OpenEuler kdump

Links

开源软件供应链点亮计划-开源之夏2024 (summer-ospp.ac.cn)
Documentation for Kdump - The kexec-based Crash Dumping Solution — The Linux Kernel documentation

Require Outcomes

- 1. 为 openeuler riscv 提供完善的 kdump 支持
- 2. 功能稳定，不影响系统稳定，不会对其他架构产生影响

Project current bg

openEuler 中的 kexec-tools 包含：

1. 自上游kexec-tools工具，
2. kdump相关的用户态工具、服务配置。如makedumpfile，kdumpctrl等。

其中，makedumpfile 在上游 v1.7.4 版本已经合入riscv架构支持，kexec-tools工具的riscv支持仍未合入。经观察，其他主流发行版也都没有完整可用的riscv kdump相关工具包提供。需要以相对成熟的x86/arm64架构为参考标准，分析缺少的主要功能和存在的问题，在 riscv 架构下提供相应的实现。

(2) 已有的工作

目前 kexec-tools 工具通过合并来自上游社区贡献者的补丁以及升级 makedumpfile 版本，已经可以实现系统崩溃时启动kdump内核，并且抓取 vmcore 文件。

(3) 存在的不足

1. 加载 kdump 内核时，使用 initrd/initramfs 时加载失败
2. kexec_file_load 方式加载失败

(4) 希望改进的点

分析失败原因，参考x86/arm64架构的支持范围，提供 riscv 相应的 kdump 支持

(5) 最终项目实现的目标

为 openEuler riscv 提供完善的 kdump 支持，代码合入上游 kexec-tools 社区或 opeEuler kexec-tools 仓库

Riscv OpenEuler qemu links

How to Build a RISC-V-based openEuler System, Deploy runc, and Run Containers

*The default user name and password for the login are **root** and **openEuler12#$**, respectively.*

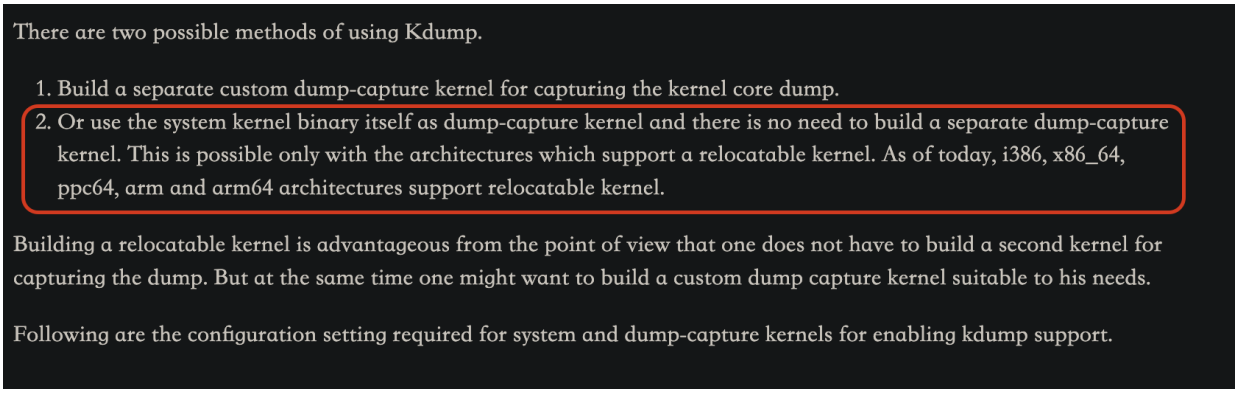
config_relocatable - kernelconfig.io

Kexec - ArchWiki (archlinux.org)

Documentation for Kdump - The kexec-based Crash Dumping Solution — The Linux Kernel documentation

Some useful info

- kdump need config_relocatable or custom dump-capture kernel



- makedumpfile

- 单纯fancy一点的cp，把kerneldump file从`/proc/vmcore`复制出来的时候可以有一些额外的筛选功能，属于是toolchain里的东西

Warm up!

- perform system crash

Linux Magic System Request Key Hacks

Documentation for sysrq.c

What is the magic SysRq key?

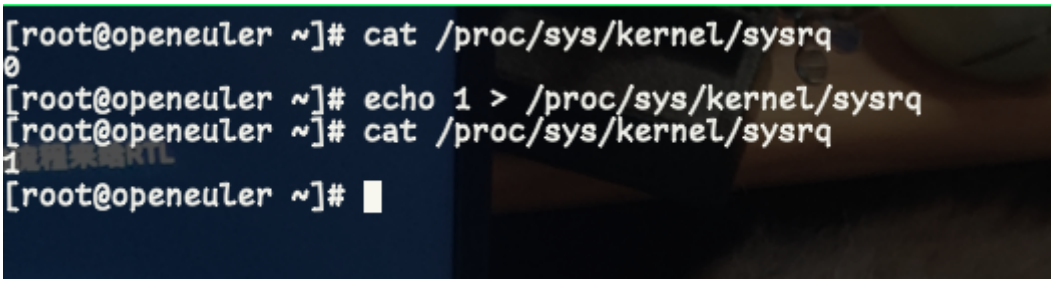
It is a 'magical' key combo you can hit which the kernel will respond to regardless of whatever else it is doing, unless it is completely locked up.

How do I enable the magic SysRq key?

You need to say "yes" to 'Magic SysRq key (CONFIG_MAGIC_SYSRQ)' when configuring the kernel. When running a kernel with SysRq compiled in, /proc/sys/kernel/sysrq controls the functions allowed to be invoked via the SysRq key. The default value in this file is set by the CONFIG_MAGIC_SYSRQ_DEFAULT_ENABLE config symbol, which itself defaults to 1. Here is the list of possible values in /proc/sys/kernel/sysrq:

- 0 - disable sysrq completely
- 1 - enable all functions of sysrq
- >1 - bitmask of allowed sysrq functions (see below for detailed function description):

```
  2 =   0x2 - enable control of console logging level
  4 =   0x4 - enable control of keyboard (SAK, unraw)
  8 =   0x8 - enable debugging dumps of processes etc.
 16 =  0x10 - enable sync command
 32 =  0x20 - enable remount read-only
 64 =  0x40 - enable signalling of processes (term, kill, oom-kill)
128 =  0x80 - allow reboot/poweroff
256 = 0x100 - allow nicing of all RT tasks
```

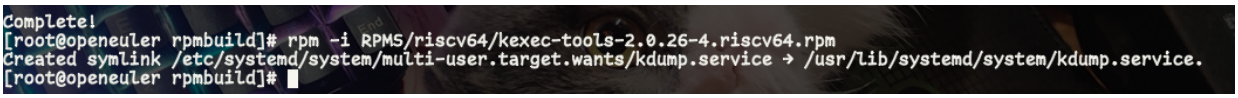


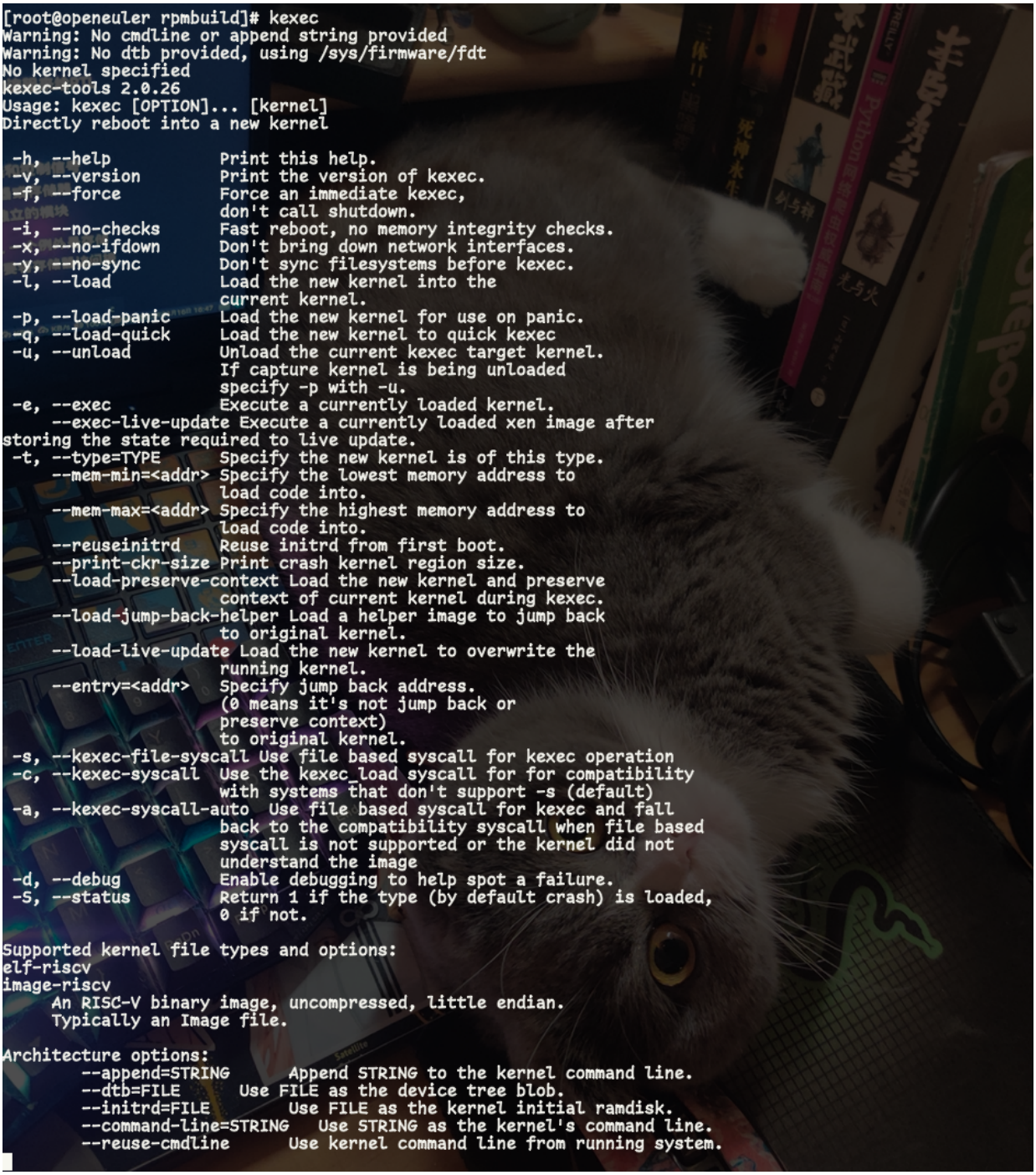
What are the 'command' keys?

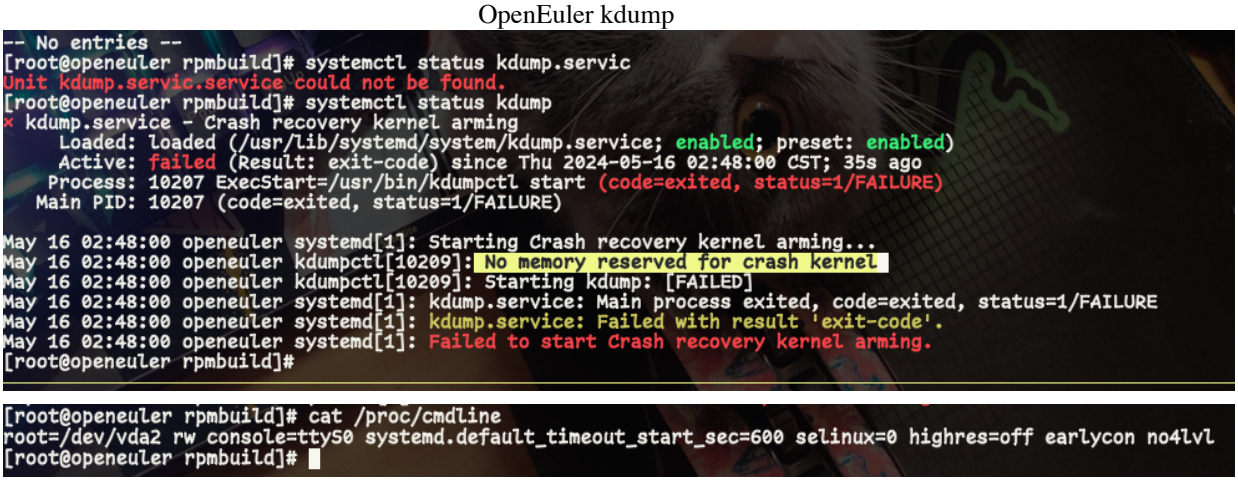
Command	Function
b	Will immediately reboot the system without syncing or unmounting your disks.
c	Will perform a system crash by a NULL pointer dereference. A crashdump will be taken if configured.

- build rpm package

- install



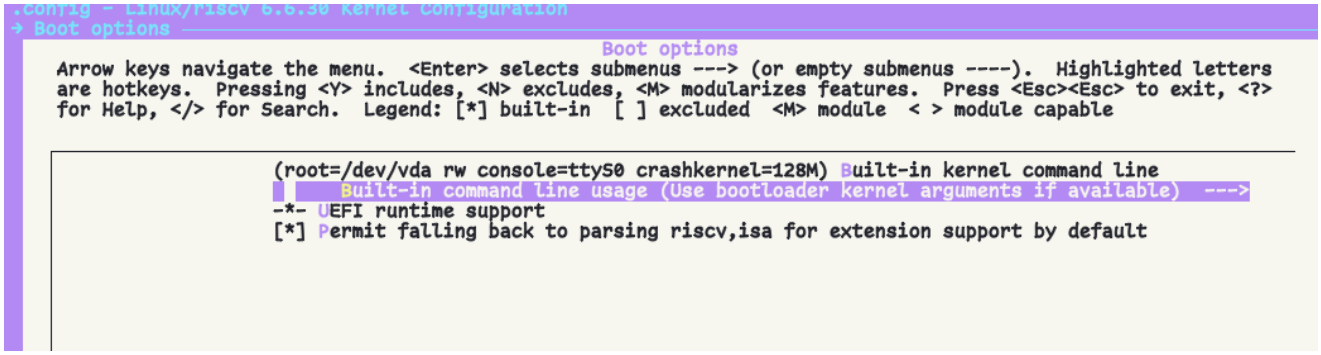


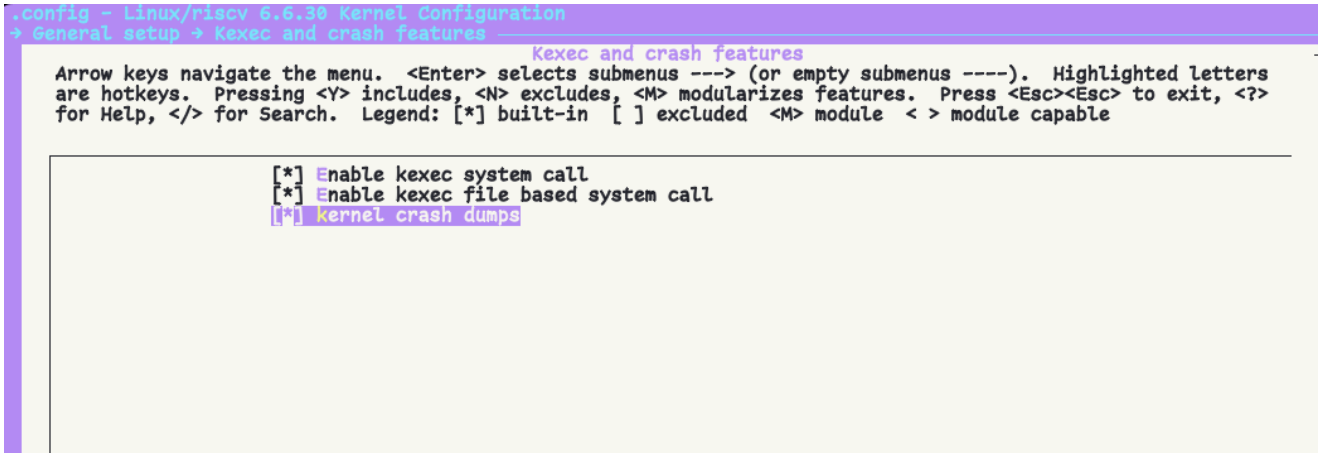


官方手册里是包含下一级boot的二进制内容的bios，-append没用，加不了crashdump command line option

rv openeuler repo:
https://mirror.iscas.ac.cn/openeuler-sig-riscv/openEuler-RISC-V/preview/openEuler-23.09-V1-riscv64/repo/23.09/EPOL/main/riscv64/

编译6.6.30版本内核，手动加上command line option，qemu直接引导内核





```
cmd="qemu-system-riscv64 \
  -nographic -machine virt \
  -smp "$vcpu" -m "$memory"G \
  -kernel "Image" \
  -drive file=openeulerfs,format=raw,id=hd0 \
  -object rng-random,filename=/dev/urandom,id=rng0 \
  -device virtio-gpu \
  -device virtio-rng-device,rng=rng0 \
  -device virtio-blk-device,drive=hd0 \
  -device virtio-net-device,netdev=usernet \
  -netdev user,id=usernet,hostfwd=tcp::"$ssh_port"-:22 \
  -device qemu-xhci -usb -device usb-kbd -device usb-tablet"
```

```
[  OK  ] Started Network Manager Script Dispatcher Service.
[  OK  ] Finished Network Manager Wait Online.
[  OK  ] Reached target Network is Online.

openEuler 23.03
Kernel 6.6.30 on an riscv64

openeuler-riscv64 login:
```

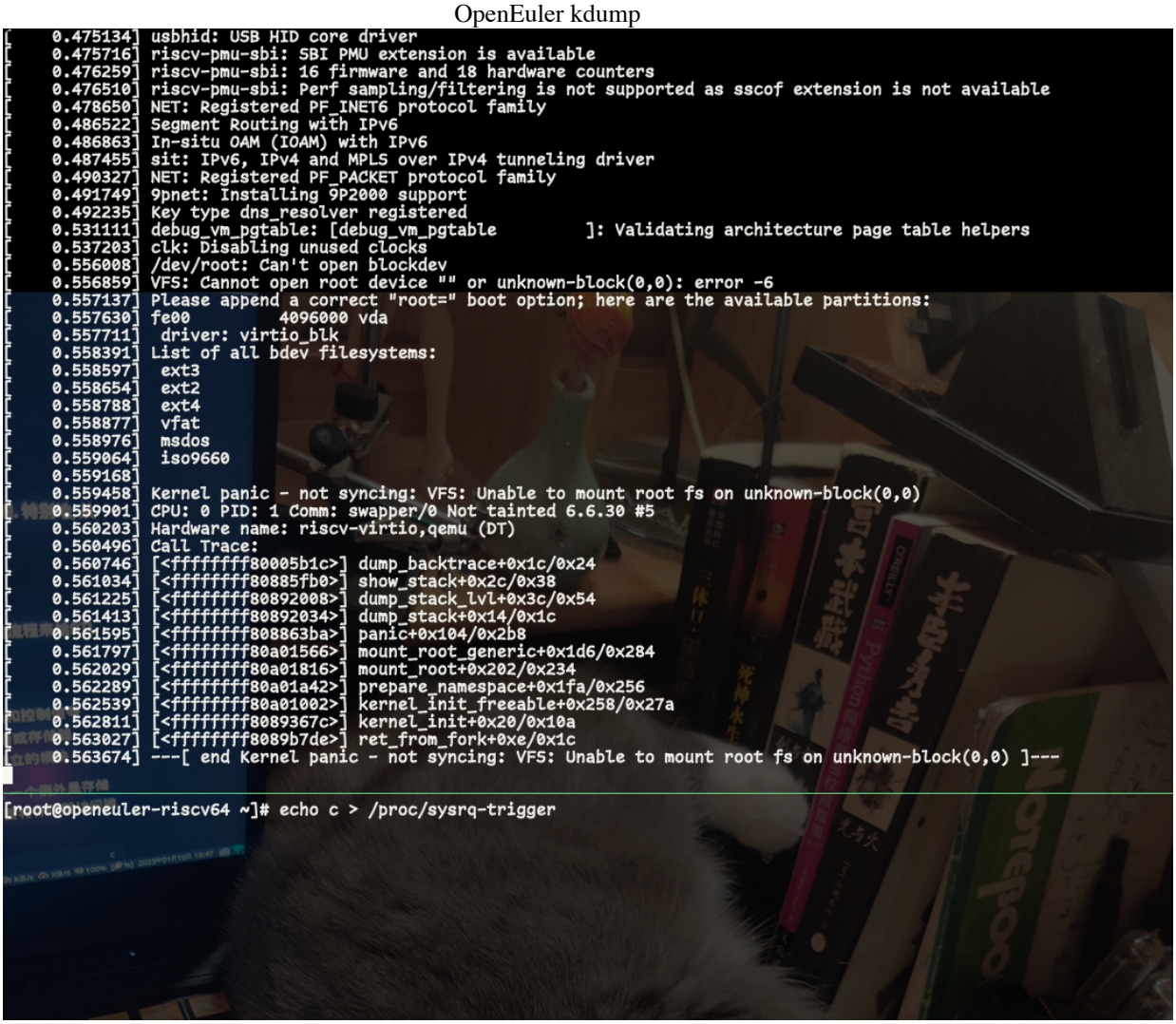
- 编译openeuler kexec-tools 的rpm包，开kdump

```
[root@openeuler-riscv64 ~]# systemctl restart kdump
[root@openeuler-riscv64 ~]# mv /boot/Image.gz /boot/vmlinuz-6.6.30^C
[root@openeuler-riscv64 ~]# systemctl status kdump
● kdump.service - Crash recovery kernel arming
     Loaded: loaded (/usr/lib/systemd/system/kdump.service; enabled; vendor preset: enabled)
     Active: active (exited) since Thu 2024-05-16 23:06:11 CST; 11s ago
    Process: 427 ExecStart=/usr/bin/kdumpctl start (code=exited, status=0/SUCCESS)
   Main PID: 427 (code=exited, status=0/SUCCESS)

May 16 23:06:01 openeuler-riscv64 dracut[694]: No dracut internal kernel commandline stored in the initramfs
May 16 23:06:02 openeuler-riscv64 dracut[694]: *** Stripping files ***
May 16 23:06:02 openeuler-riscv64 dracut[694]: *** Stripping files done ***
May 16 23:06:02 openeuler-riscv64 dracut[694]: *** Creating image file '/boot/initramfs-6.6.30kdump.img' ***
May 16 23:06:02 openeuler-riscv64 dracut[694]: Using auto-determined compression method 'pigz'
May 16 23:06:08 openeuler-riscv64 dracut[694]: *** Creating initramfs image file '/boot/initramfs-6.6.30kdump.img' done>
May 16 23:06:10 openeuler-riscv64 kdumpctl[2875]: Warning: No dtb provided, using /sys/firmware/fdt
May 16 23:06:11 openeuler-riscv64 kdumpctl[429]: kexec: loaded kdump kernel
May 16 23:06:11 openeuler-riscv64 kdumpctl[429]: Starting kdump: [OK]
May 16 23:06:11 openeuler-riscv64 systemd[1]: Finished Crash recovery kernel arming.
lines 1-16/16 (END)
```

- enable sysrq key

```
.config - Linux/riscv 6.6.30 Kernel Configuration
→ Kernel hacking → Generic Kernel Debugging Instruments
                    Generic Kernel Debugging Instruments
  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  [ ] excluded  <M> module  < > module capable

                  [*] Magic SysRq key
                  (0x1) Enable magic SysRq key functions by default
                  [*]   Enable magic SysRq key over serial
                  ()      Char sequence that enables magic SysRq over serial
                  [*] Debug Filesystem
                        Debugfs default access (Access normal)  --->
                  [ ] KGDB: kernel debugger  ----
                  [ ] Undefined behaviour sanity checker  ----
```

- trigger kernel crash, but kernel panic while loading crash kernel


[0.475134] usbhid: USB HID core driver
[0.475716] riscv-pmu-sbi: SBI PMU extension is available
[0.476259] riscv-pmu-sbi: 16 firmware and 18 hardware counters
[0.476510] riscv-pmu-sbi: Perf sampling/filtering is not supported as sscof extension is not available
[0.478650] NET: Registered PF_INET6 protocol family
[0.486522] Segment Routing with IPv6
[0.486863] In-situ OAM (IOAM) with IPv6
[0.487455] sit: IPv6, IPv4 and MPLS over IPv4 tunneling driver
[0.490327] NET: Registered PF_PACKET protocol family
[0.491749] 9pnet: Installing 9P2000 support
[0.492235] Key type dns_resolver registered
[0.531111] debug_vm_pgtable: [debug_vm_pgtable]: Validating architecture page table helpers
[0.537203] clk: Disabling unused clocks
[0.556008] /dev/root: Can't open blockdev
[0.556859] VFS: Cannot open root device "" or unknown-block(0,0): error -6
[0.557137] Please append a correct "root=" boot option; here are the available partitions:
[0.557630] fe00 4096000 vda
[0.557711] driver: virtio_blk
[0.558391] List of all bdev filesystems:
[0.558597] ext3
[0.558654] ext2
[0.558788] ext4
[0.558877] vfat
[0.558976] msdos
[0.559064] iso9660
[0.559168]
[0.559458] Kernel panic - not syncing: VFS: Unable to mount root fs on unknown-block(0,0)
[0.559901] CPU: 0 PID: 1 Comm: swapper/0 Not tainted 6.6.30 #5
[0.560203] Hardware name: riscv-virtio,qemu (DT)
[0.560496] Call Trace:
[0.560746] [<ffffffff80005b1c>] dump_backtrace+0x1c/0x24
[0.561034] [<ffffffff80885fb0>] show_stack+0x2c/0x38
[0.561225] [<ffffffff80892008>] dump_stack_lvl+0x3c/0x54
[0.561413] [<ffffffff80892034>] dump_stack+0x14/0x1c
[0.561595] [<ffffffff808863ba>] panic+0x104/0x2b8
[0.561797] [<ffffffff80a01566>] mount_root_generic+0x1d6/0x284
[0.562029] [<ffffffff80a01816>] mount_root+0x202/0x234
[0.562289] [<ffffffff80a01a42>] prepare_namespace+0x1fa/0x256
[0.562539] [<ffffffff80a01002>] kernel_init_freeable+0x258/0x27a
[0.562811] [<ffffffff8089367c>] kernel_init+0x20/0x10a
[0.563027] [<ffffffff8089b7de>] ret_from_fork+0xe/0x1c
[0.563674] ---[end Kernel panic - not syncing: VFS: Unable to mount root fs on unknown-block(0,0)]---
[root@openeuler-riscv64 ~]# echo c > /proc/sysrq-trigger