

how to add your system call the Linux OS kernel.

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To

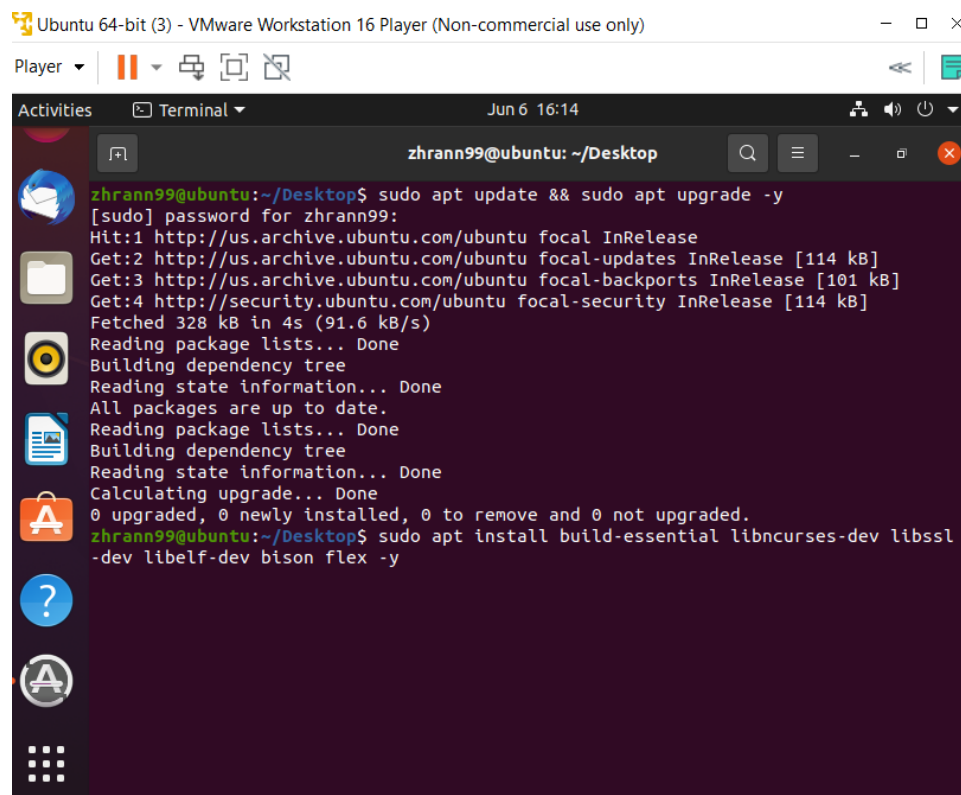
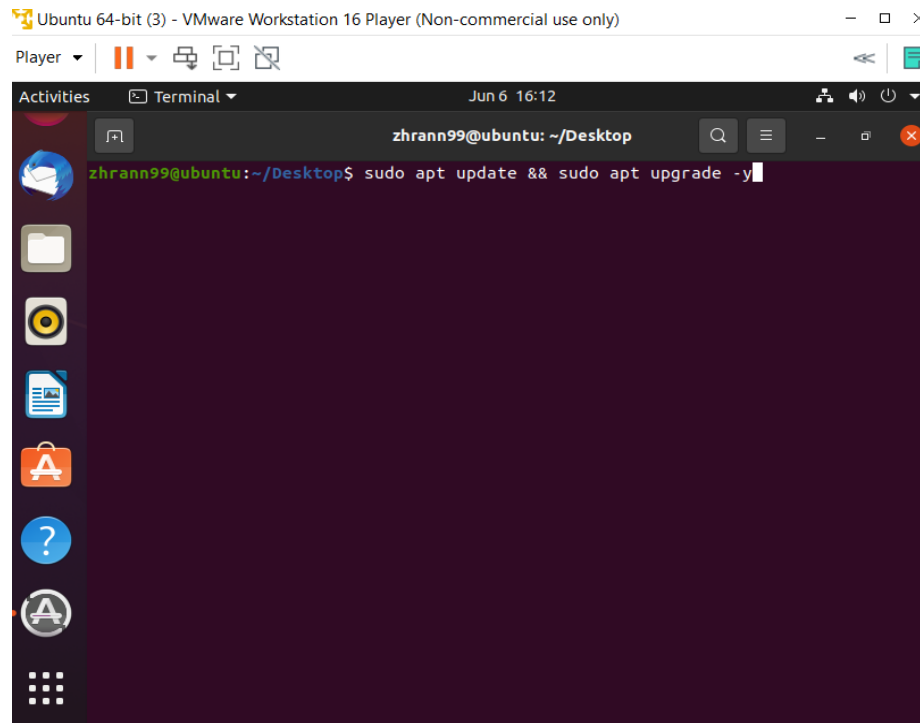
Dr Samer Shaban AbdelFatah

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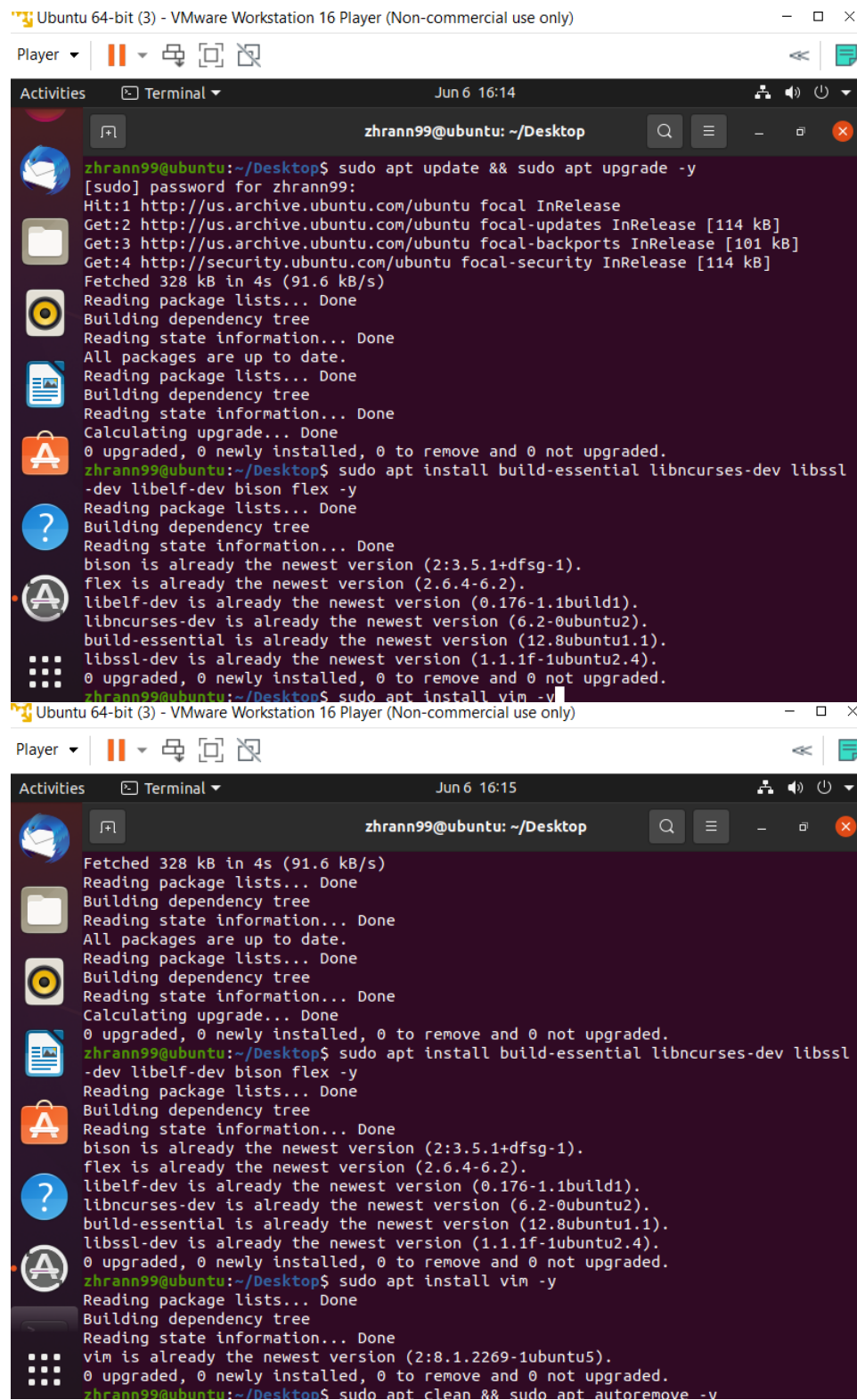
In this section, you will download all necessary tools to add a basic system call to the Linux kernel and run it. This is the only part of the entire process where network connectivity is necessary.

1.a - Fully update your operating system.

1.b - Download and install the essential packages to compile kernels.



1.c - Download and install the essential packages to compile kernels.



The image shows two screenshots of a terminal window in a VMware Workstation 16 Player. The window title is "Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)". The terminal shows the user "zhrann99@ubuntu: ~/Desktop" performing the following commands and output:

```
zhrann99@ubuntu:~/Desktop$ sudo apt update && sudo apt upgrade -y
[sudo] password for zhrann99:
Hit:1 http://us.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://us.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu focal-backports InRelease [101 kB]
Get:4 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Fetched 328 kB in 4s (91.6 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
All packages are up to date.
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt install build-essential libncurses-dev libssl
-dev libelf-dev bison flex -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
bison is already the newest version (2:3.5.1+dfsg-1).
flex is already the newest version (2.6.4-6.2).
libelf-dev is already the newest version (0.176-1.1build1).
libncurses-dev is already the newest version (6.2-0ubuntu2).
build-essential is already the newest version (12.8ubuntu1.1).
libssl-dev is already the newest version (1.1.1f-1ubuntu2.4).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt install vim -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
vim is already the newest version (2:8.1.2269-1ubuntu5).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt clean && sudo apt autoremove -y
```

1.e - Download the source code of the latest stable version and Clean up your installed packages..

```
Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)
Player
Jun 6 16:16
zhrann99@ubuntu: ~/Desktop
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt install build-essential libncurses-dev libssl
-dev libelf-dev bison flex -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
bison is already the newest version (2:3.5.1+dfsg-1).
flex is already the newest version (2.6.4-6.2).
libelf-dev is already the newest version (0.176-1.1build1).
libncurses-dev is already the newest version (6.2-0ubuntu2).
build-essential is already the newest version (12.8ubuntu1.1).
libssl-dev is already the newest version (1.1.1f-1ubuntu2.4).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt install vim -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
vim is already the newest version (2:8.1.2269-1ubuntu5).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt clean && sudo apt autoremove -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$
```

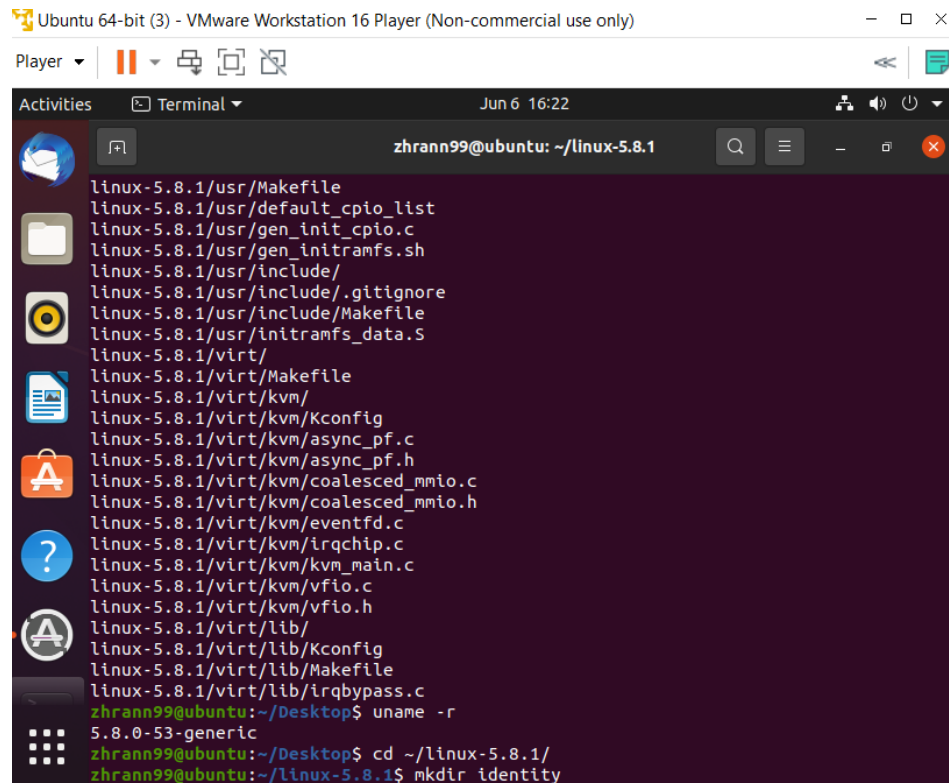
```
Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)
Player
Jun 6 16:16
zhrann99@ubuntu: ~/Desktop
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt install build-essential libncurses-dev libssl
-dev libelf-dev bison flex -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
bison is already the newest version (2:3.5.1+dfsg-1).
flex is already the newest version (2.6.4-6.2).
libelf-dev is already the newest version (0.176-1.1build1).
libncurses-dev is already the newest version (6.2-0ubuntu2).
build-essential is already the newest version (12.8ubuntu1.1).
libssl-dev is already the newest version (1.1.1f-1ubuntu2.4).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt install vim -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
vim is already the newest version (2:8.1.2269-1ubuntu5).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ sudo apt clean && sudo apt autoremove -y
Reading package lists... Done
Building dependency tree
Reading state information... Done
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
zhrann99@ubuntu:~/Desktop$ wget -P ~/ https://cdn.kernel.org/pub/linux/kernel/v5.
x/linux-5.8.1.tar.xz
```

-part2- Check the version of your current kernel. And Change your working directory to the root directory of the recently unpacked source code.

```
Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)
Player
Jun 6 16:20
zhrann99@ubuntu: ~/Desktop
linux-5.8.1/usr/
linux-5.8.1/usr/.gitignore
linux-5.8.1/usr/Kconfig
linux-5.8.1/usr/Makefile
linux-5.8.1/usr/default_cpio_list
linux-5.8.1/usr/gen_init_cpio.c
linux-5.8.1/usr/gen_initramfs.sh
linux-5.8.1/usr/include/
linux-5.8.1/usr/include/.gitignore
linux-5.8.1/usr/include/Makefile
linux-5.8.1/usr/initramfs_data.S
linux-5.8.1/virt/
linux-5.8.1/virt/Makefile
linux-5.8.1/virt/kvm/
linux-5.8.1/virt/kvm/Kconfig
linux-5.8.1/virt/kvm/async_pf.c
linux-5.8.1/virt/kvm/async_pf.h
linux-5.8.1/virt/kvm/coalesced_mmio.c
linux-5.8.1/virt/kvm/coalesced_mmio.h
linux-5.8.1/virt/kvm/eventfd.c
linux-5.8.1/virt/kvm/irqchip.c
linux-5.8.1/virt/kvm/kvm_main.c
linux-5.8.1/virt/kvm/vfio.c
linux-5.8.1/virt/kvm/vfio.h
linux-5.8.1/virt/lib/
linux-5.8.1/virt/lib/Kconfig
linux-5.8.1/virt/lib/Makefile
linux-5.8.1/virt/lib/irqbypass.c
zhrann99@ubuntu:~/Desktop$ uname -r
```

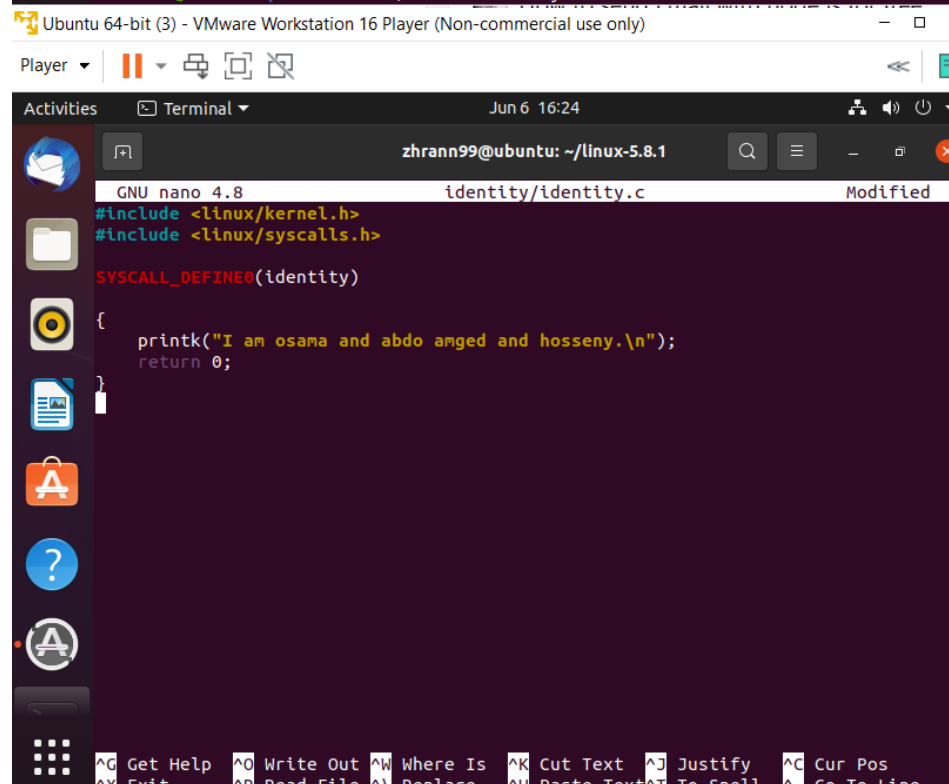
```
Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)
Player
Jun 6 16:21
zhrann99@ubuntu: ~/Desktop
linux-5.8.1/usr/Kconfig
linux-5.8.1/usr/Makefile
linux-5.8.1/usr/default_cpio_list
linux-5.8.1/usr/gen_init_cpio.c
linux-5.8.1/usr/gen_initramfs.sh
linux-5.8.1/usr/include/
linux-5.8.1/usr/include/.gitignore
linux-5.8.1/usr/include/Makefile
linux-5.8.1/usr/initramfs_data.S
linux-5.8.1/virt/
linux-5.8.1/virt/Makefile
linux-5.8.1/virt/kvm/
linux-5.8.1/virt/kvm/Kconfig
linux-5.8.1/virt/kvm/async_pf.c
linux-5.8.1/virt/kvm/async_pf.h
linux-5.8.1/virt/kvm/coalesced_mmio.c
linux-5.8.1/virt/kvm/coalesced_mmio.h
linux-5.8.1/virt/kvm/eventfd.c
linux-5.8.1/virt/kvm/irqchip.c
linux-5.8.1/virt/kvm/kvm_main.c
linux-5.8.1/virt/kvm/vfio.c
linux-5.8.1/virt/kvm/vfio.h
linux-5.8.1/virt/lib/
linux-5.8.1/virt/lib/Kconfig
linux-5.8.1/virt/lib/Makefile
linux-5.8.1/virt/lib/irqbypass.c
zhrann99@ubuntu:~/Desktop$ uname -r
5.8.0-53-generic
zhrann99@ubuntu:~/Desktop$ cd ~/linux-5.8.1/
```

We will Create the home directory of your system call and Create a C file for your system call.



Terminal window showing the directory listing of the /linux-5.8.1 directory and the creation of the identity directory.

```
zhrann99@ubuntu: ~/linux-5.8.1
linux-5.8.1/usr/Makefile
linux-5.8.1/usr/default_cpio_list
linux-5.8.1/usr/gen_init_cpio.c
linux-5.8.1/usr/gen_initramfs.sh
linux-5.8.1/usr/include/
linux-5.8.1/usr/include/.gitignore
linux-5.8.1/usr/include/Makefile
linux-5.8.1/usr/initramfs_data.S
linux-5.8.1/virt/
linux-5.8.1/virt/Makefile
linux-5.8.1/virt/kvm/
linux-5.8.1/virt/kvm/Kconfig
linux-5.8.1/virt/kvm/async_pf.c
linux-5.8.1/virt/kvm/async_pf.h
linux-5.8.1/virt/kvm/coalesced_mmio.c
linux-5.8.1/virt/kvm/coalesced_mmio.h
linux-5.8.1/virt/kvm/eventfd.c
linux-5.8.1/virt/kvm/irqchip.c
linux-5.8.1/virt/kvm/kvm_main.c
linux-5.8.1/virt/kvm/vfio.c
linux-5.8.1/virt/kvm/vfio.h
linux-5.8.1/virt/lib/
linux-5.8.1/virt/lib/Kconfig
linux-5.8.1/virt/lib/Makefile
linux-5.8.1/virt/lib/irqbypass.c
zhrann99@ubuntu: ~/Desktop$ uname -r
5.8.0-53-generic
zhrann99@ubuntu: ~/Desktop$ cd ~/linux-5.8.1/
zhrann99@ubuntu: ~/linux-5.8.1$ mkdir identity
```



Terminal window showing the nano editor editing the identity.c file.

```
GNU nano 4.8 identity/identity.c Modified
#include <linux/kernel.h>
#include <linux/syscalls.h>

SYSCALL_DEFINE0(identity)
{
    printk("I am osama and abdo amged and hosseny.\n");
    return 0;
}
```

We will Create a Makefile for your system call. And Add the home directory of your system call to the main Makefile of the kernel.

Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)

Player ▾

Activities Terminal Jun 6 16:26

zhrann99@ubuntu: ~/linux-5.8.1

```
GNU nano 4.8 Makefile
# SPDX-License-Identifier: GPL-2.0
VERSION = 5
PATCHLEVEL = 8
SUBLEVEL = 1
EXTRAVERSION =
NAME = Kleptomaniac Octopus

# *DOCUMENTATION*
# To see a list of typical targets execute "make help"
# More info can be located in ./README
# Comments in this file are targeted only to the developer, do not
# expect to learn how to build the kernel reading this file.

$(if $(filter __%, $(MAKECMDGOALS)), \
    $(error targets prefixed with '__' are only for internal use))

# That's our default target when none is given on the command line
PHONY := __all
__all:

# We are using a recursive build, so we need to do a little thinking
# to get the ordering right.
#
# Most importantly: sub-Makefiles should only ever modify files in
# their own directory. If in some directory we have a dependency on
```

Read 1882 lines

^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit ^R Read File ^\ Replace ^U Paste Text ^T To Spell ^_ Go To Line

After we will Add a corresponding function prototype for your system call to the header file of system calls.

Ubuntu 64-bit (3) - VMware Workstation 16 Player (Non-commercial use only)

Player ▾ | [Icons] | [Icons]

Activities | Terminal ▾ | Jun 6 16:35

zhrann99@ubuntu: ~/linux-5.8.1

```
GNU nano 4.8 include/linux/syscalls.h Modified
#include <linux/personality.h>
#include <trace/syscall.h>

#ifdef CONFIG_ARCH_HAS_SYSCALL_WRAPPER
/*
 * It may be useful for an architecture to override the definitions of the
 * SYSCALL_DEFINE0() and __SYSCALL_DEFINEx() macros, in particular to use a
 * different calling convention for syscalls. To allow for that, the prototypes
 * for the sys_*() functions below will *not* be included if
 * CONFIG_ARCH_HAS_SYSCALL_WRAPPER is enabled.
 */
#include <asm/syscall_wrapper.h>
asmlinkage long sys_identity(void);
#endif /* CONFIG_ARCH_HAS_SYSCALL_WRAPPER */

/*
 * __MAP - apply a macro to syscall arguments
 * __MAP(n, m, t1, a1, t2, a2, ..., tn, an) will expand to
 * m(t1, a1), m(t2, a2), ..., m(tn, an)
 * The first argument must be equal to the amount of type/name
 * pairs given. Note that this list of pairs (i.e. the arguments
 * of __MAP starting at the third one) is in the same format as
 * for SYSCALL_DEFINE<n>/COMPAT_SYSCALL_DEFINE<n>
 */
```

Get Help Write Out Where Is Cut Text Justify Cur Pos
Exit Read File Replace Paste Text To Spell Go To Line

After this Add your system call to the kernel's system call table.

Ubuntu 64-bit (5) - VMware Workstation 10 Player (non-commercial use only)

Player

Activities Terminal Jun 6 16:37

zhrann99@ubuntu: ~/linux-5.8.1

```
GNU nano 4.8 arch/x86/entry/syscalls/syscall_64.tbl Modified
428 common open_tree sys_open_tree
429 common move_mount sys_move_mount
430 common fsopen sys_fsopen
431 common fsconfig sys_fsconfig
432 common fsmount sys_fsmount
433 common fspick sys_fspick
434 common pidfd_open sys_pidfd_open
435 common clone3 sys_clone3
437 common openat2 sys_openat2
438 common pidfd_getfd sys_pidfd_getfd
439 common faccessat2 sys_faccessat2
440 common identity sys_identity
#
# x32-specific system call numbers start at 512 to avoid cache impact
# for native 64-bit operation. The __x32_compat_sys stubs are created
# on-the-fly for compat_sys_*() compatibility system calls if X86_X32
# is defined.
#
512 x32 rt_sigaction compat_sys_rt_sigaction
513 x32 rt_sigreturn compat_sys_x32_rt_sigreturn
514 x32 ioctl compat_sys_ioctl
515 x32 readv compat_sys_readv
516 x32 writev compat_sys_writev
517 x32 recvfrom compat_sys_recvfrom
518 x32 sendmsg compat_sys_sendmsg
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit ^R Read File ^M Replace ^U Paste Text ^T To Spell ^_ Go To Line
```

Configure the kernel.

Ubuntu 64-bit (5) - VMware Workstation 10 Player (non-commercial use only)

Player

Activities Terminal Jun 6 16:40

zhrann99@ubuntu: ~/linux-5.8.1

```
config - Linux/x86 5.8.1 Kernel Configuration

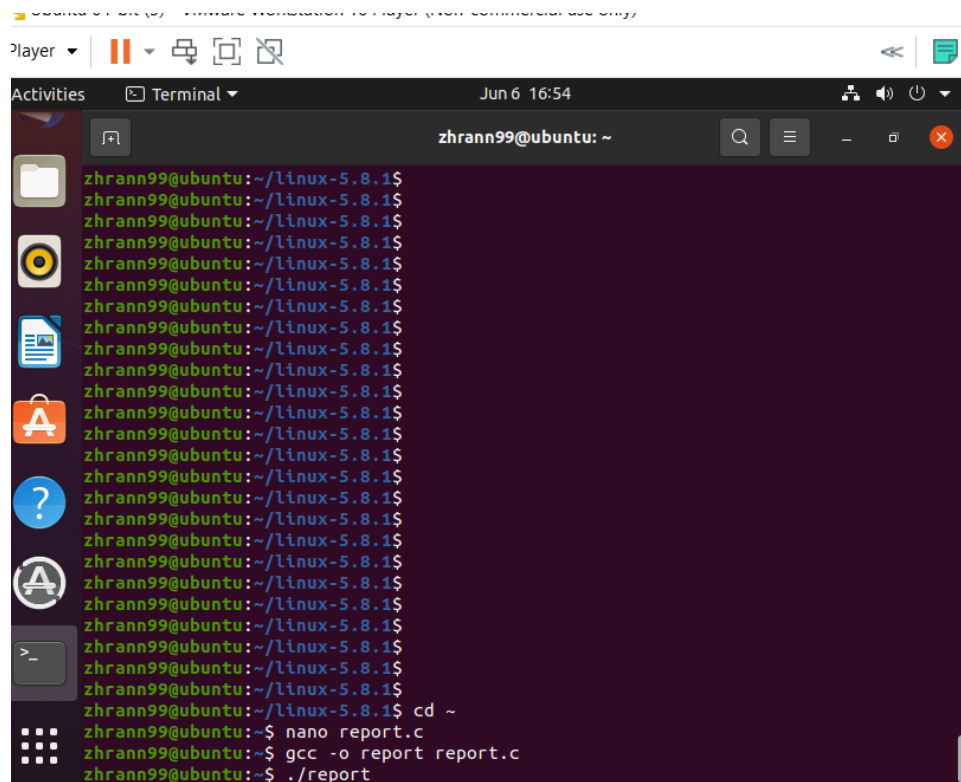
Linux/x86 5.8.1 Kernel Configuration
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
submenu ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ] excluded

[*] General setup --->
  [*] 64-bit kernel
  Processor type and features --->
  Power management and ACPI options --->
  Bus options (PCI etc.) --->
  Binary Emulations --->
  Firmware Drivers --->
  [*] Virtualization --->
  General architecture-dependent options --->
  [*] Enable loadable module support --->
  [*] Enable the block layer --->
  IO Schedulers --->
  Executable file formats --->
  Memory Management options --->
  [*] Networking support --->
  v(+)

<Select> <Exit> <Help> <Save> <Load>
```

We skip some screenshotsfor some commend like

In final - Run the C file you just compiled.



It shoe to me Congratulations, osama Your system call is functional.but I forget to photo screen

Thanks.