tracing multi attachment

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tracing multi attachment

fast attachment to all traceable functions

trampoline runtime is faster

```
fentry          :   74.602 ± 0.474M/s
fexit           :   59.906 ± 0.300M/s
fmodret         :   62.760 ± 0.120M/s
kprobe          :   36.247 ± 0.057M/s
kprobe-multi    :   57.150 ± 0.076M/s
kretprobe       :   12.896 ± 0.046M/s
kretprobe-multi:   17.353 ± 0.061M/s
```

how did we get in here..

- based on old ftrace direct API
- static multi trampoline (Menglong Dong)
- based on new ftrace direct API

how did we get in here..

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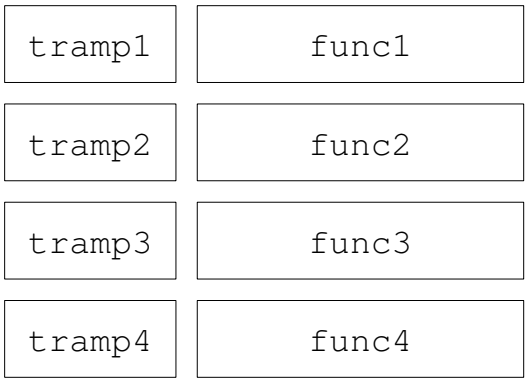
based on new ftrace direct API

```
register_ftrace_direct(tramp1.fops, tramp1.image)
register_ftrace_direct(tramp2.fops, tramp1.image)
register_ftrace_direct(tramp3.fops, tramp1.image)
register_ftrace_direct(tramp4.fops, tramp1.image)
```



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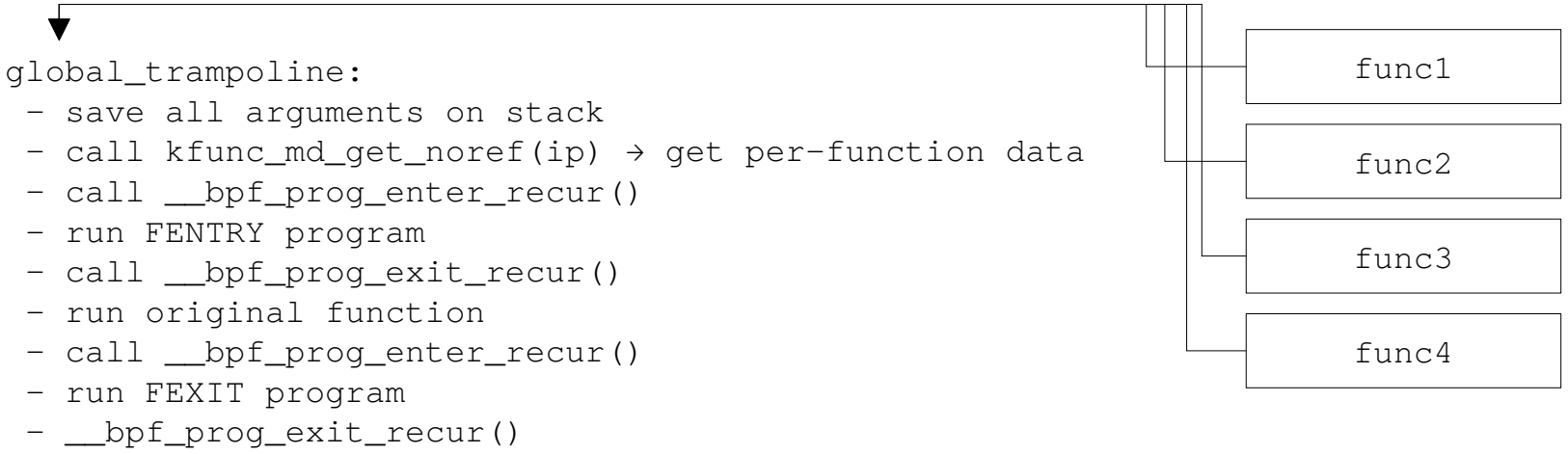


how did we get in here..

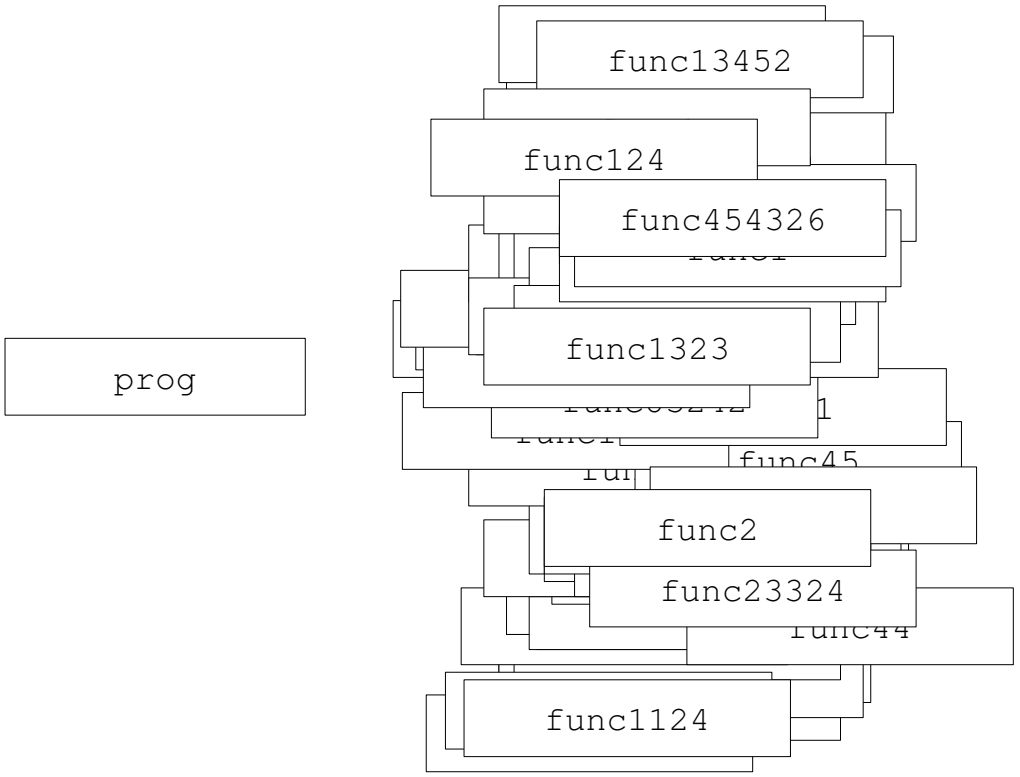
based on old ftrace direct API

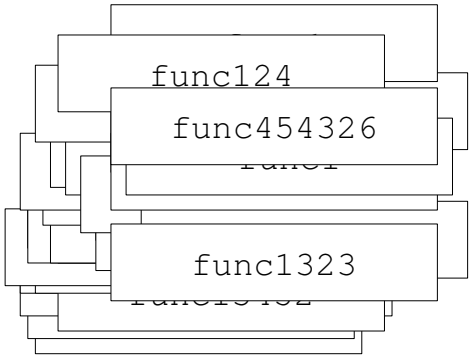
static multi trampoline (Menglong Dong)

based on new ftrace direct API

```
update_ftrace_direct_add(direct_ops, hash_reg)
update_ftrace_direct_mod(direct_ops, hash_mod)
update_ftrace_direct_del(direct_ops, hash_del)
```

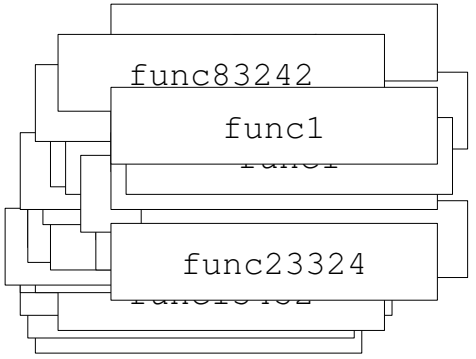
```
struct ftrace_func_entry {
        struct hlist_node hlist;
        unsigned long ip;
        unsigned long direct;
};
```


prog
func13452
func124
func454326
func1323
func45
func2
func23324
func1124

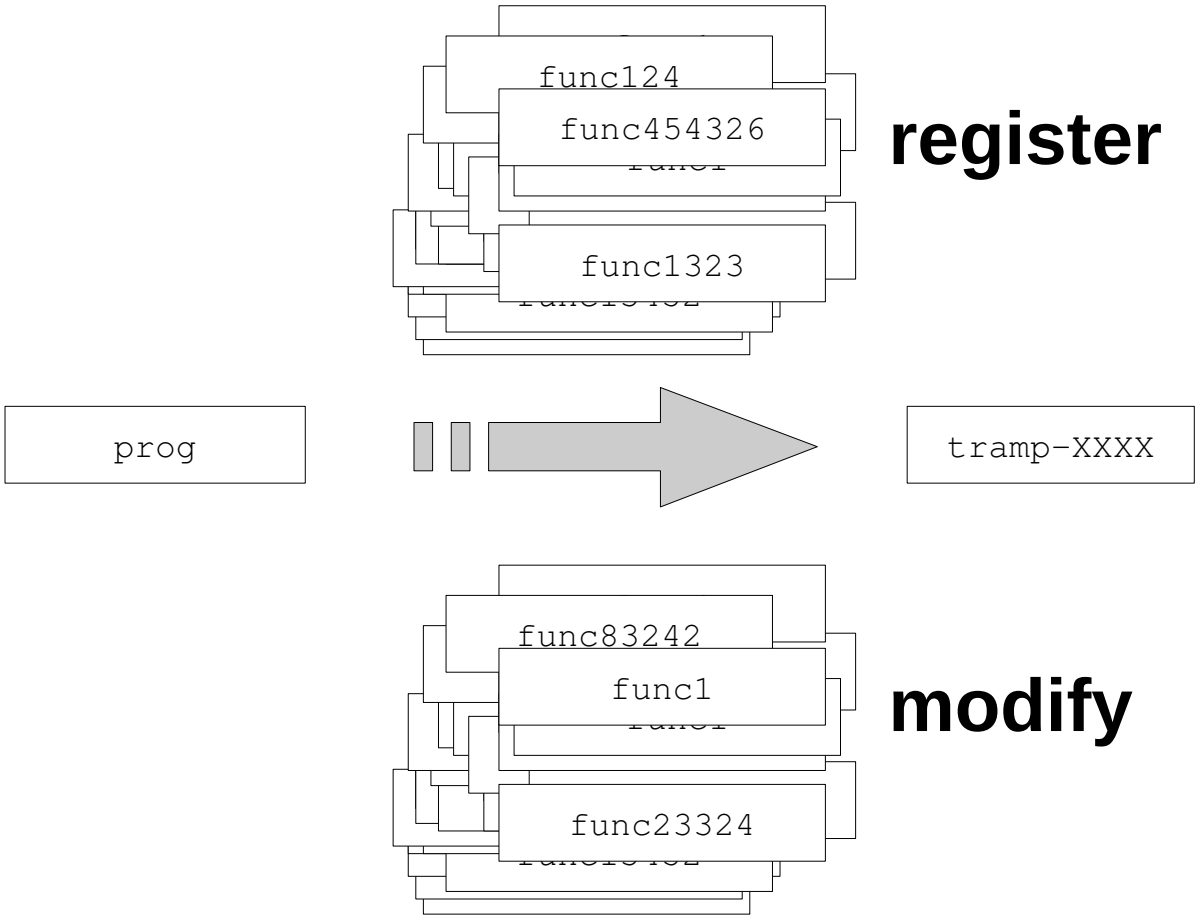


register

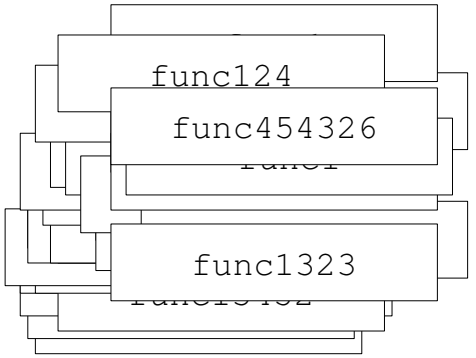
prog



modify



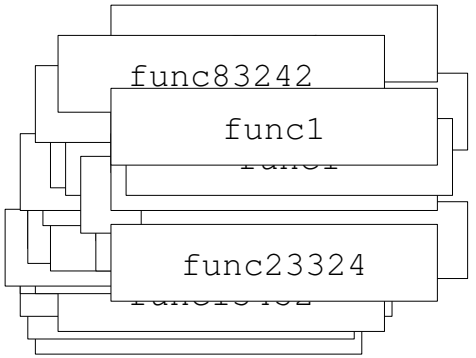

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```



register

prog

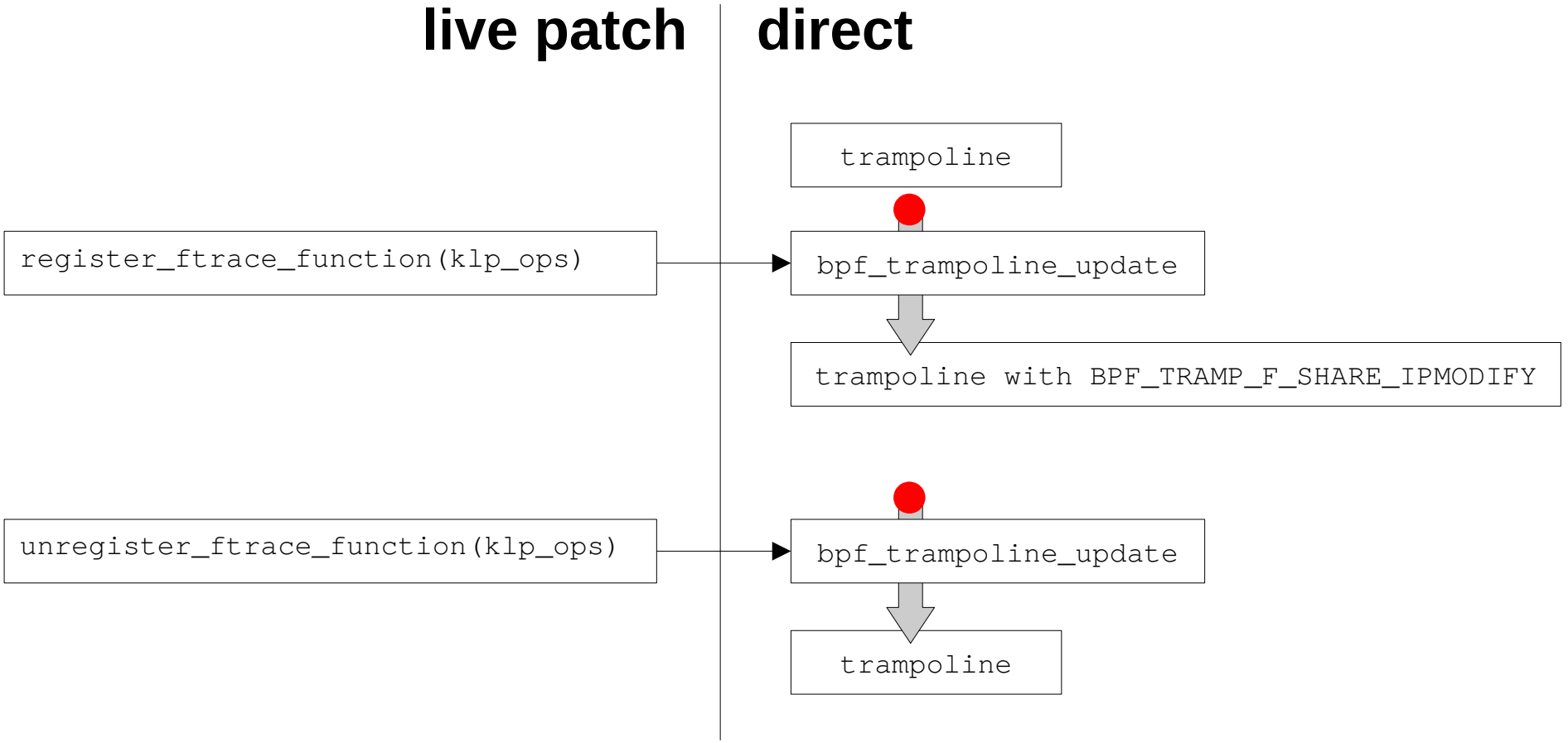
```
update_ftrace_direct_add(direct_ops, hash_reg)
update_ftrace_direct_mod(direct_ops, hash_mod)
```



modify

locking

- **each trampoline has lock**
- **what if I want to attach program 20k functions**
- **there’s 48 lockdep limit**
- **pool of 32 locks (Andrii)**
- **possible issue with live-patch**




```
if (!mutex_trylock(select_trampoline_lock(tr))) {
    /* sleep 1 ms to make sure whatever holding mutex makes
     * some progress.
     */
    msleep(1);
    return -EAGAIN;
}
```

```
struct { /* struct used by BPF_LINK_CREATE command */
  union {
    ...
    struct {
      __aligned_u64   ids;
      __aligned_u64   cookies;
      __u32           cnt;
    } tracing_multi;
  };
} link_create;
```

kernel

---

libbpf

```
struct bpf_link *
bpf_program__attach_tracing_multi(const struct bpf_program *prog,
                                  const char *pattern,
                                  const struct bpf_tracing_multi_opts *opts);

struct bpf_tracing_multi_opts {
  size_t sz;
  __u32 *ids;
  __u64 *cookies;
  size_t cnt;
  size_t :0;
};
```

module attachment

```
struct { /* anonymous struct used by BPF_PROG_LOAD command */
  union {
    ...
    /* or valid module BTF object fd or 0 to attach to vmlinux */
    __u32 attach_btf_obj_fd;
  };
};
```

kernel

---

libbpf

```
SEC("fentry.multi/bpf_testmod:bpf_testmod_fentry_test*")
int BPF_PROG(test_fentry)
{
  ...
```

```
link = bpf_program__attach_tracing_multi(skel->progs.test_fentry,
                  "bpf_testmod:bpf_testmod_fentry_test*", NULL);
```

supported program types

- **FENTRY / FEXIT / FSESSION**

```
BPF_TRACE_FENTRY_MULTI
BPF_TRACE_FEXIT_MULTI
BPF_TRACE_FSESSION_MULTI
```

not supported program types

- **FMOD_RET / LSM**

sleepable programs

attach cookies

arguments

single trampoline attach

- **program verified against specific function 1:1**

multi trampoline attach

- **program verified against stub function**
- **attached to multiple standard trampolines 1:N**

arguments

no direct access

```
bpf_get_func_arg()
bpf_get_func_ret()
bpf_get_func_arg_cnt()
```

can’t traverse arguments objects

but we can access arguments in fexit program

thanks, questions?

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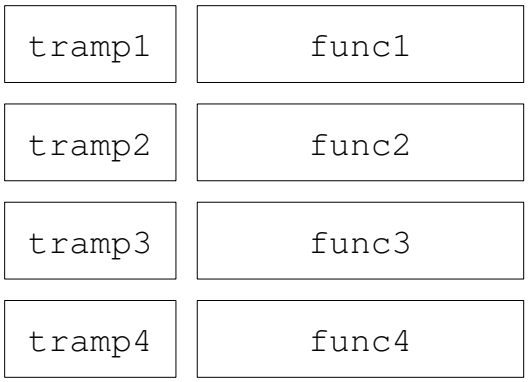
register_ftrace_direct(tramp2.fops, tramp1.image)
register_ftrace_direct(tramp3.fops, tramp1.image)
register_ftrace_direct(tramp4.fops, tramp1.image)
```



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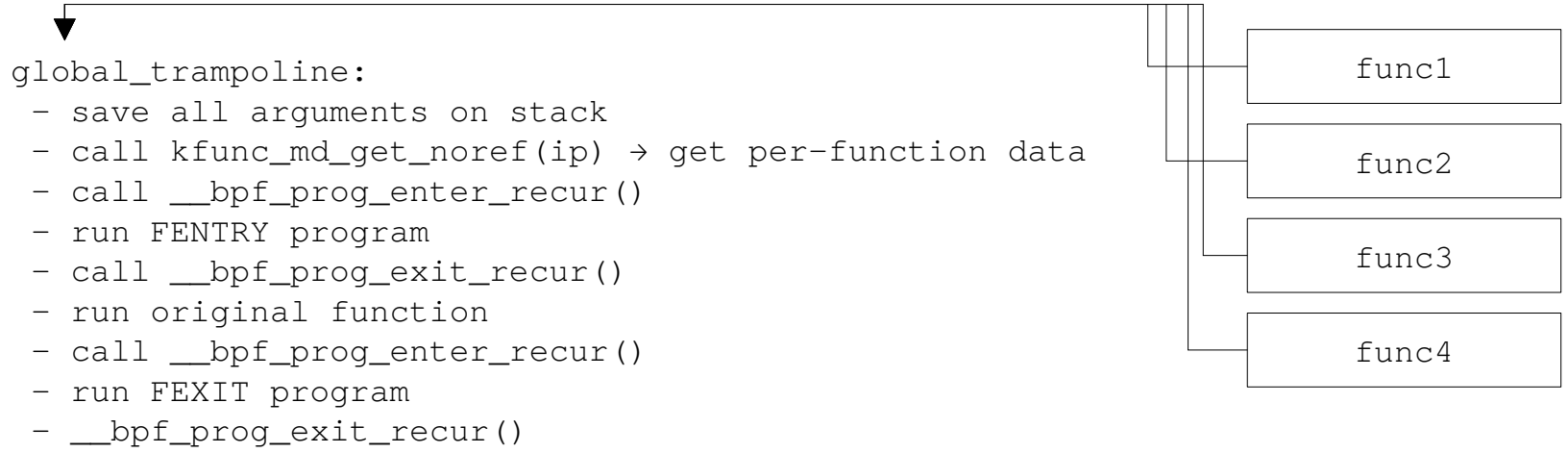

how did we get in here..

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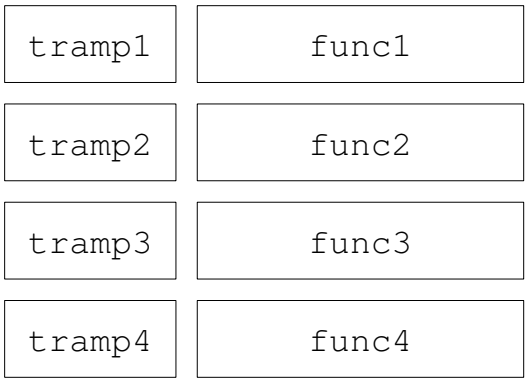
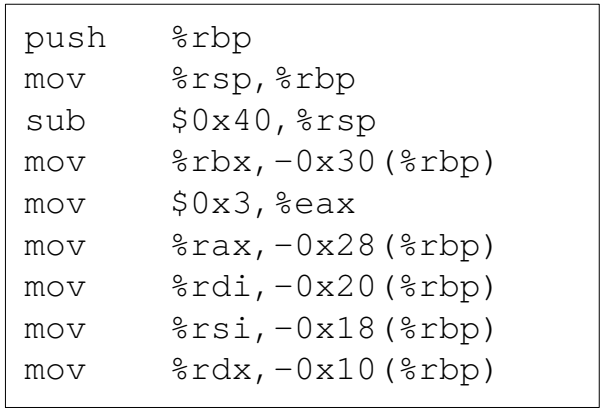
```
update_ftrace_direct_add(direct_ops, hash)
```



trampolines

- **generated for each function 1:1**
- **based on BTF**
- **execute fentry/fexit/fmod_ret/fsession**




```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
movabs bpf_tramp_image,%rdi
call   __bpf_tramp_enter
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
xor     %edi,%edi
mov     %rdi,-0x40(%rbp)
movabs  $0xffffc900001e0000,%rdi
lea     -0x40(%rbp),%rsi
call    __bpf_prog_enter_recur
mov     %rax,%rbx
test    %rax,%rax
je      0xffffffffa001379a
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
lea     -0x20(%rbp),%rdi
call    fentry
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
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lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   __bpf_prog_exit_recur
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
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mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
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mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
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call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   __bpf_prog_exit_recur
```

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push   %rbp
mov    %rsp,%rbp
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mov    %rbx,-0x30(%rbp)
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mov    %rax,-0x28(%rbp)
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movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
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mov    %rax,-0x8(%rbp)
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mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

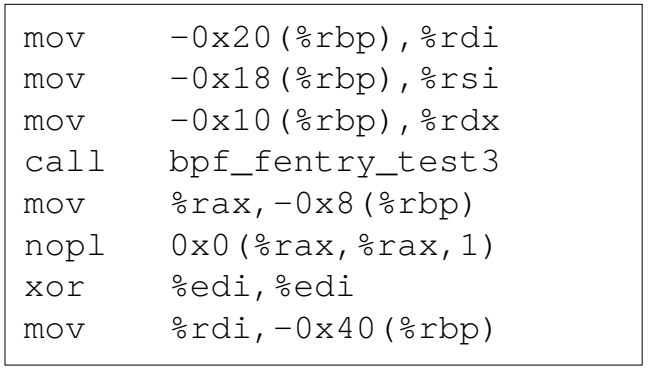


```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   __bpf_prog_enter_recur
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
lea    -0x20(%rbp),%rdi
call   fexit
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   __bpf_prog_exit_recur
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
movabs $0xffff88810b117000,%rdi
call   __bpf_tramp_exit
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```

```
mov     -0x8(%rbp),%rax
mov     -0x30(%rbp),%rbx
leave
ret
```

```
push   %rbp
mov    %rsp,%rbp
sub    $0x40,%rsp
mov    %rbx,-0x30(%rbp)
mov    $0x3,%eax
mov    %rax,-0x28(%rbp)
mov    %rdi,-0x20(%rbp)
mov    %rsi,-0x18(%rbp)
mov    %rdx,-0x10(%rbp)
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df00
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900001e0000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa001379a
lea    -0x20(%rbp),%rdi
call   0xffffffffa000f2d8
movabs $0xffffc900001e0000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
mov    -0x20(%rbp),%rdi
mov    -0x18(%rbp),%rsi
mov    -0x10(%rbp),%rdx
call   0xffffffff824e2b29
mov    %rax,-0x8(%rbp)
nopl   0x0(%rax,%rax,1)
xor    %edi,%edi
mov    %rdi,-0x40(%rbp)
movabs $0xffffc900002d5000,%rdi
lea    -0x40(%rbp),%rsi
call   0xffffffff8166d5e0
mov    %rax,%rbx
test   %rax,%rax
je     0xffffffffa00137f4
lea    -0x20(%rbp),%rdi
call   0xffffffffa0000bdc
movabs $0xffffc900002d5000,%rdi
mov    %rbx,%rsi
lea    -0x40(%rbp),%rdx
call   0xffffffff8166d8a0
movabs $0xffff88810b117000,%rdi
call   0xffffffff8166df40
mov    -0x8(%rbp),%rax
mov    -0x30(%rbp),%rbx
leave
ret
```