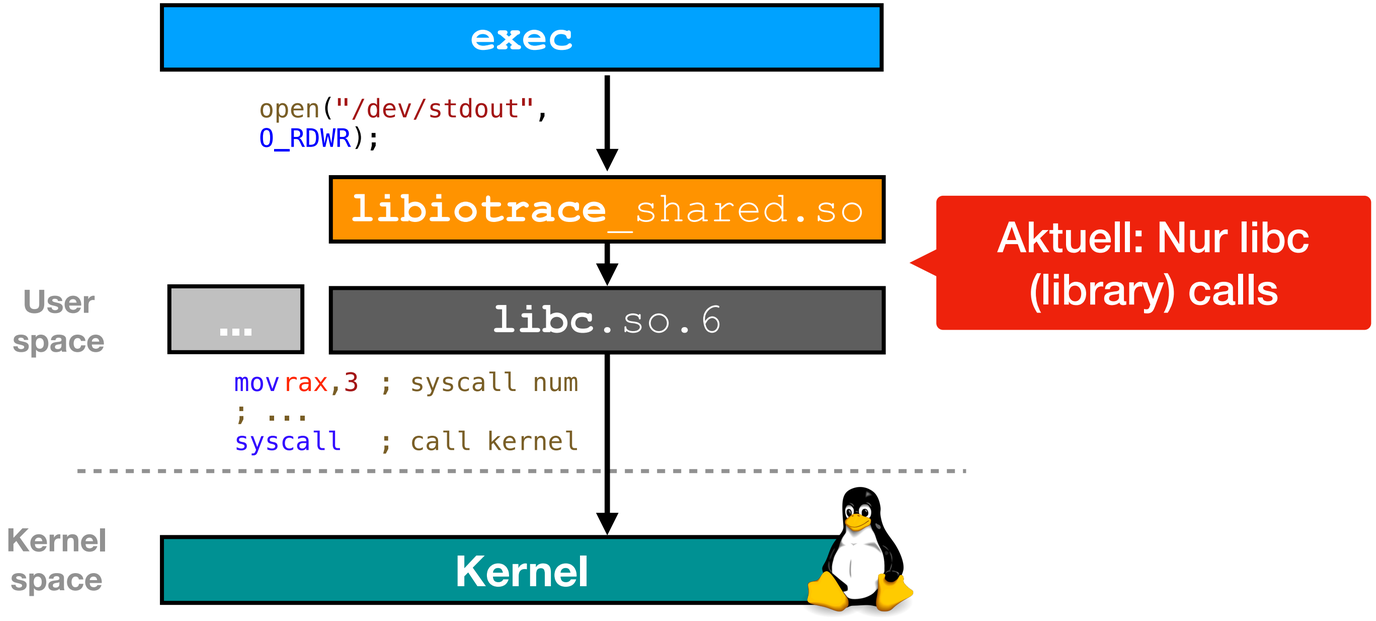
"Remedy"


exec
open("/dev/stdout",
O_RDWR);
libiotrace_shared.so
User space
...
libc.so.6
mov rax,3 ; syscall num
; ...
syscall ; call kernel
Kernel space
Kernel

"Remedy"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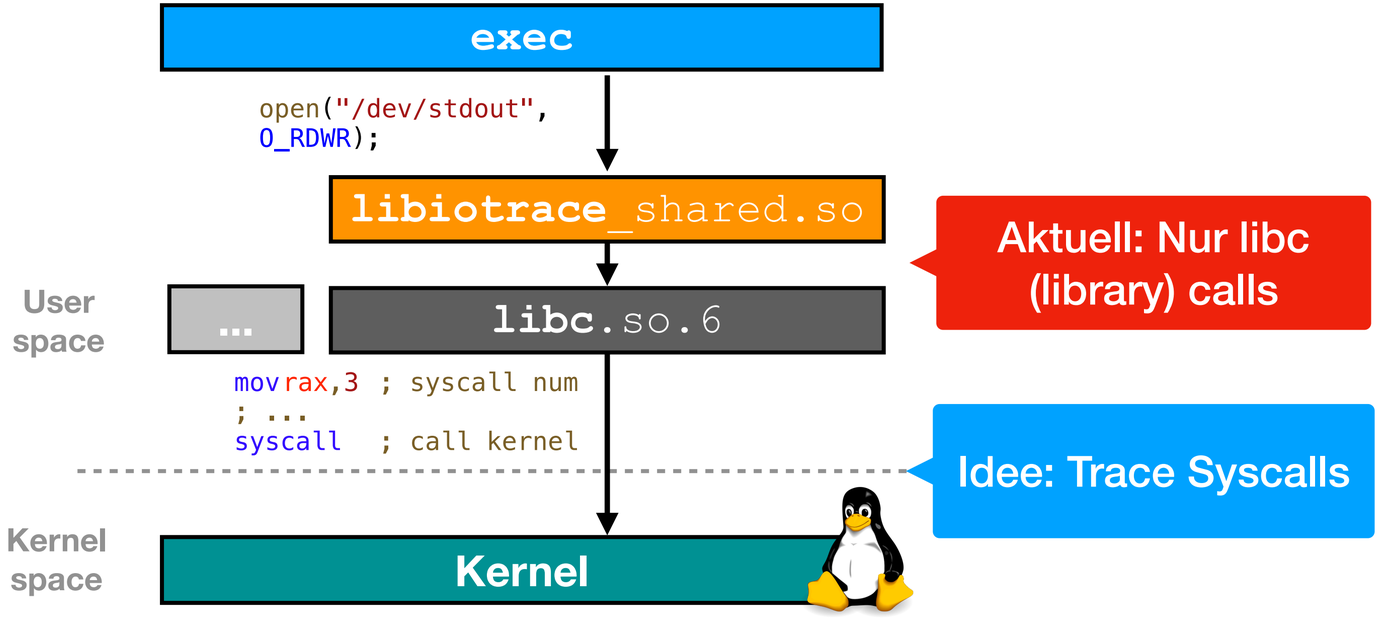
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Idee: Trace Syscalls

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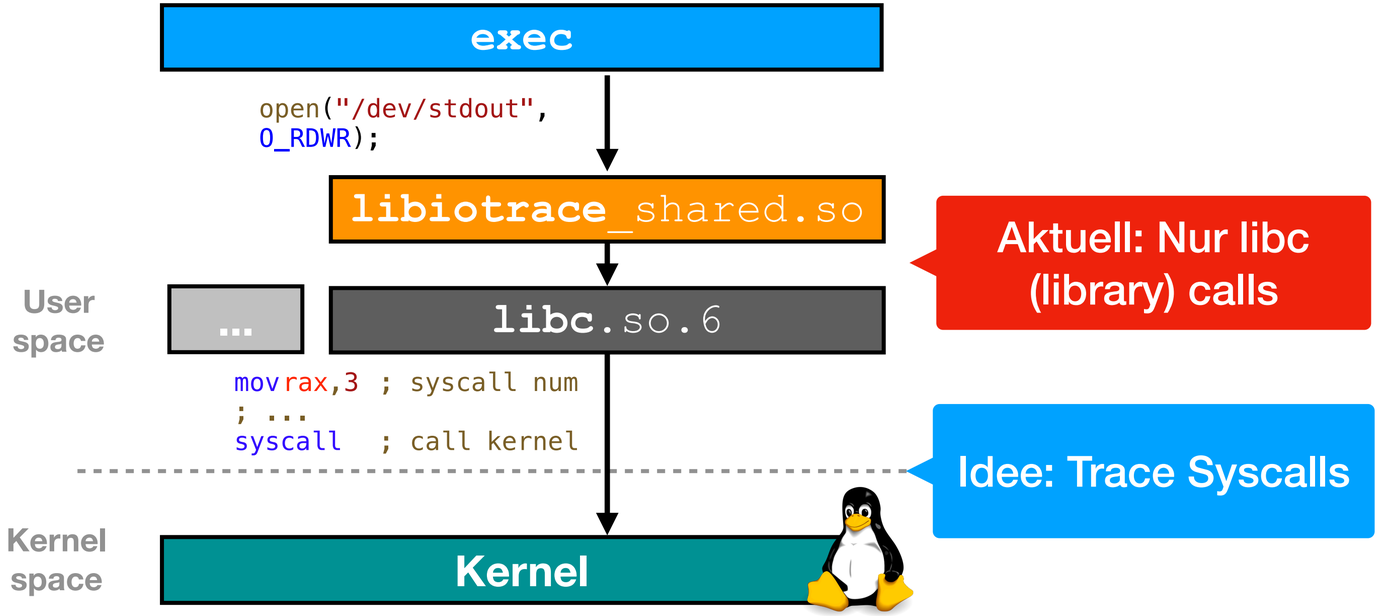

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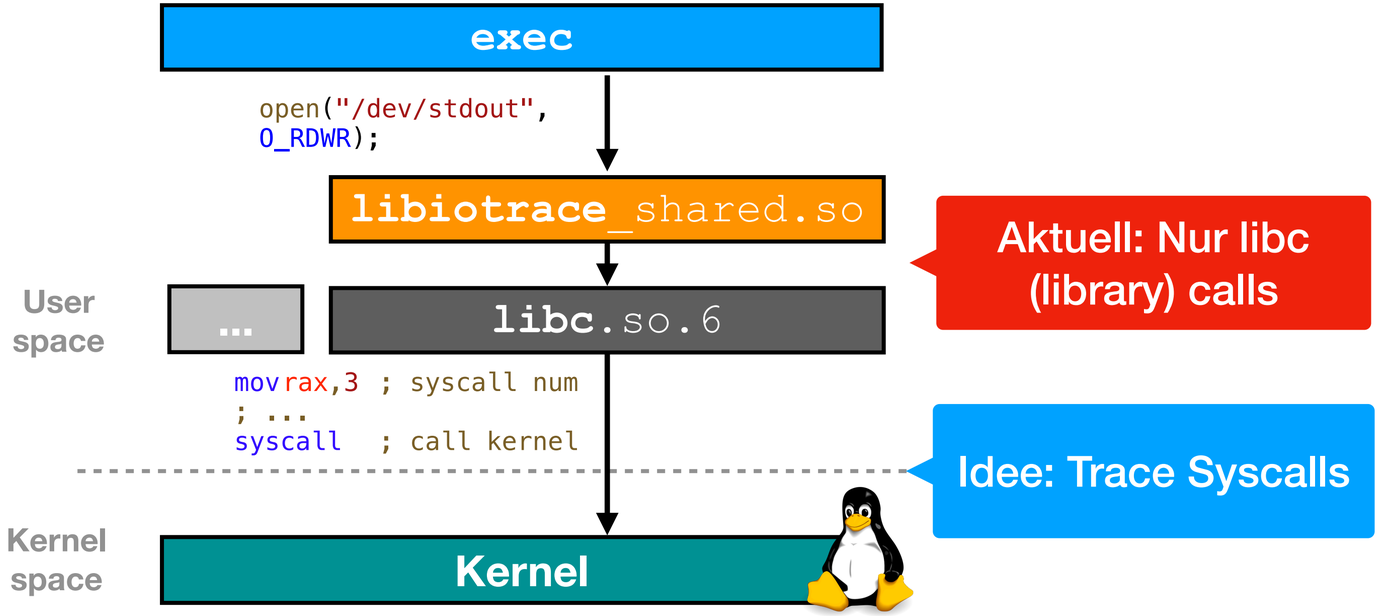

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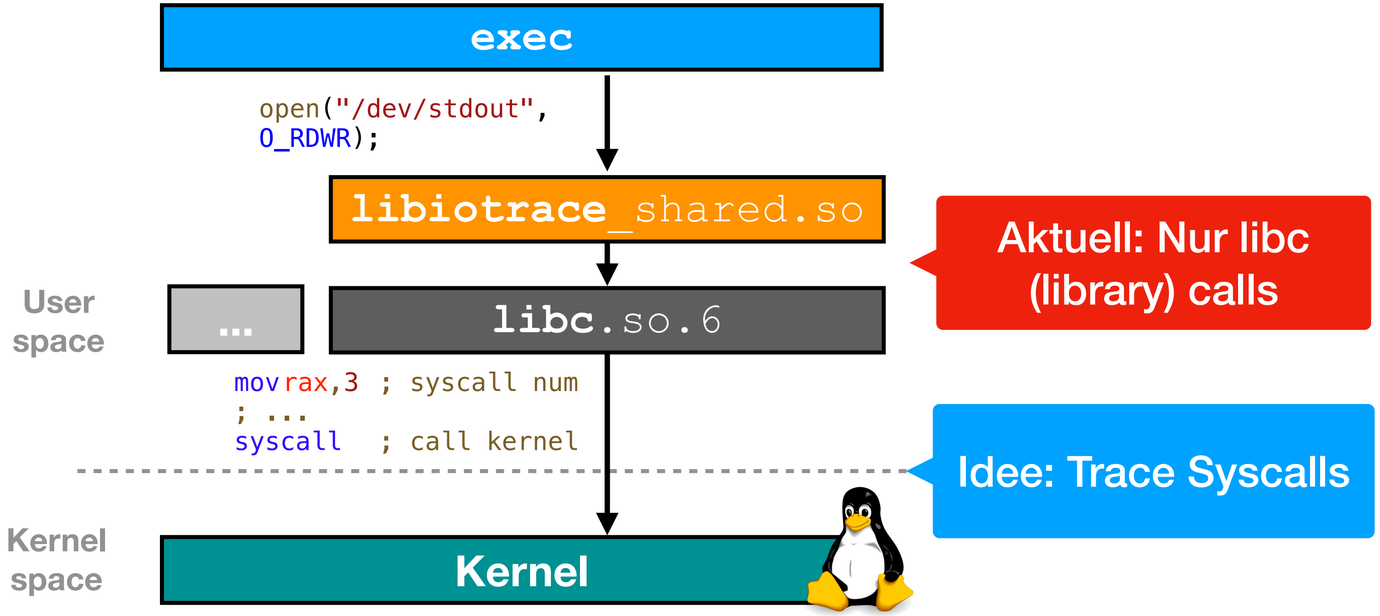

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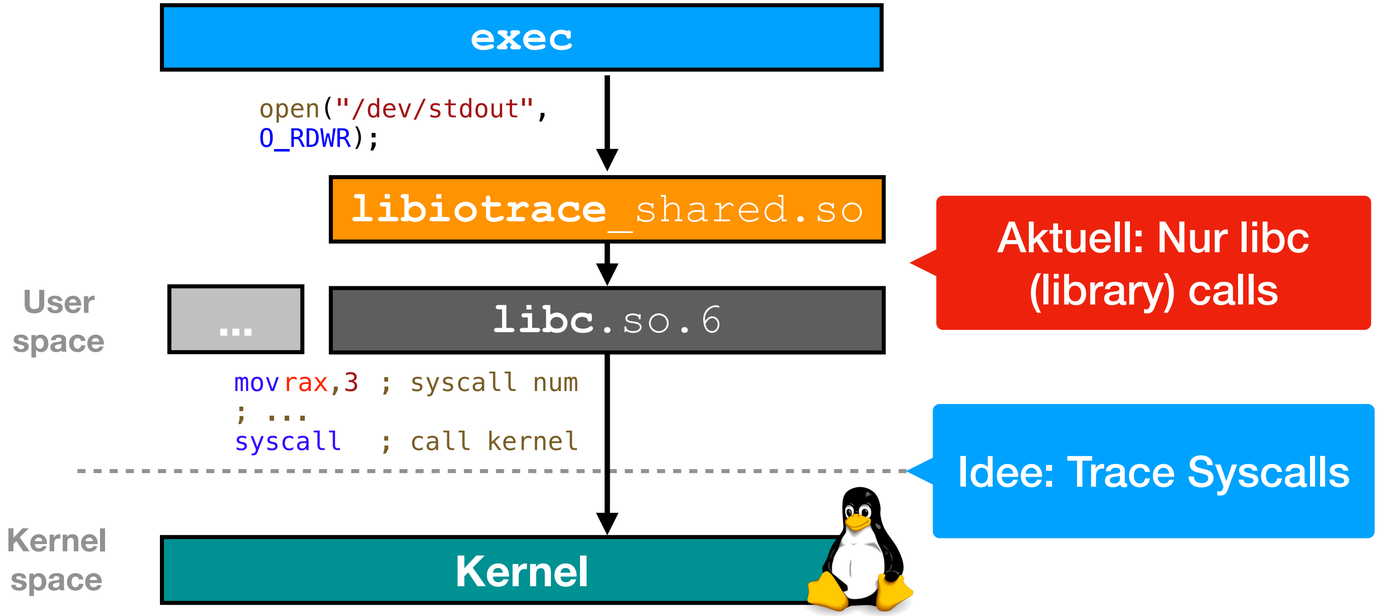

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Warnung,
Eintrag ergänzen,
....

`ptrace`(2)

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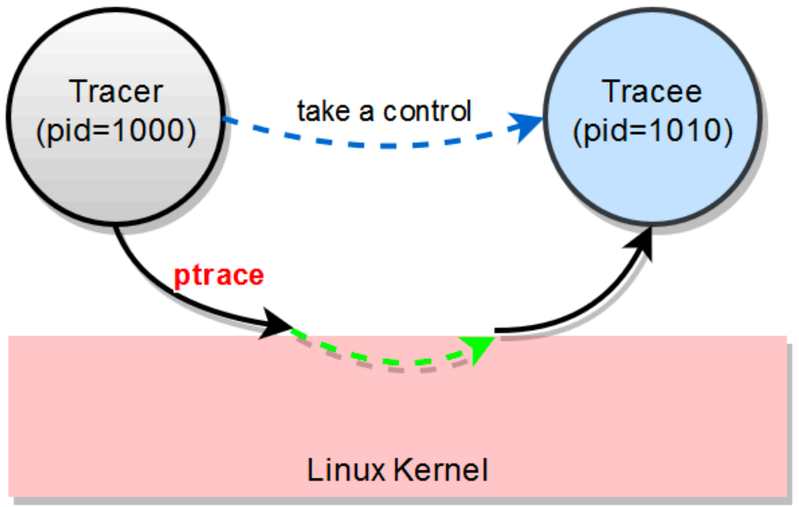

Quelle: fadeevab.com

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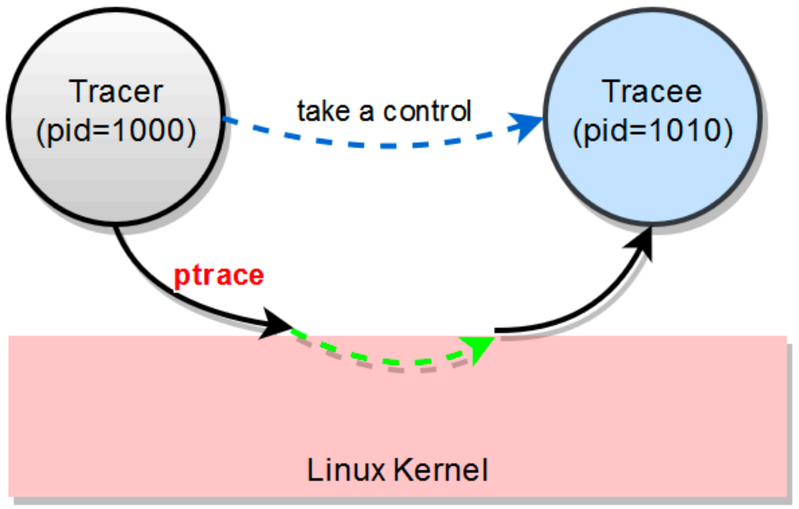

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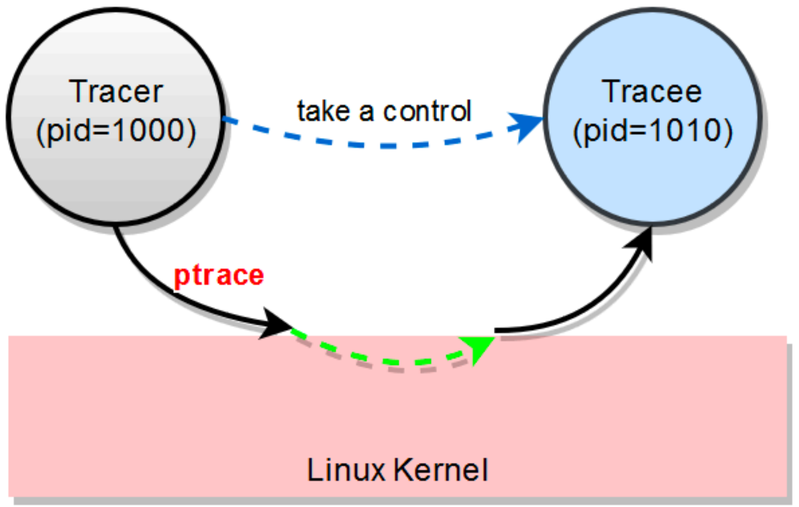
- Use-cases: Breakpoint Debugging -> `gdb`(1) & **Syscall Tracing** -> `strace`(1)



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%rax	System call	%rdi	%rsi	%rdx	%r10	%r8	%r9
0	sys_read	unsigned int fd	char *buf	size_t count			
1	sys_write	unsigned int fd	const char *buf	size_t count			
2	sys_open	const char *filename	int flags	int mode			
3	sys_close	unsigned int fd					
4	sys_stat	const char *filename	struct stat *statbuf				
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Quelle: blog.rchapman.org

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- Für tracee auslesen: `PTRACE_GETREGSET`

ministrace

`strace`**(1)**

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```
→  ~ strace sleep 5
execve("/usr/bin/sleep", ["sleep", "5"], 0xfffff1e5f048 /* 25 vars */) = 0
brk(NULL)                                   = 0xaaaad0698000
faccessat(AT_FDCWD, "/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=29405, ...}) = 0
mmap(NULL, 29405, PROT_READ, MAP_PRIVATE, 3, 0) = 0xffff88deb000
close(3)                                    = 0
...
clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=5, tv_nsec=0},
```

`strace`(1)

- `man`: "trace system calls and signals"
  - Verwendet `ptrace`(2)

Syscall-Name (NR)

```
→  ~ strace sleep 5
execve("/usr/bin/sleep", ["sleep", "5"], 0xfffff1e5f048 /* 25 vars */) = 0
brk(NULL)                                   = 0xaaaad0698000
faccessat(AT_FDCWD, "/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=29405, ...}) = 0
mmap(NULL, 29405, PROT_READ, MAP_PRIVATE, 3, 0) = 0xffff88deb000
close(3)                                    = 0
...
clock_nanosleep(CLOCK_REALTIME, 0, {tv_sec=5, tv_nsec=0},
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- `ministrace` = Minimaler `strace` Nachbau

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  - **Nr**, **Name**: tbl file

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Tracing - Rollen

- "`-D` Run tracer [...] as a **grandchild**, not as parent"

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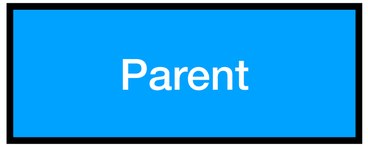

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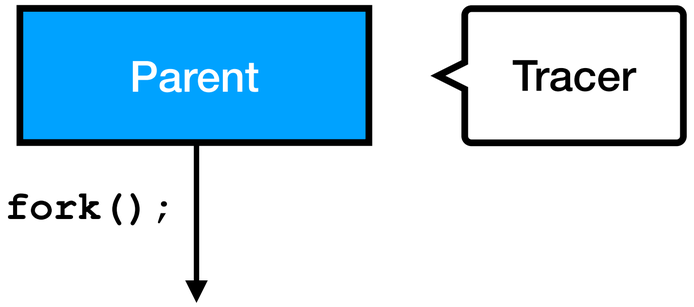

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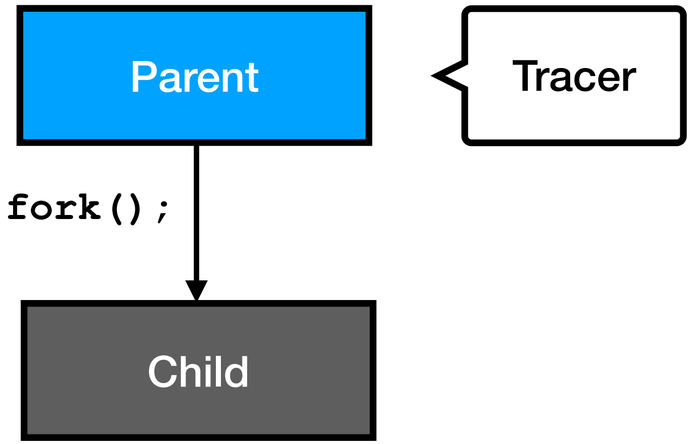

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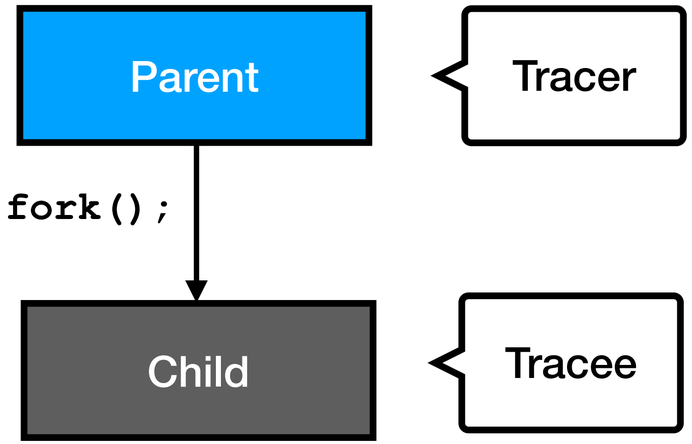

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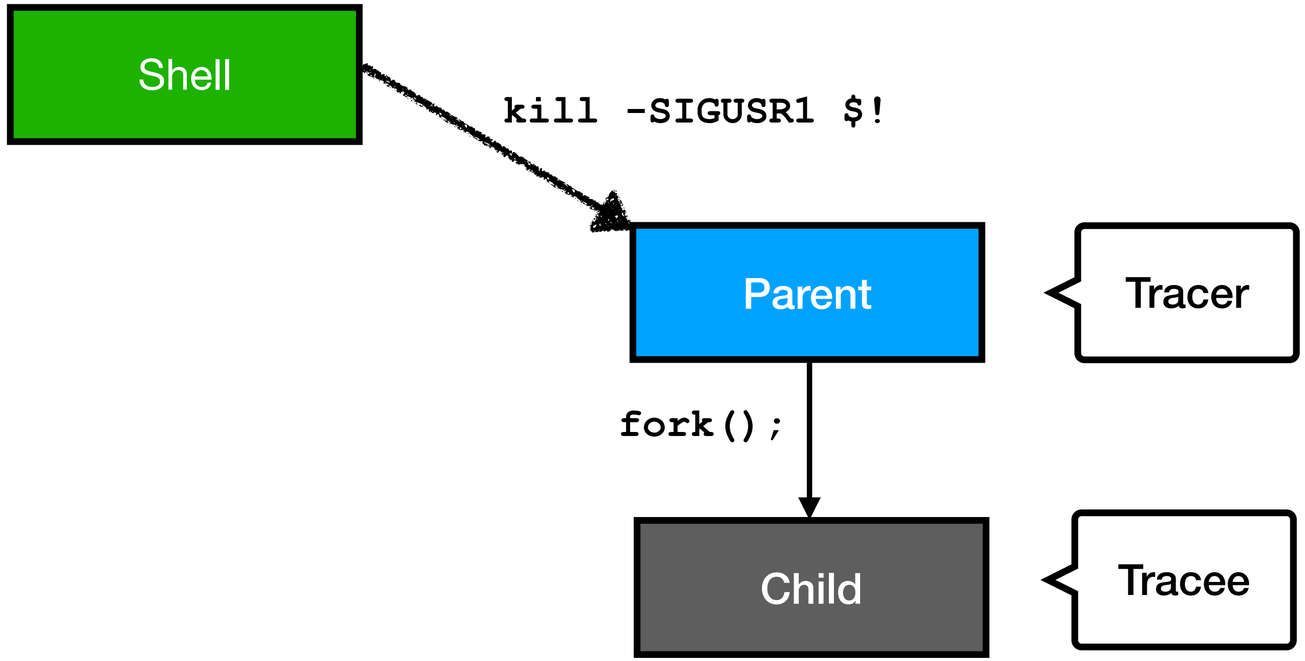

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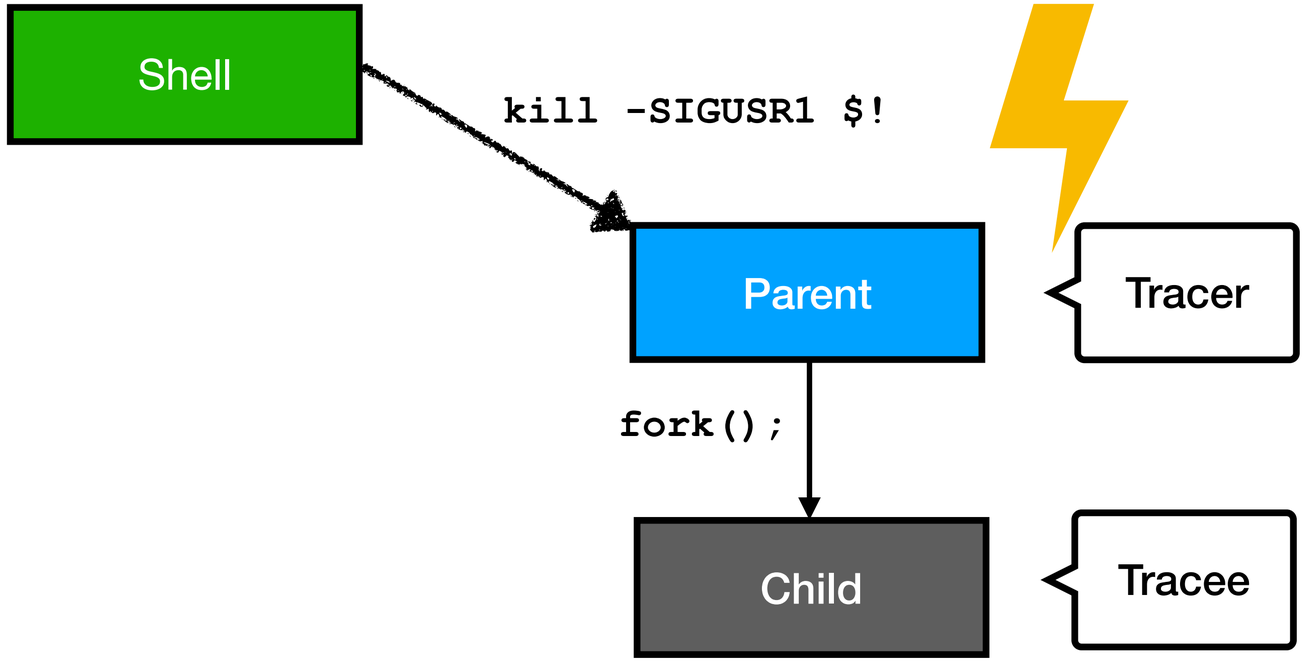

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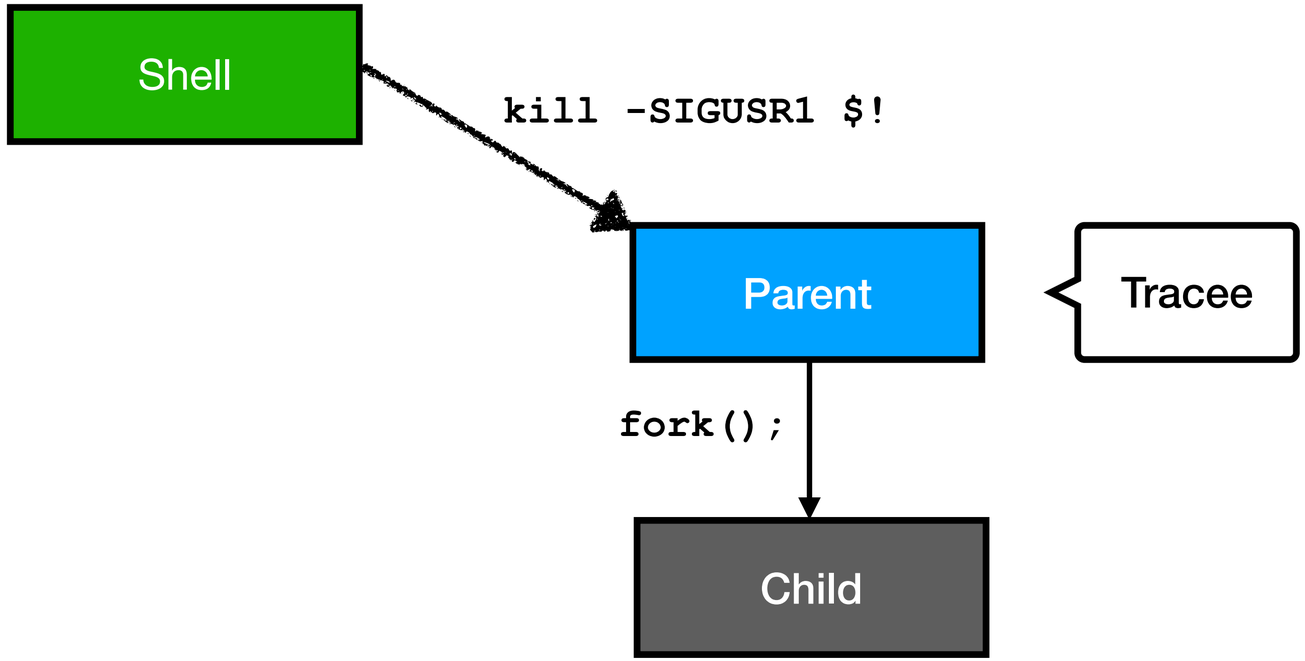

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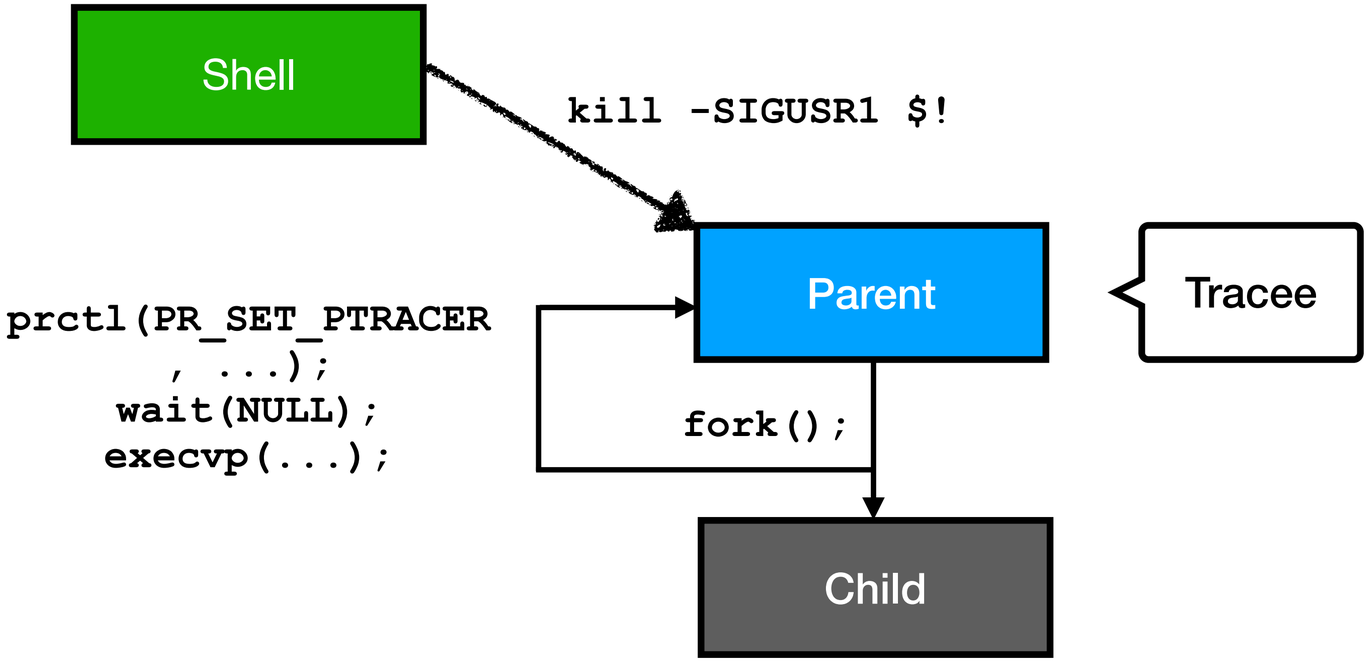

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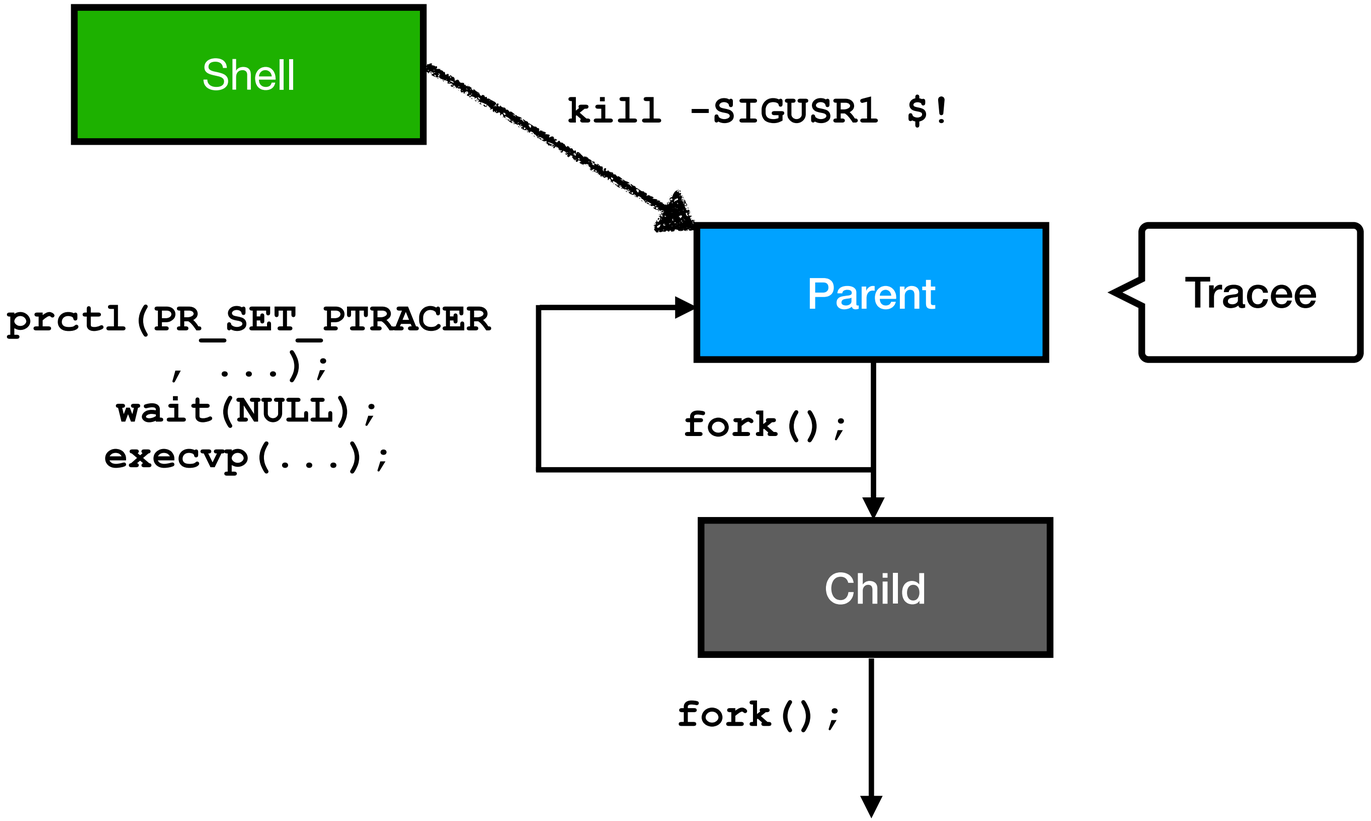

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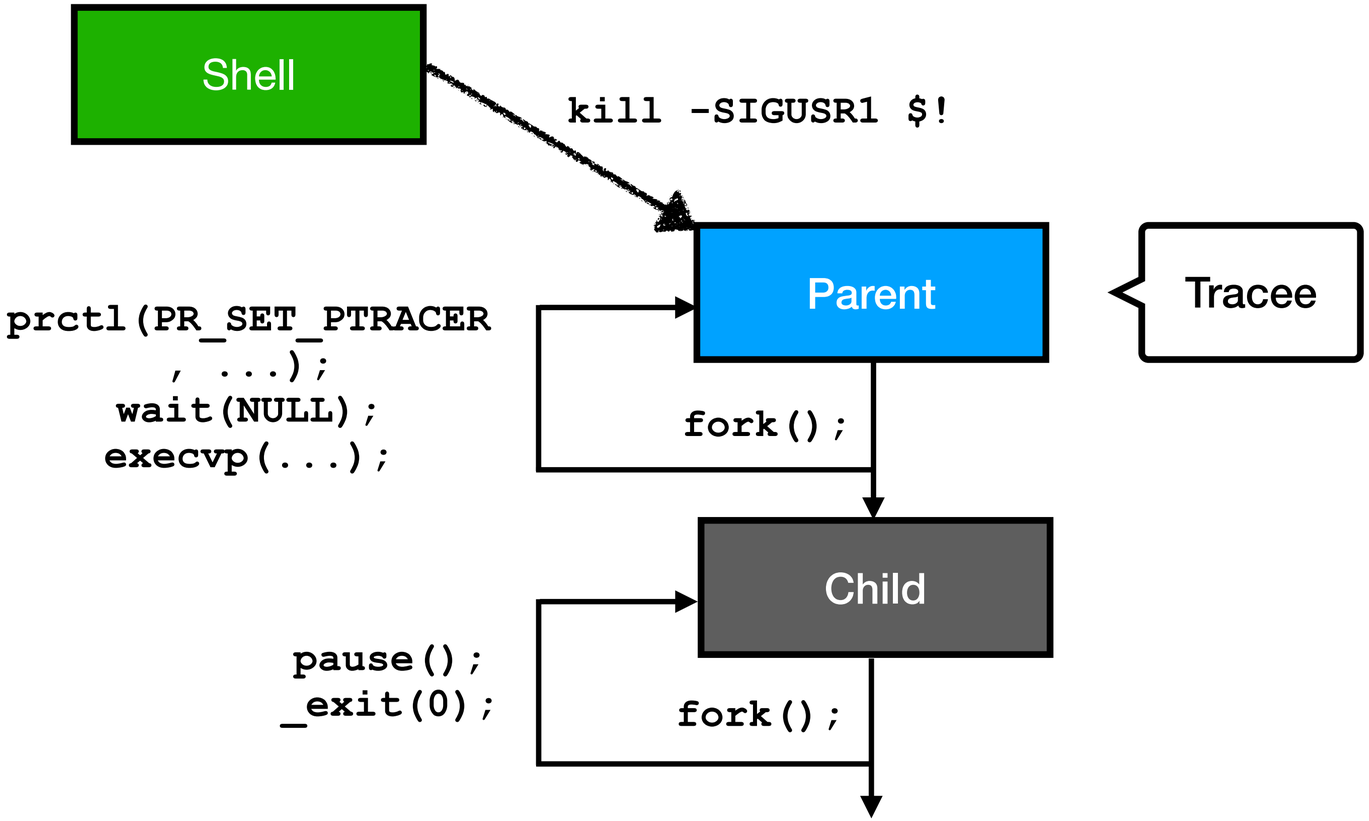

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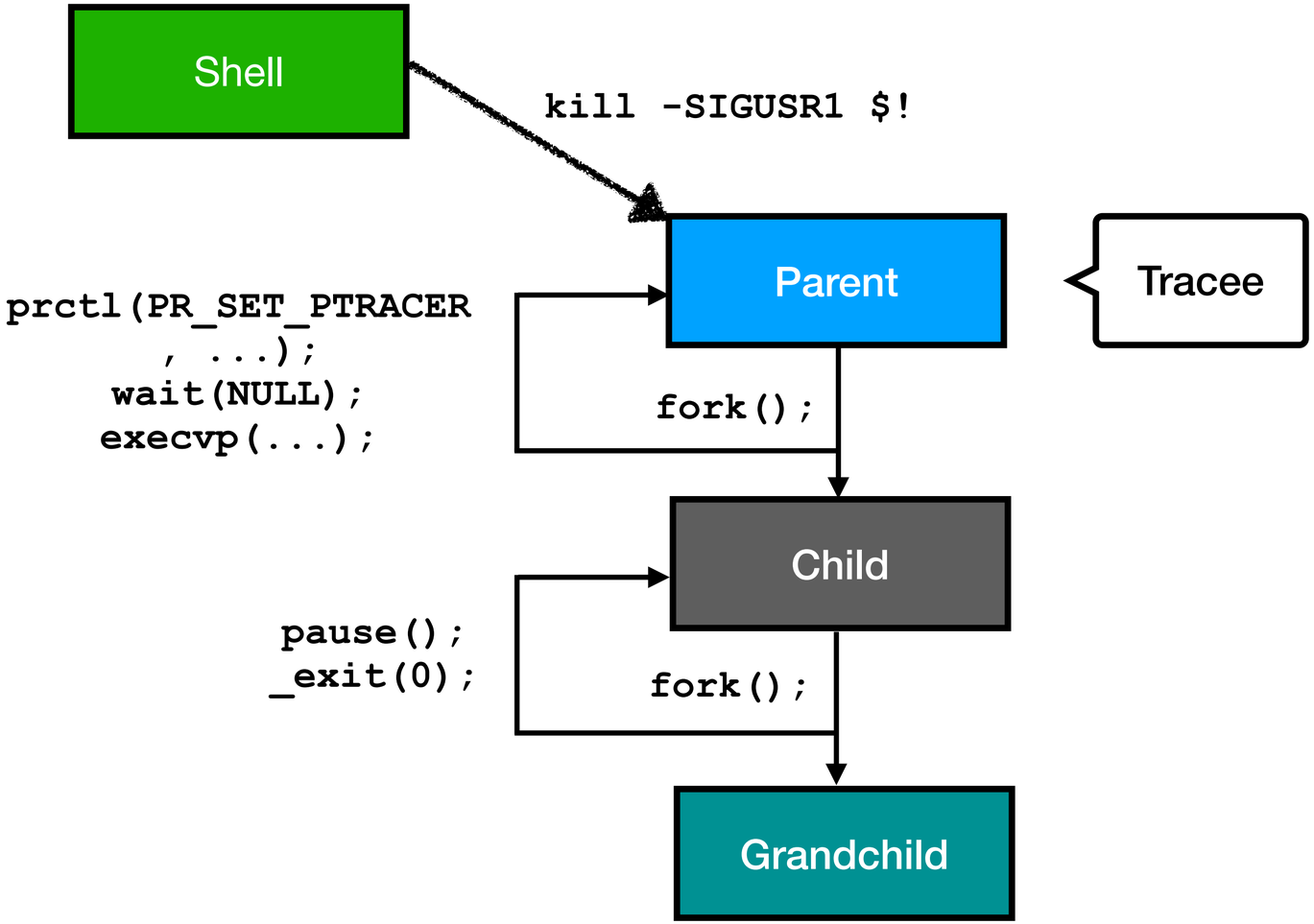

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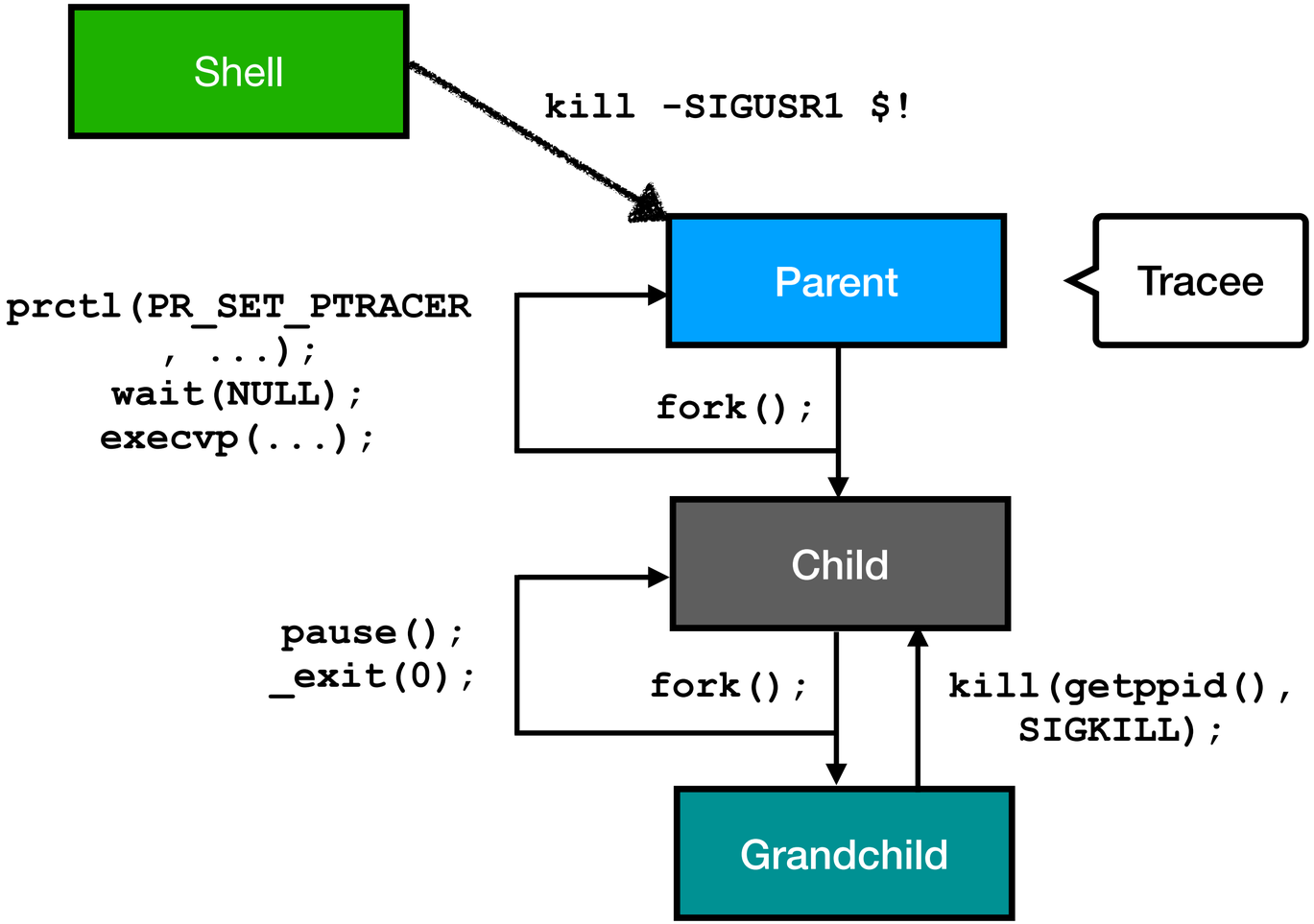

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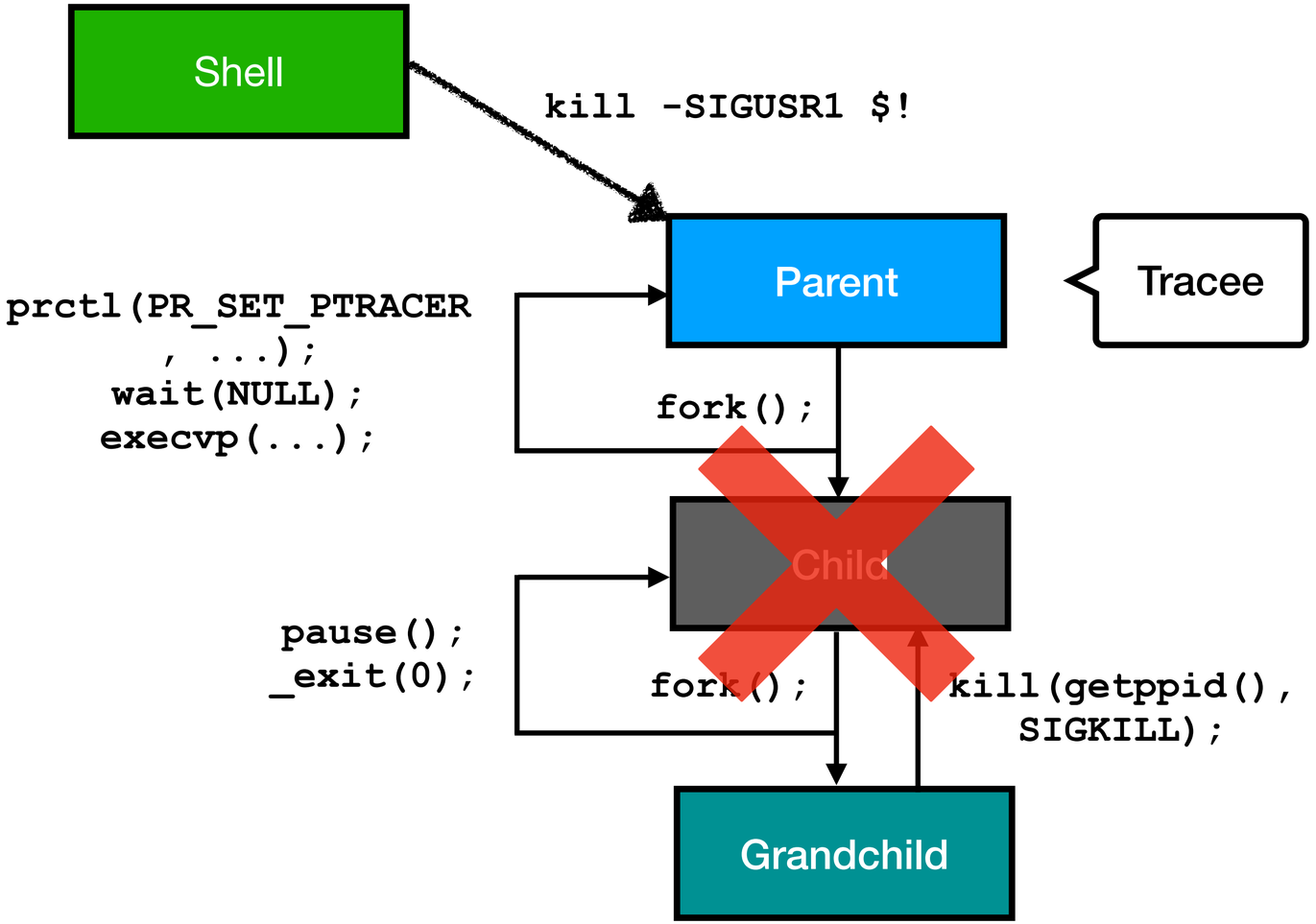

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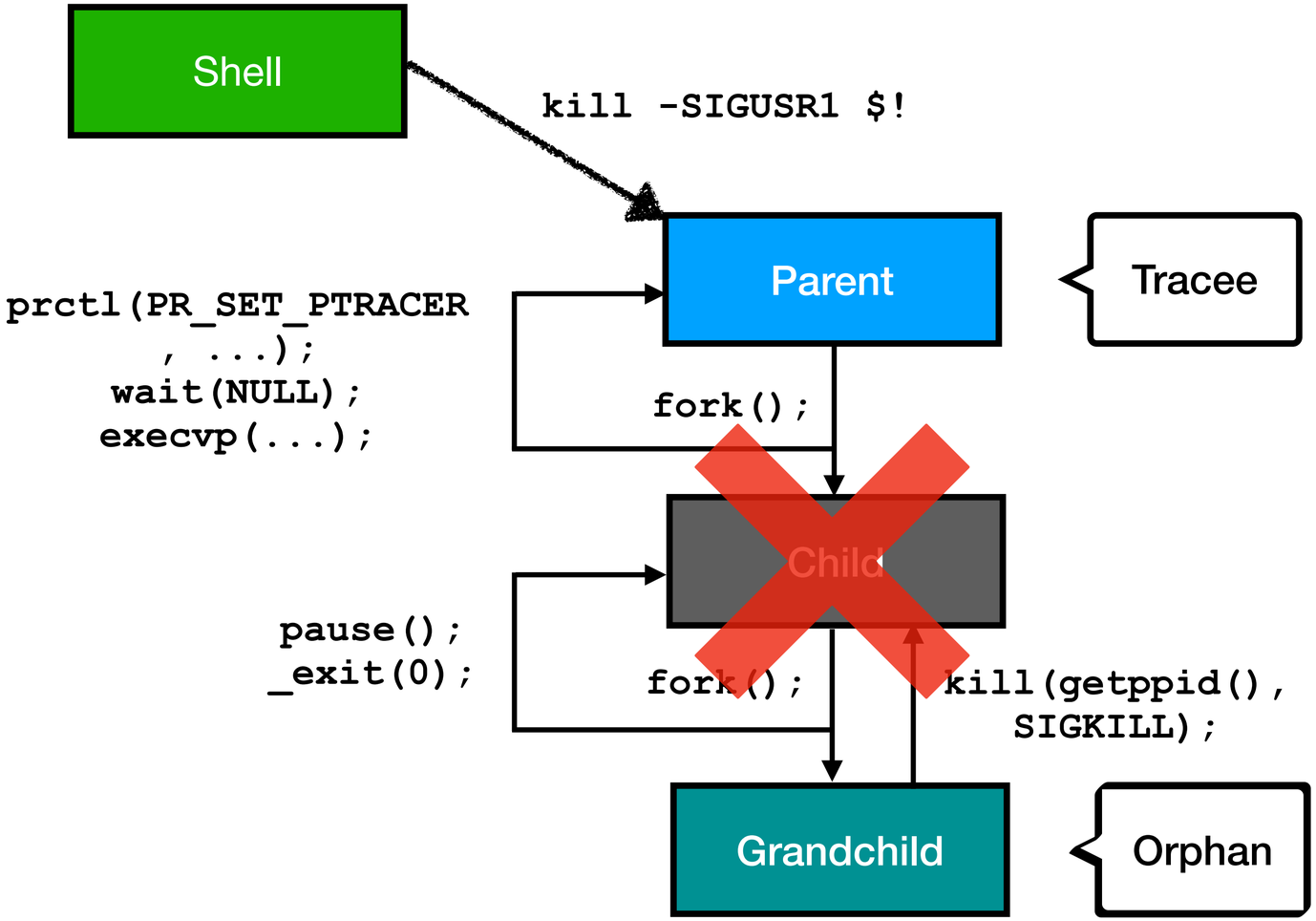

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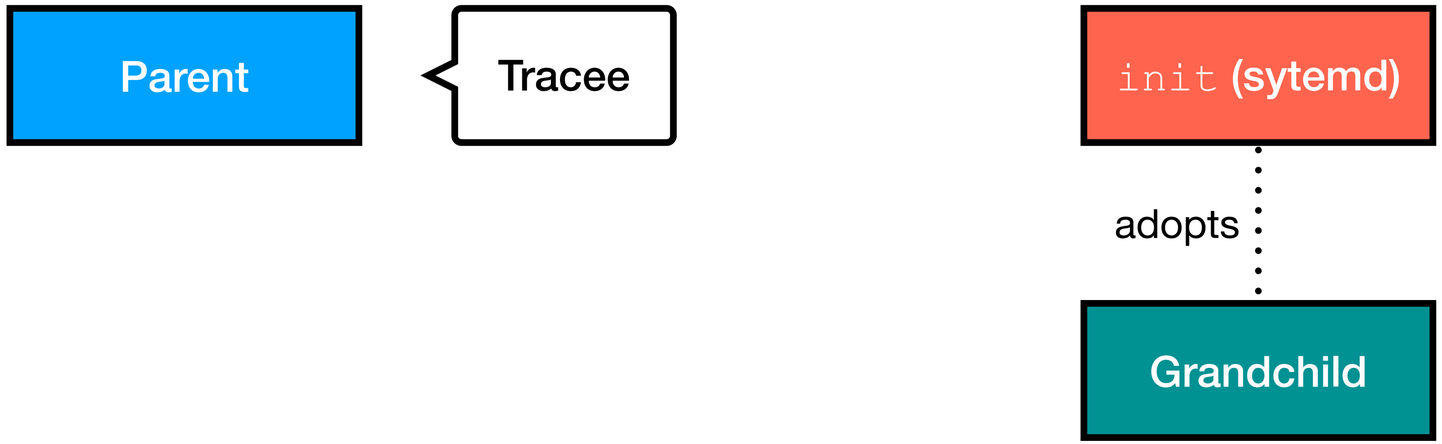

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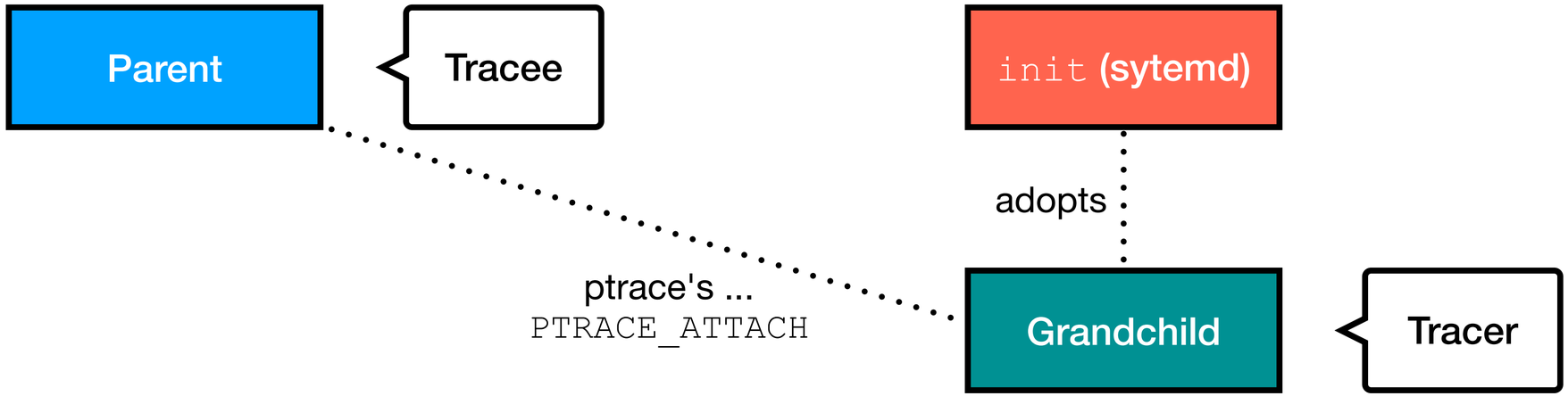

Tracing - Flow

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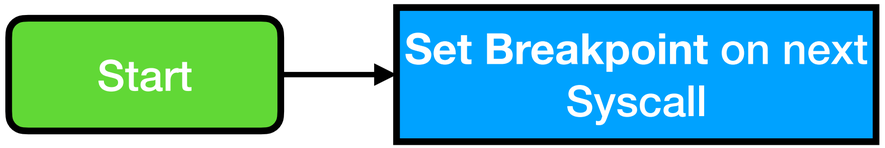

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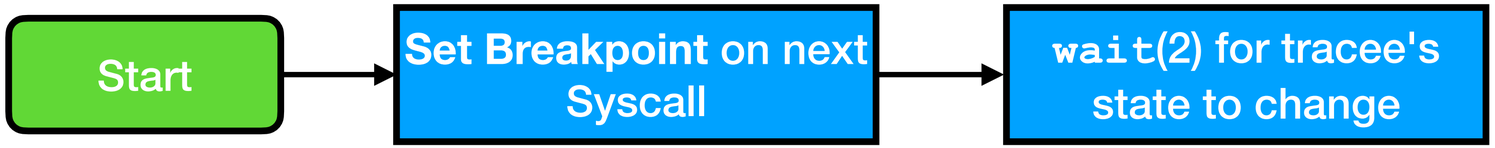

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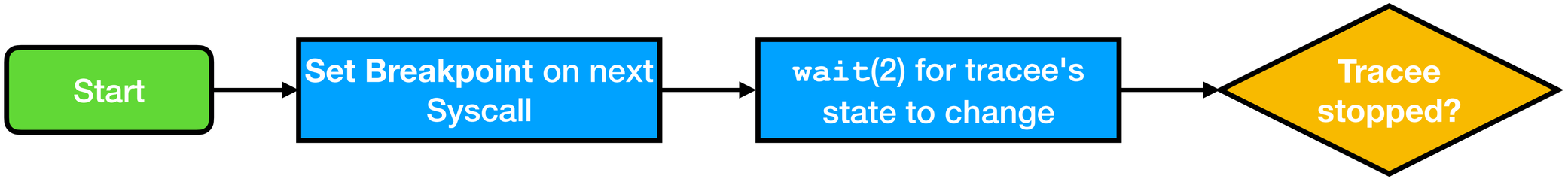

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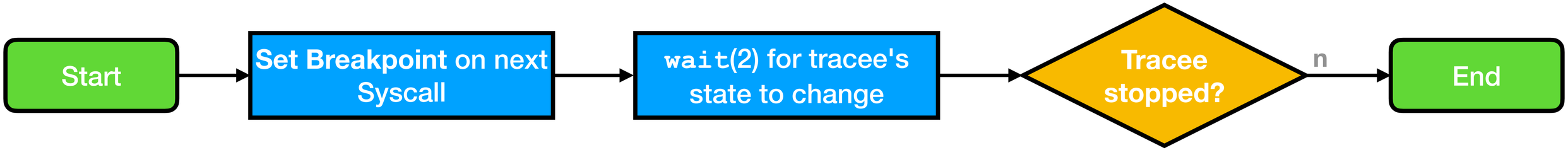

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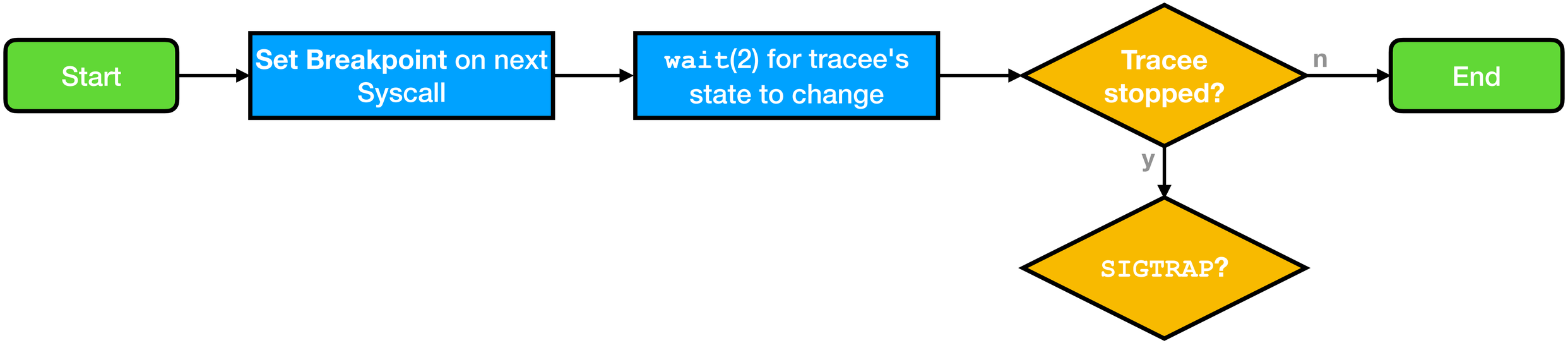

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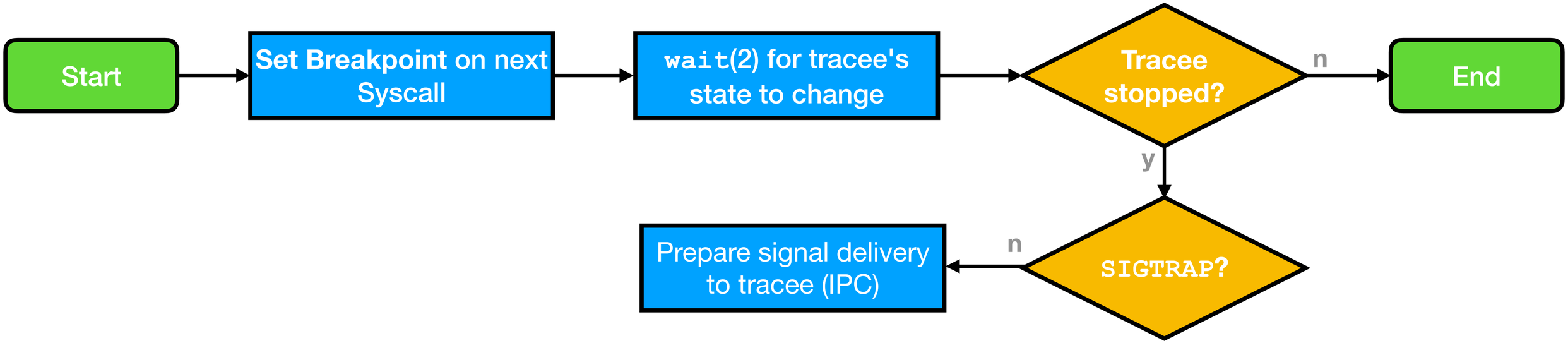

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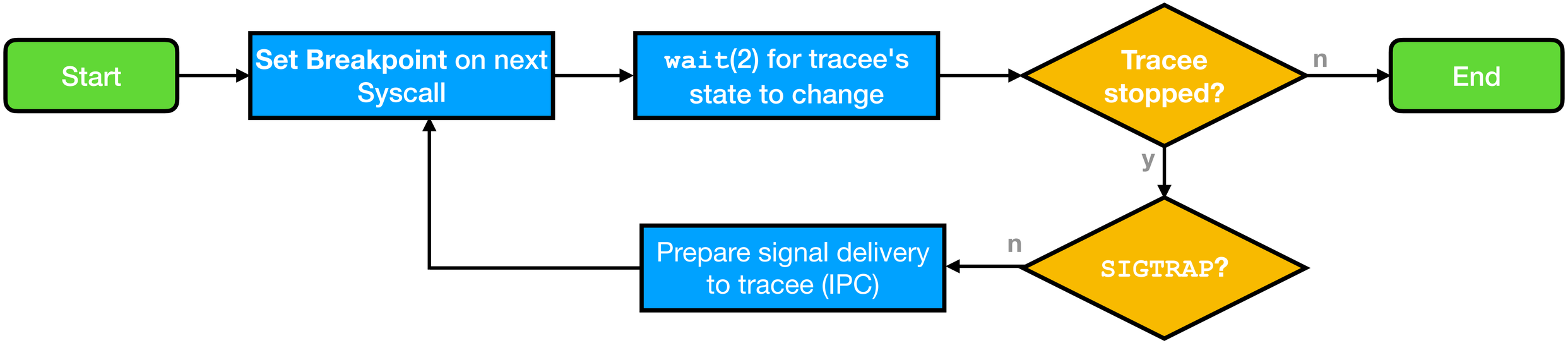

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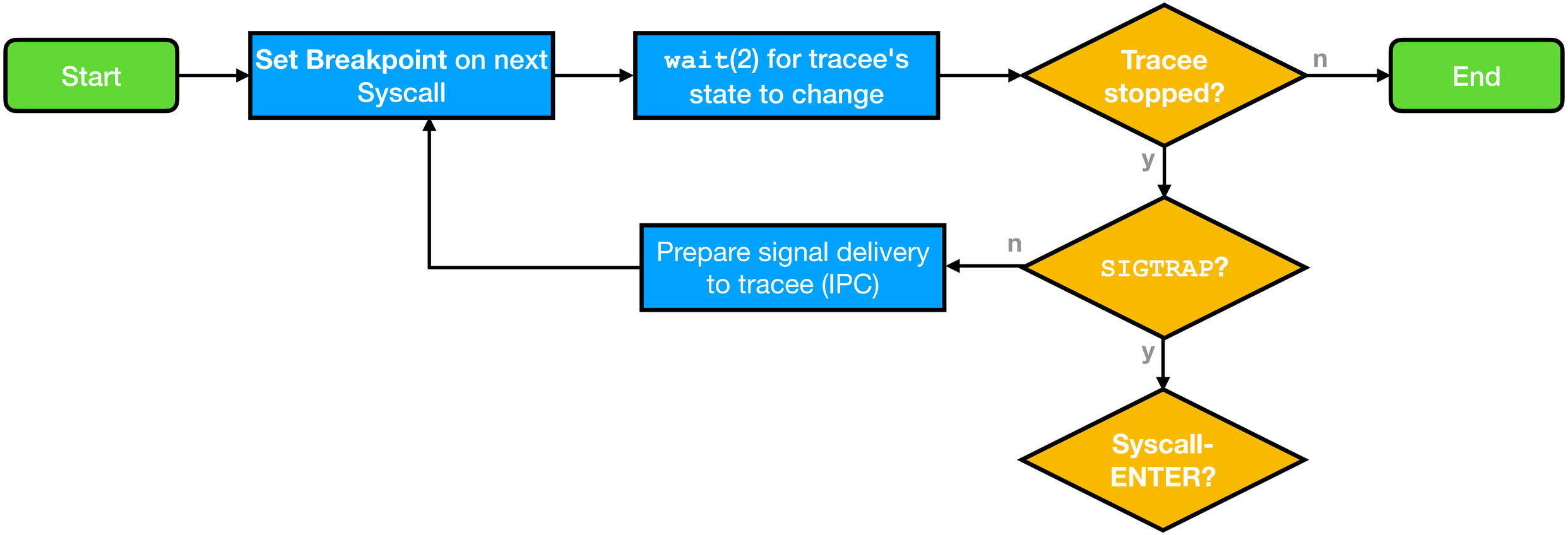

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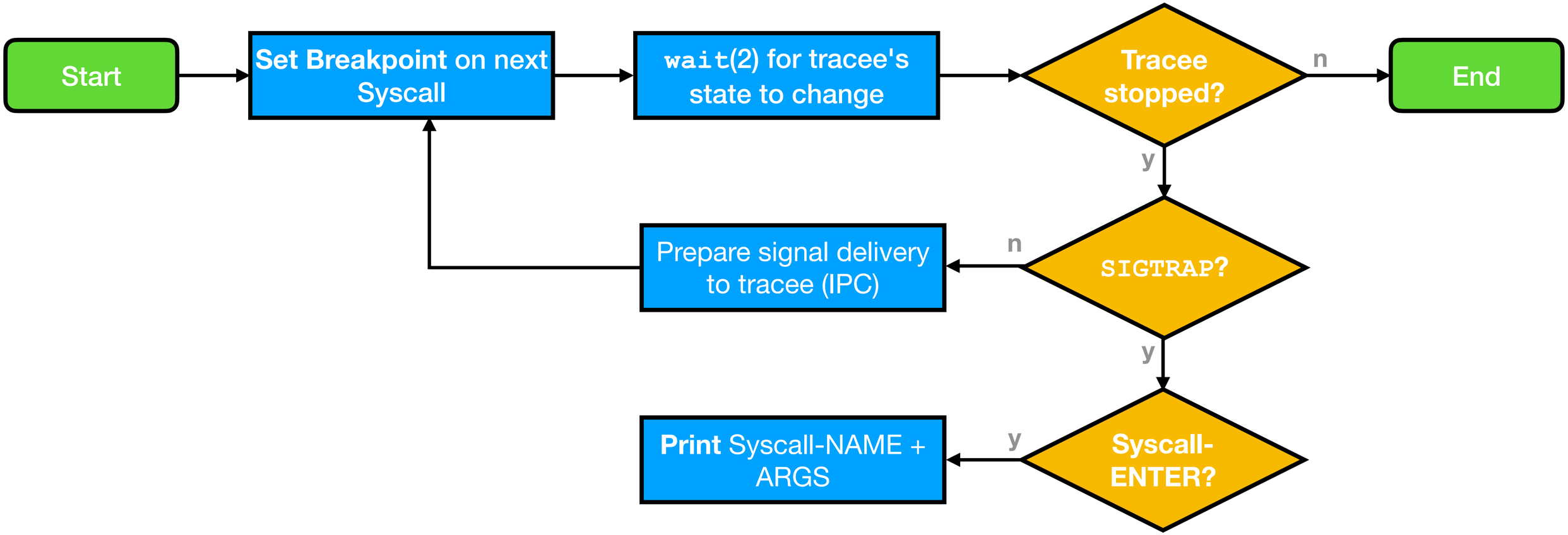

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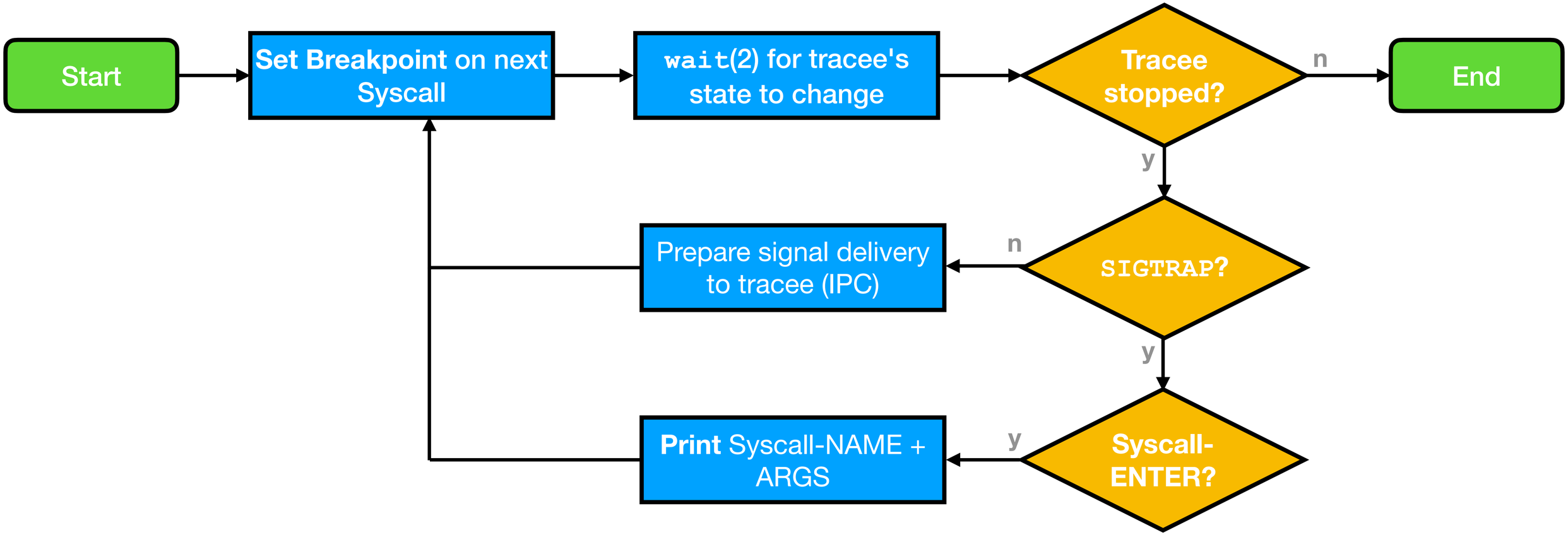

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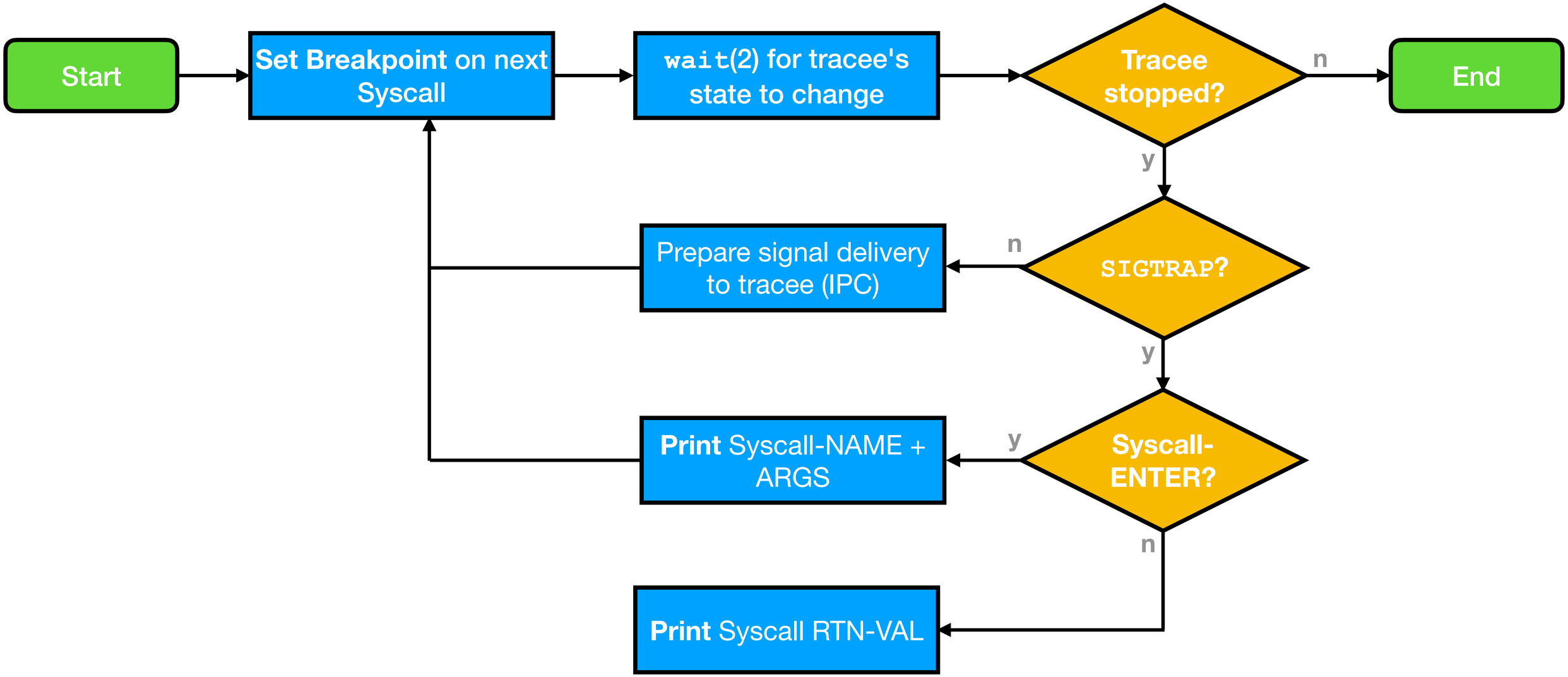

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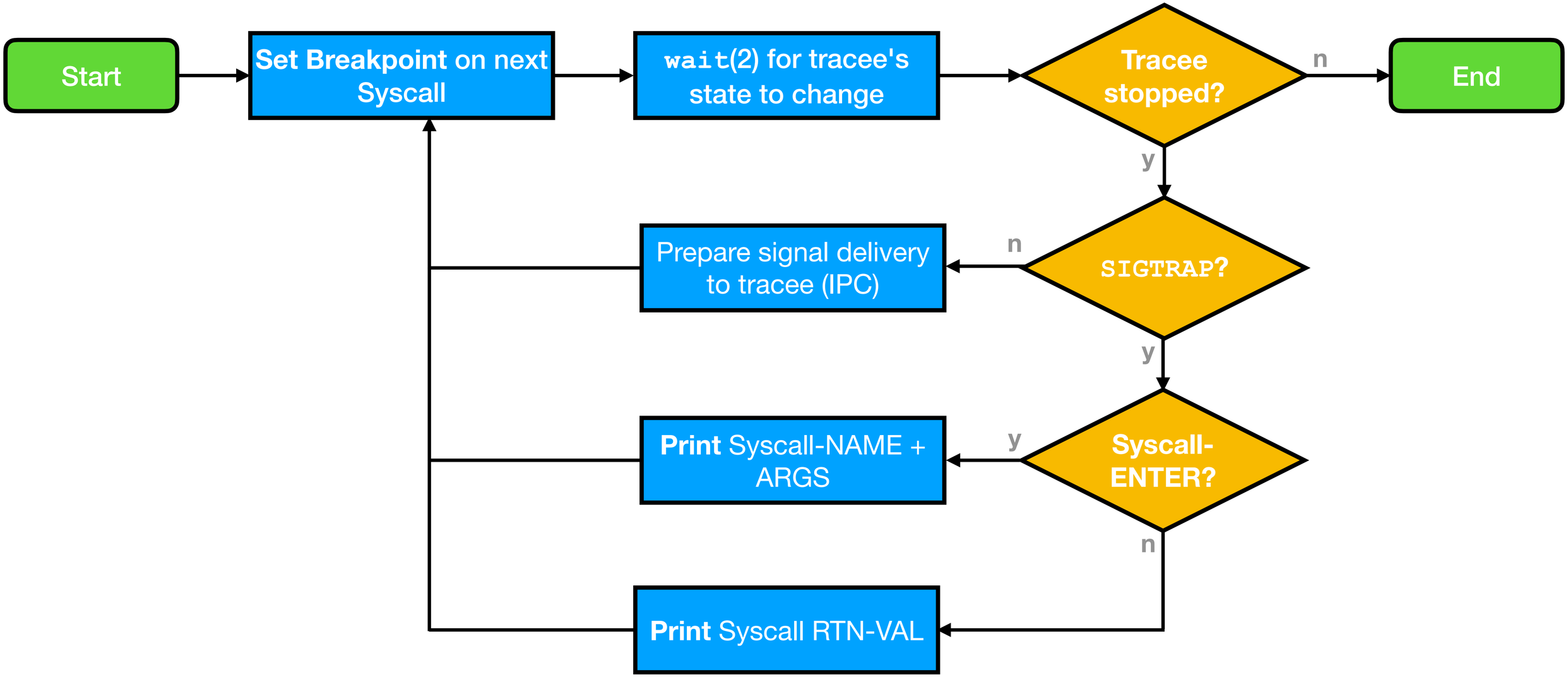

Probleme

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Todo: Integration

Ansatz

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  - Problem: Buffer Mutex => Deadlock

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  - Idee: Atomare Queue

Quellen

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