The Lind Virtual Machine

Userspace system call emulation and auditing

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contracted for implementation by

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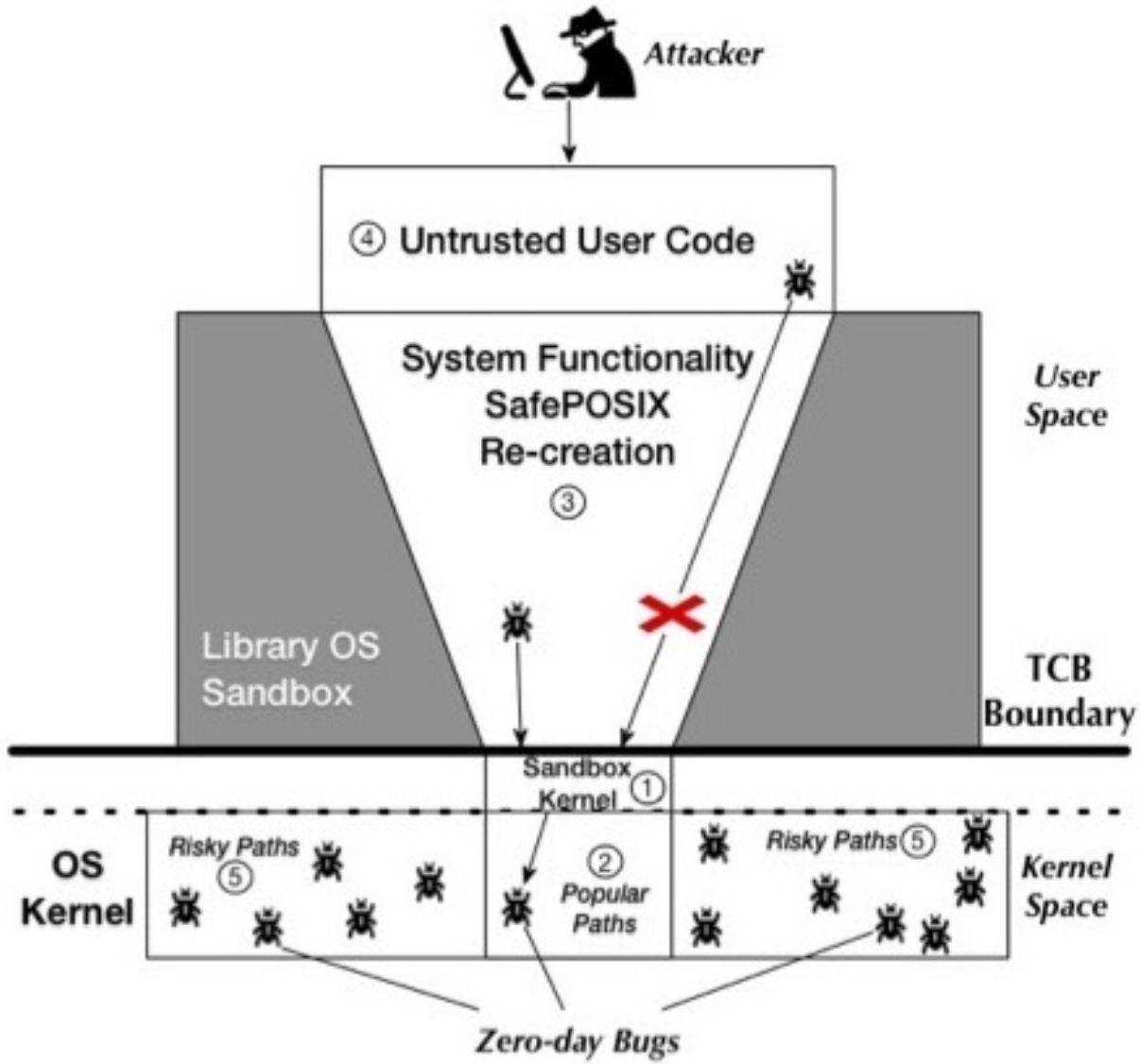
Purpose

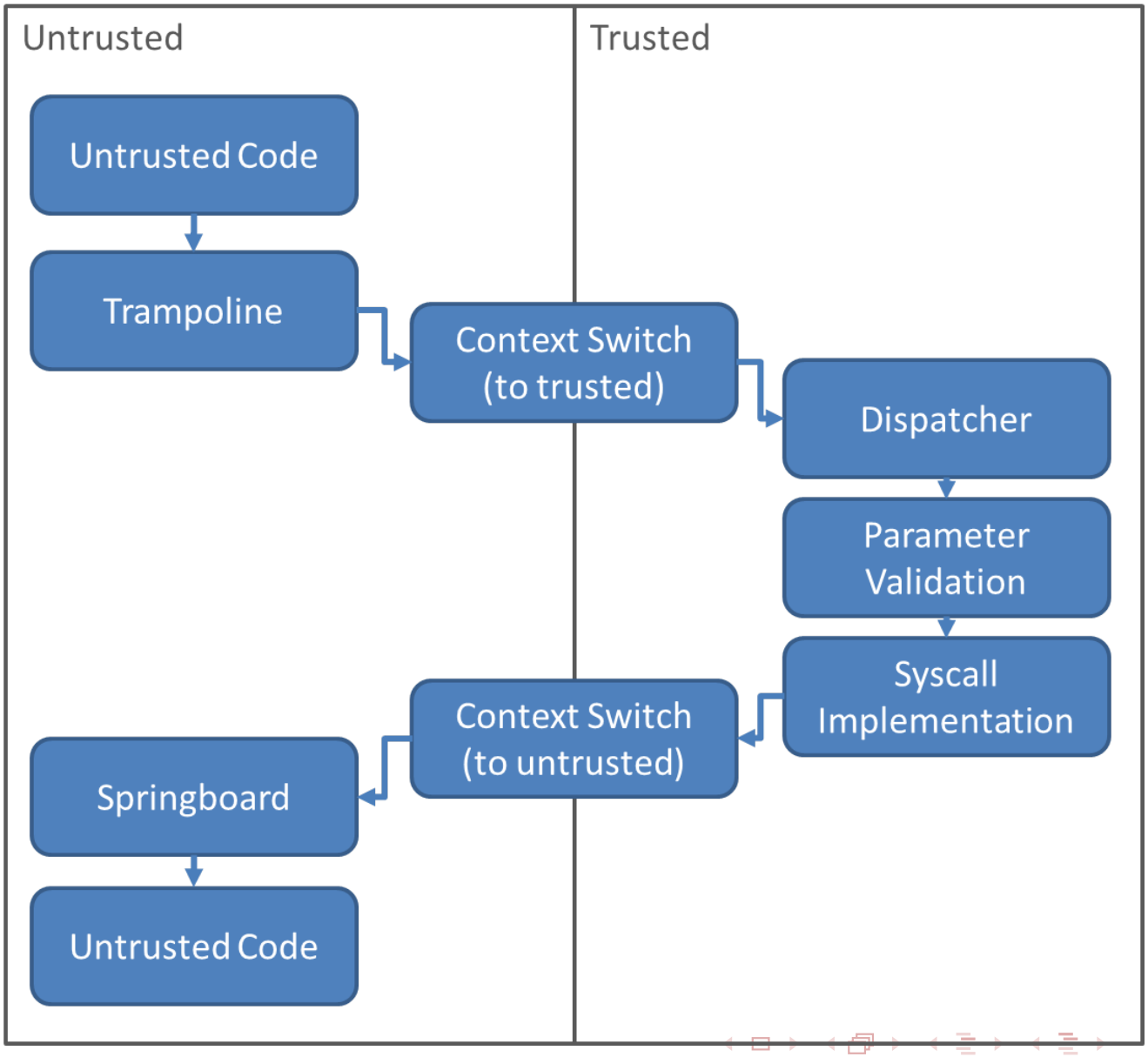
Lind is a fork of Google's NaCl.

1. Security goals fall somewhere in-between a virtual machine and a container
2. All system calls are trapped and handled by Lind
   - Safe System Calls - Python POSIX Compatibility Layer
   - Low-level System Calls - NaCl Internal Emulation
   - Unsafe System Calls - Return Unimplemented

Architecture



System Call Anatomy



Debugging Segfaults Inside Lind

```
$ lind -g /bin/bash -c '/hello; /hello'

Starting program: sel_ldr [...]
Thread 7 "sel_ldr" received signal
SIGSEGV, Segmentation fault.

0x0000690501297143 in ?? ()
```

Our Incrediby Useful Backtrace

```
@ [#7:None()] backtrace

#0  0x0006905012971 43 in ?? ()
#1  0x0000000000000000 in ?? ()
```

This ASM Doesn't Seem Right...

```
@ [#7: None()] x/10i $rip

=> 0x690501297143:   lock cmpxchg %edx,(%r15,%r13,1)
   0x690501297149:   test   %eax,%eax
   0x69050129714b:   je     0x6905012971a0
   0x69050129714d:   nopl   0x0(%rax)
   0x690501297151:   data16 nopw %cs:0x0(%rax,%rax,1)
   0x690501297160:   mov    %r13d,%edi
   0x690501297163:   mov    %r12d,%esi
   0x690501297166:   xor    %ebx,%ebx
   0x690501297168:   nopl   0x0(%rax)
   0x69050129716c:   data16 nopw %cs:0x0(%rax,%rax,1)
```

The Fault Address

```
@ [#7:None()] print $_siginfo._sifields._sigfault.si_addr

$5 = (void *) 0x6905000368e0
```

Conclusion: The Problem Address: r15 + r13

```
@ [#7: None()] info registers

rax            0x0                 0
rbx            0x10057910          268794128
rcx            0x1297120           19493152
[...]
r13            0x368e0             223456
r14            0x0                 0
r15            0x690500000000      115470195752960
rip            0x690501297143      0x690501297143
eflags         0x10246             [ PF ZF IF RF ]
```

Conclusion: Memory Not Writable

```
$ grep 6905000 /proc/$(pidof sel_ldr)/maps

    68fb00000000-690500000000 ---p 00000000 00:00 0
    690500000000-690500010000 rw-p 00000000 00:00 0
=> 690500010000-690510020000 r-xp 00000000 00:00 0
```

Questions?

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[1] 3286 segmentation fault (core dumped)

Thank you.