

操作系统课程设计 实验报告

姓名：刘天祺

班级：07121502

学号：1320151097

学院：计算机学院

专业：物联网工程

日期：2018 年 3 月 10 日

实验一 编译 Linux 内核

一、实验要求

下载 Linux 内核源码，编译并生成 Linux 内核，将新编译出来的内核更新到自己的 Linux 系统中。

二、实验环境

操作系统：Ubuntu 14.04.5 LTS 64bit

CPU 信息：

```
keep peace in mind.
taqini@q2:~$ lscpu
Architecture:          x86_64
CPU op-mode(s):        32-bit, 64-bit
Byte Order:            Little Endian
CPU(s):                4
On-line CPU(s) list:   0-3
Thread(s) per core:    2
Core(s) per socket:    2
Socket(s):              1
NUMA node(s):          1
Vendor ID:             GenuineIntel
CPU family:             6
Model:                 42
Stepping:              7
CPU MHz:               2108.722
BogoMIPS:              4589.58
Virtualization:        VT-x
L1d cache:             32K
L1i cache:             32K
L2 cache:              256K
L3 cache:              3072K
NUMA node0 CPU(s):    0-3
taqini@q2:~$
```

内存信息：

```
keep peace in mind.
taqini@q2:~$ free -h
               total        used        free      shared    buffers     cached
Mem:           3.8G         1.0G         2.8G         199M          59M          557M
-/+ buffers/cache:  390M         3.4G
Swap:          0B           0B           0B
taqini@q2:~$
```

磁盘情况：

```
keep peace in mind.
taqini@q2:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            1.9G   12K   1.9G   1% /dev
tmpfs           387M   1.3M   385M   1% /run
/dev/sda1       193G   19G   165G  10% /
none            4.0K    0   4.0K   0% /sys/fs/cgroup
none            5.0M    0   5.0M   0% /run/lock
none            1.9G  488K   1.9G   1% /run/shm
none            100M   52K   100M   1% /run/user
/dev/sdb1        29G   27G   2.0G  94% /media/taqini/NSC
/dev/sr0        578K  578K    0 100% /media/taqini/12 17 2017
taqini@q2:~$
```

原内核版本：

```
keep peace in mind.
taqini@q2:~$ uname -r
3.19.0-75-generic
taqini@q2:~$
```

三、实验步骤

1. 下载最新版 linux 内核

```
keep peace in mind.
taqini@q2:~$ wget https://cdn.kernel.org/pub/linux/kernel/v4.x/linux-4.15.7.tar.xz
--2018-03-10 17:11:35-- https://cdn.kernel.org/pub/linux/kernel/v4.x/linux-4.15.7.tar.xz
Resolving cdn.kernel.org (cdn.kernel.org)... 151.101.25.176, 2a04:4e42:6::432
Connecting to cdn.kernel.org (cdn.kernel.org)|151.101.25.176|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 102203424 (97M) [application/x-xz]
Saving to: 'linux-4.15.7.tar.xz'

100%[=====] 102,203,424 3.28MB/s in 39s

2018-03-10 17:12:15 (2.50 MB/s) - 'linux-4.15.7.tar.xz' saved [102203424/102203424]
taqini@q2:~$
```

2. 解压内核文件

```
keep peace in mind.
taqini@q2:~/Desktop$ tar xvf linux-4.15.7.tar.xz
```

```
keep peace in mind.
taqini@q2:~/Desktop$ ls
linux-4.15.7  linux-4.15.7.tar.xz
taqini@q2:~/Desktop$
```

3.安装编译所需的软件

```
$ sudo apt-get -y install git fakeroot build-essential
ncurses-dev xz-utils libssl-dev bc libelf-dev
```

4.配置内核

进入含有内核文件的文件夹，拷贝原内核配置文件以配置内核。

```
keep peace in mind.
root@q2:/home/taqini/Desktop/linux-4.15.7# cp /boot/config-3.19.0-75-generic ./config
root@q2:/home/taqini/Desktop/linux-4.15.7# make menuconfig
```

```
keep peace in mind.
.config - Linux/x86 4.15.7 Kernel Configuration

Linux/x86 4.15.7 Kernel Configuration
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

[*] 64-bit kernel
  General setup --->
  [*] Enable loadable module support --->
  [*] Enable the block layer --->
  Processor type and features --->
  Power management and ACPI options --->
  Bus options (PCI etc.) --->
  Executable file formats / Emulations --->
  [*] Networking support --->
  Device Drivers --->

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

配置完毕，如下图：

```
keep peace in mind.
root@q2:/home/taqini/Desktop/linux-4.15.7# make menuconfig
scripts/kconfig/mconf Kconfig
.config:930:warning: symbol value 'm' invalid for NF_CT_PROTO_DCCP
.config:932:warning: symbol value 'm' invalid for NF_CT_PROTO_SCTP
.config:933:warning: symbol value 'm' invalid for NF_CT_PROTO_UDPLITE
.config:951:warning: symbol value 'm' invalid for NF_NAT_PROTO_DCCP
.config:952:warning: symbol value 'm' invalid for NF_NAT_PROTO_UDPLITE
.config:953:warning: symbol value 'm' invalid for NF_NAT_PROTO_SCTP
.config:1574:warning: symbol value 'm' invalid for RXKAD
.config:2144:warning: symbol value 'm' invalid for SCSI_DH
.config:3440:warning: symbol value 'm' invalid for SERIAL_8250_FINTEK
.config:5625:warning: symbol value 'm' invalid for USB_ISP1760_HCD
configuration written to .config

*** End of the configuration.
*** Execute 'make' to start the build or try 'make help'.

root@q2:/home/taqini/Desktop/linux-4.15.7#
```

5.编译内核

切换用户为 root，并使用 make 命令编译内核，使用-j4 参数加快编译过程，如下图：

```
keep peace in mind.
root@q2:/home/taqini/Desktop/linux-4.15.7# make -j4
scripts/kconfig/conf --silentoldconfig Kconfig
CHK include/config/kernel.release
CHK include/generated/uapi/linux/version.h
DESCEND objtool
CHK include/generated/utsrelease.h
CHK scripts/mod/devicetable-offsets.h
CHK include/generated/bounds.h
CHK include/generated/timeconst.h
CHK include/generated/asm-offsets.h
CALL scripts/checksyscalls.sh
CHK include/generated/compile.h
```

编译过程耗时约两小时。

6.安装内核

使用 `make modules_install` 命令安装模块，如下图：

```
keep peace in mind.
root@q2:/home/taqini/Desktop/linux-4.15.7# make modules_install -j4
INSTALL arch/x86/crypto/aes-x86_64.ko
INSTALL arch/x86/crypto/aesni-intel.ko
INSTALL arch/x86/crypto/blowfish-x86_64.ko
INSTALL arch/x86/crypto/camellia-aesni-avx-x86_64.ko
INSTALL arch/x86/crypto/camellia-aesni-avx2.ko
INSTALL arch/x86/crypto/camellia-x86_64.ko
INSTALL arch/x86/crypto/cast5-avx-x86_64.ko
INSTALL arch/x86/crypto/cast6-avx-x86_64.ko
INSTALL arch/x86/crypto/crc32-pclmul.ko
INSTALL arch/x86/crypto/crct10dif-pclmul.ko
INSTALL arch/x86/crypto/des3_ede-x86_64.ko
INSTALL arch/x86/crypto/ghash-clmulni-intel.ko
INSTALL arch/x86/crypto/glue_helper.ko
INSTALL arch/x86/crypto/salsa20-x86_64.ko
INSTALL arch/x86/crypto/serpent-avx-x86_64.ko
INSTALL arch/x86/crypto/serpent-avx2.ko
INSTALL arch/x86/crypto/serpent-sse2-x86_64.ko
INSTALL arch/x86/crypto/sha1-mb/sha1-mb.ko
```

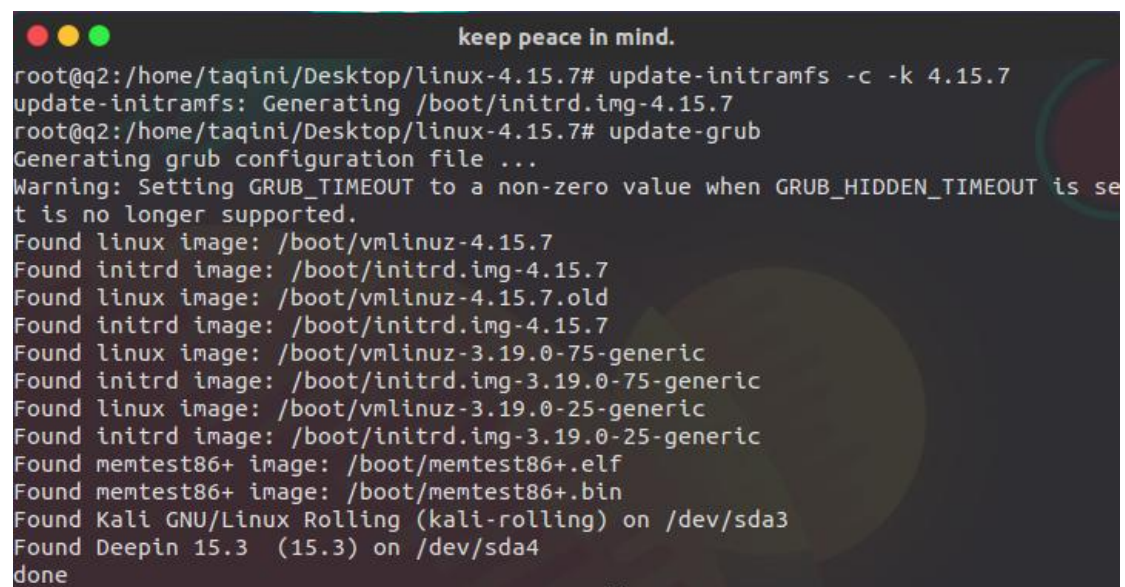
使用 `make install` 命令安装内核，如下图：

```
keep peace in mind.
root@q2:/home/taqini/Desktop/linux-4.15.7# make install -j4
sh ./arch/x86/boot/install.sh 4.15.7 arch/x86/boot/bzImage \
    System.map "/boot"
run-parts: executing /etc/kernel/postinst.d/apt-auto-removal 4.15.7 /boot/vmlinuz-4.15.7
run-parts: executing /etc/kernel/postinst.d/initramfs-tools 4.15.7 /boot/vmlinuz-4.15.7
update-initramfs: Generating /boot/initrd.img-4.15.7
run-parts: executing /etc/kernel/postinst.d/pm-utils 4.15.7 /boot/vmlinuz-4.15.7
run-parts: executing /etc/kernel/postinst.d/update-notifier 4.15.7 /boot/vmlinuz-4.15.7
run-parts: executing /etc/kernel/postinst.d/zz-update-grub 4.15.7 /boot/vmlinuz-4.15.7
Generating grub configuration file ...
Warning: Setting GRUB_TIMEOUT to a non-zero value when GRUB_HIDDEN_TIMEOUT is set is no longer supported.
Found linux image: /boot/vmlinuz-4.15.7
Found initrd image: /boot/initrd.img-4.15.7
Found linux image: /boot/vmlinuz-4.15.7.old
Found initrd image: /boot/initrd.img-4.15.7
Found linux image: /boot/vmlinuz-3.19.0-75-generic
Found initrd image: /boot/initrd.img-3.19.0-75-generic
Found linux image: /boot/vmlinuz-3.19.0-25-generic
Found initrd image: /boot/initrd.img-3.19.0-25-generic
```

7. 替换内核

make install 命令中所执行的脚本已经完成该操作，以防万一，手动替换内核。

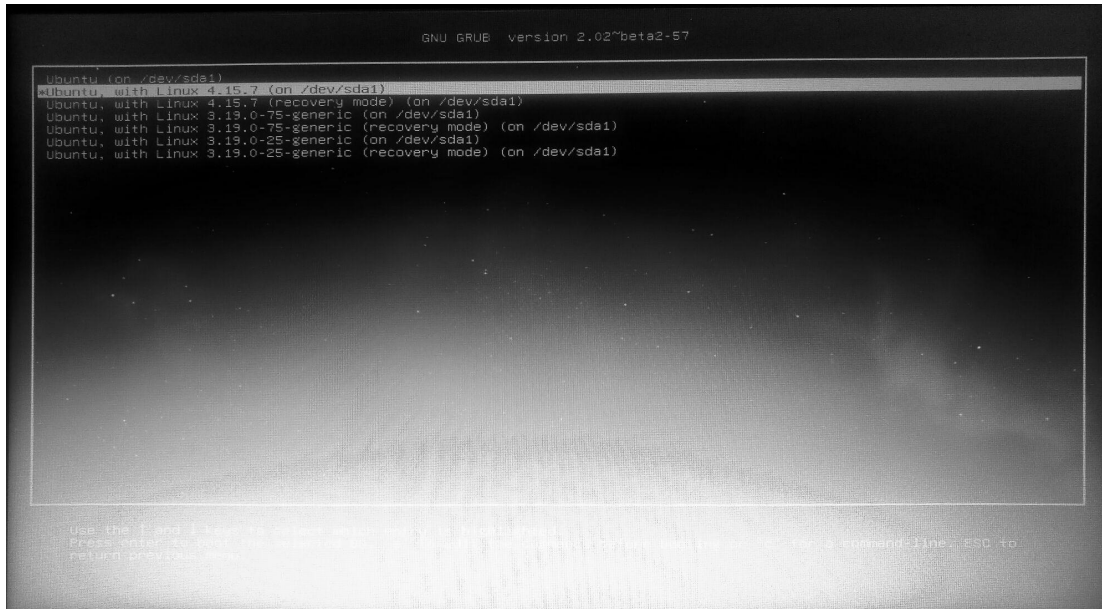
使用 update-initramfs 命令，创建新的 initramfs，并指定其版本为新内核版本，随后更新 grub 引导，如下图：

A terminal window with a dark background and light-colored text. The window title is "keep peace in mind." The terminal shows the following commands and output:

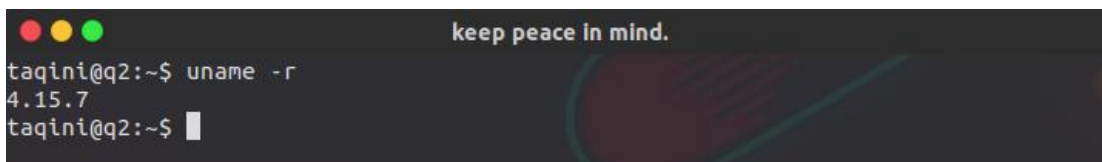
```
root@q2:/home/taqini/Desktop/linux-4.15.7# update-initramfs -c -k 4.15.7
update-initramfs: Generating /boot/initrd.img-4.15.7
root@q2:/home/taqini/Desktop/linux-4.15.7# update-grub
Generating grub configuration file ...
Warning: Setting GRUB_TIMEOUT to a non-zero value when GRUB_HIDDEN_TIMEOUT is set is no longer supported.
Found linux image: /boot/vmlinuz-4.15.7
Found initrd image: /boot/initrd.img-4.15.7
Found linux image: /boot/vmlinuz-4.15.7.old
Found initrd image: /boot/initrd.img-4.15.7
Found linux image: /boot/vmlinuz-3.19.0-75-generic
Found initrd image: /boot/initrd.img-3.19.0-75-generic
Found linux image: /boot/vmlinuz-3.19.0-25-generic
Found initrd image: /boot/initrd.img-3.19.0-25-generic
Found memtest86+ image: /boot/memtest86+.elf
Found memtest86+ image: /boot/memtest86+.bin
Found Kali GNU/Linux Rolling (kali-rolling) on /dev/sda3
Found Deepin 15.3 (15.3) on /dev/sda4
done
```

四、实验结果

开机进入 grub 引导，可选项中出现新安装的内核版本，如图：



选择新版本内核进入操作系统后，查看内核版本，结果如图：



内核版本已经由原先的 3.19.0 替换为 4.15.7。

五、实验总结

该实验较为简单，但是细节方面需要注意，例如编译 4.15.7 版本内核的过程中，会产生大量的中间文件，所以应有足够大的磁盘空间以保证编译正常进行。

从安全方面考虑，当内核漏洞出现时，手动更新内核很有必要。