Linux Kernel Development

Abu_Shahid
B20CS003

Abhishek_Rajora
B20CS002

Ayush_Anand
B20CS082

Objectives

01

Sandboxing Redox OS

02

Hacking the linux kernel

03

Adding an additional syscall to linux kernel

Getting to know Redox

Understanding Rust and Redox

Topic 1

Build and Execution

Topic 2

Sandboxing

Topic 3

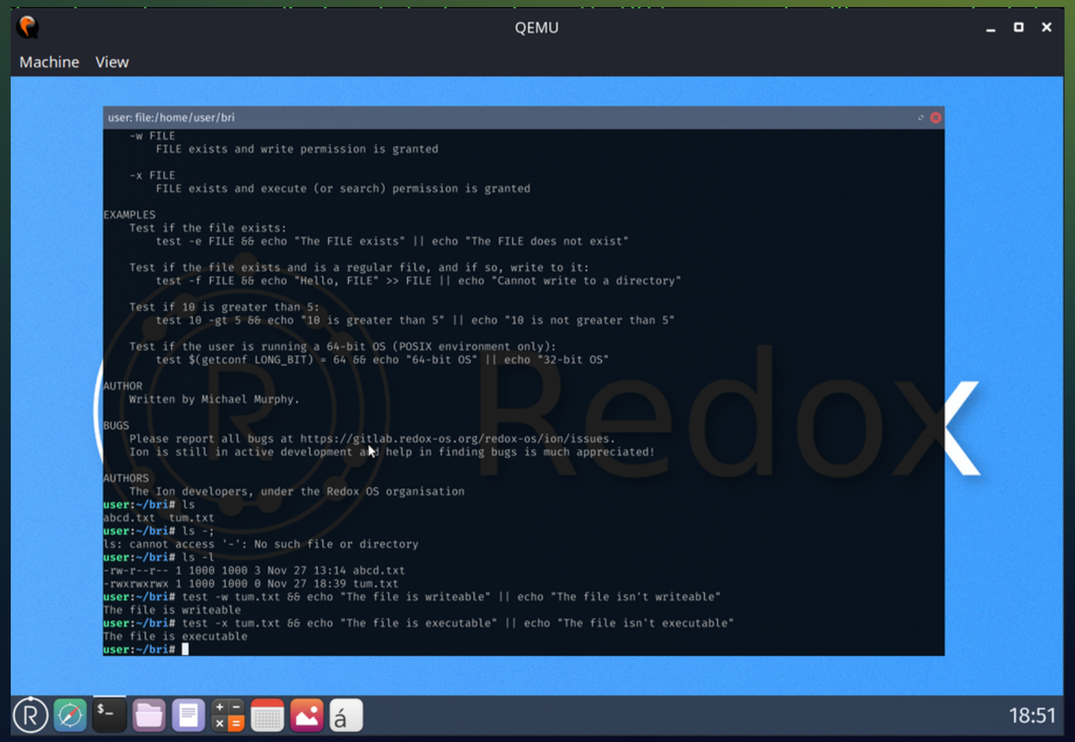
Understanding Redox

Redox is a Unix-like Operating System written in Rust.

Minimal syscall interface. Only 16k lines of kernel code.

Under heavy development. Lots of features yet to be incorporarted.

Rust based Implementation



Follows the microkernel design and aims to be secure, usable, and free.

Rust attempts to avoid the unexpected memory unsafe conditions which are a major source of security critical bugs.

300 invocations of unsafe in about 16,000 lines of code. Carefully audited to ensure correctness.

Redox OS:

How to setup Redox?

```
2022-11-27T23-44-58..202++00:00 [@ihdad::hda::device:379 INFO] Addr: 00:04, Type: AudioInput, Inputs: 1: [(0, 5)].
2022-11-27T23-44-58..233++00:00 [@ihdad::hda::device:379 INFO] Addr: 00:05, Type: PinComplex: LineIn, Inputs: 0: [].
2022-11-27T23-44-58..262++00:00 [@ihdad::hda::device:471 INFO] Best pin: 0:03
2022-11-27T23-44-58..282++00:00 [@ihdad::hda::device:478 INFO] Path to DAC: [(0, 3), (0, 2)]
2022-11-27T23-44-58..315++00:00 [@ihdad::hda::device:490 INFO] Supported Formats: 000201FC
2022-11-27T23-44-58..339++00:00 [@ihdad::hda::device:491 INFO] Capabilities: 00400101
2022-11-27T23-44-58..362++00:00 [@ihdad::hda::device:212 INFO] IHDA: Initialization finished.
2022-11-27T23-44-58..390++00:00 [@pcid:278 INFO] PCI 00/03/00 8086:100E 02.00.00.03 Network 0=FEBC0000 1=C000
2022-11-27T23-44-58..410++00:00 [@pcid:401 INFO] PCI DEVICE CAPABILITIES for e1000d: []
2022-11-27T23-44-58..439++00:00 [@pcid:463 INFO] PCID SPAWN "e1000d" "pci-00.03.00" "FEBC0000" "00020000" "11"
 + E1000 pci-00.03.00_e1000 on: FEBC0000 size: 131072 IRQ: 11
   - MAC: 52:54:00:12:34:56
   - Link is up with speed 1000 Mb/s
2022-11-27T23-44-58..623++00:00 [@pcid:278 INFO] PCI 00/04/00 1033:0194 0C.03.30.03 SerialBus XHCI 0=00000000FEBF4000
2022-11-27T23-44-58..848++00:00 [@pcid:278 INFO] PCI 00/1F/00 8086:2918 06.01.00.02 Bridge
2022-11-27T23-44-58..864++00:00 [@pcid:278 INFO] PCI 00/1F/02 8086:2922 01.06.01.02 Storage SATA AHCI 4=C080 5=FEBF90
00
user:~# ls
bri  work
user:~# exit
########## Redox OS ##########
# Login with the following:  #
# `user`                     #
# `root`:`password`          #
##############################

redox login: user
Welcome to Redox OS!

user:~#
```

How to setup Redox OS for kernel development?

install rust toolchain

$ curl https://sh.rustup.rs -sSf | sh
$ source HOME/.cargo/env

Clone the source

$ git clone https://gitlab.redox-os.org/redox-os/redox.git --origin upstream --recursive

Compile and build the kernel

$ cargo install xargo cargo-config

$ git submodule update --recursive --init

$ make all
$ make qemu

Linux Kernel Development

Adding a syscall to the linux-6.0 kernel

Linux Kernel 6.0

The epicenter of open source development

Starting from linux-6 parts are being rewritten in rust

One of the most active open source projects

Setting up Linux kernel

clone the source

```
git clone
git://git.kernel.org/p
ub/scm/linux/kernel/gi
t/torvalds/linux.git
```

Compile and build the kernel image

```
$make defconfig
$make oldconfig
   $make -j8
```

Mount a filesystem

TO EMULATE THE KERNEL IMAGE IN QEMU EMULATOR WE NEED A FILESYSTEM, TO DO THAT WE USE SYZKALLER SCRIPT

```
./create-image.sh
```

SYSCALL

Adding a syscall to the linux-6.0 kernel

```
root@syzkaller:~# ./a.out
[  108.762614] Hi I am Ayush here :)
0
root@syzkaller:~# dmesg | tail
[   11.260781] systemd[1]: Started Load/Save Random Seed.
[   12.082287] systemd[1]: Started Journal Service.
[   13.246477] audit: type=1107 audit(1669591791.263:5): pid=1 uid=0 auid=4294967295 ses=
t:s0 msg='avc:  denied  { stop } for auid=n/a uid=0 gid=0 path="/lib/systemd/system/syste
lctl --flush" scontext=system_u:system_r:kernel_t:s0 tcontext=system_u:object_r:unlabeled
                exe="/lib/systemd/systemd" sauid=0 hostname=? addr=? terminal=?'
[   13.303204] systemd-journald[103]: Received request to flush runtime journal from PID
[   20.471282] audit: type=1107 audit(1669591798.490:6): pid=1 uid=0 auid=4294967295 ses=
t:s0 msg='avc:  denied  { status } for auid=n/a uid=0 gid=0 path="/lib/systemd/system/gra
emd-update-utmp runlevel" scontext=system_u:system_r:kernel_t:s0 tcontext=system_u:object
                exe="/lib/systemd/systemd" sauid=0 hostname=? addr=? terminal=?'
[   23.761205] e1000: eth0 NIC Link is Up 1000 Mbps Full Duplex, Flow Control: RX
[   23.824616] IPv6: ADDRCONF(NETDEV_CHANGE): eth0: link becomes ready
[  108.762614] Hi I am Ayush here :)
root@syzkaller:~#
```

```c
#include<stdio.h>
#include<unistd.h>
#include<sys/syscall.h>


int main() {
        long res = syscall(451);
        printf("%d\n",res);
        return res;
}
~
~
~
~
~
~
~
```

Creating a syscall overview

Update the syscall table with a new entry

```
$cd arch/x86/entry/syscalls/
$vi syscall_64.tbl
"451 common hello_there
sys_hello_there"
```

Implement the function in kernel/sys.c

```
SYSCALL_DEFINE0(hello_there){
  printk(KERN_INFO "xyz");
  return 0;
};
```

Make the source again

COMPILE AND BUILD THE KERNEL IMAGE AGAIN

Thank you