Status Updates for Clonezilla on ARM and RISC-V Architectures

Steven Shiau, Ceasar Sun, Thomas Tsai

clonezilla.org

Mar 2025

Outline

- Introduction to Clonezilla
- ARM & RISC-V Architectures
- Progress about Clonezilla Live for ARM & RISC-V
- Comparative Analysis
- Future Outlook
- Q&A

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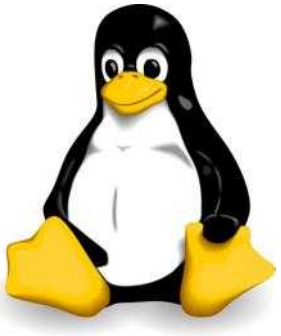
System imaging and cloning - backup

image source: maggiesfarm.anotherdotcom.com
www.compsults.com, and jervisdabreo.com

Massive system deployment

What is Clonezilla?

- A partition and disk imaging/cloning utility similar to True image® or Ghost®
- GPL license
- A bare metal recovery tool for


*1


*2

*3


*4

VMFS

VMware ESX/ESXi

*5


*6

*Logo source: (1) Larry Ewing, Simon Budig and Anja Gerwinski, (2) Apple ,(3) Microsoft, (4) Marshall Kirk McKusick, (5) VMWare (6) Distrowatch.com

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ARM & RISC-V Architectures

- ARM-Advanced RISC Machines, originally Acorn RISC Machine
  - Proprietary. Introduced in 1985
  - 32-bit & 64-bit
  - Arm Holdings develops the ISAs (instruction set architectures) and licenses them
  - Vendors: Apple, MediaTek, NVIDIA, Qualcomm, Samsung…
  - Linux kernel support ARM64/AArch64 from V3.7 in 2012
- RISC-V
  - Open Source (Creative Commons or BSD). Introduced in 2014
  - 32-bit, 64-bit & 128-bit
  - U. C.Berkeley -> RISC-V Foundation -> RISC-V International
  - Vendors: SiFive, Andes, Ventana…
  - Linux kernel support from V5.17 in 2022. Debian Supports riscv64 in 2023.

Images source: wikipedia.org

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Clonezilla Live for ARM & RISC-V

- Live system based on Debian Linux. Use Live-build from Debian to create it.
  - aarch64 (arm64) from v5.0~a3-1 in 2015
  - riscv64 still needs to be patched
    - https://salsa.debian.org/live-team/live-build/-/merge_requests/383
- Experimental releases are available
  - https://free.nchc.org.tw/clonezilla-live/experimental/

Progress about Clonezilla Live for ARM

- Clonezilla live arm64 release after 2024/10/26 works well with
  - NVIDIA GH200 Grace Hopper, tested OK with clonezilla-live-20241026-oracular-arm64
  - Raspberry Pi 5
- Dirty work needed
  - Apple Mac Mini - M2

Image source: nvidia.com; raspberrypi.com; apple.com

Progress about Clonezilla Live for ARM

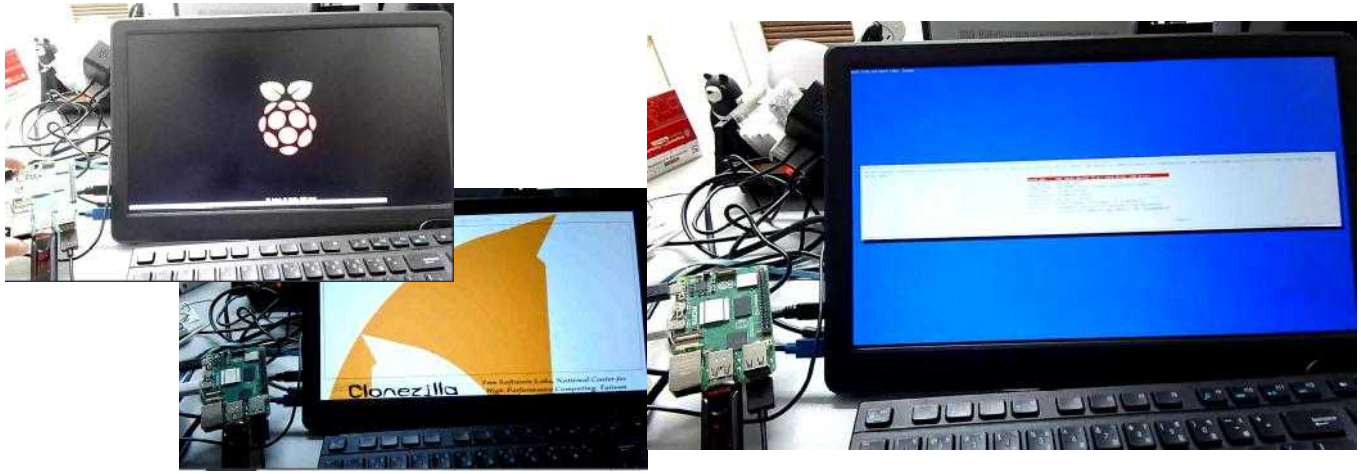
- NVIDIA GH200 Grace Hopper
  - Tested with Clonezilla-live-20241026-oracular-arm64.iso using IMPI (Intelligent Platform Management Interface) to upload iso file
  - Boots just like x86-64 version of Clonezilla live
  - Run smoothly

Image source: nvidia.com; raspberrypi.com; apple.com

```
$ ls -l GH-ubuntu-20241029/
total 4.7G
-rw-r--r-- 1 steven steven 1.5K Oct 29 20:45 blkdev.list
-rw-r--r-- 1 steven steven  603 Oct 29 20:45 blkid.list
-rw-r--r-- 1 steven steven 6.3K Oct 29 20:45 clonezilla-img
-rw-r--r-- 1 steven steven  189 Oct 29 20:42 dev-fs.list
-rw-r--r-- 1 steven steven    8 Oct 29 20:45 disk
-rw-r--r-- 1 steven steven 7.8K Oct 29 20:45 efi-nvram.dat
-rw-r--r-- 1 steven steven  14K Oct 29 20:45 Info-dmi.txt
-rw-r--r-- 1 steven steven  236 Oct 29 20:45 Info-img-id.txt
-rw-r--r-- 1 steven steven   59 Oct 29 20:45 Info-img-size.txt
-rw-r--r-- 1 steven steven  30K Oct 29 20:45 Info-lshw.txt
-rw-r--r-- 1 steven steven 2.2K Oct 29 20:45 Info-lspci.txt
-rw-r--r-- 1 steven steven 2.2K Oct 29 20:45 Info-OS-prober.txt
-rw-r--r-- 1 steven steven  214 Oct 29 20:45 Info-packages.txt
-rw-r--r-- 1 steven steven  102 Oct 29 20:45 Info-saved-by-cmd.txt
-rw-r--r-- 1 steven steven 2.9K Oct 29 20:45 Info-smart.txt
-rw-r--r-- 1 steven steven   37 Oct 29 20:45 nvme0n1-chs.sf
-rw-r--r-- 1 steven steven  17K Oct 29 20:45 nvme0n1-gpt-1st
-rw-r--r-- 1 steven steven  16K Oct 29 20:45 nvme0n1-gpt-2nd
-rw-r--r-- 1 steven steven  18K Oct 29 20:45 nvme0n1-gpt.gdisk
-rw-r--r-- 1 steven steven  642 Oct 29 20:45 nvme0n1-gpt.sgdisk
-rw-r--r-- 1 steven steven  512 Oct 29 20:45 nvme0n1-mbr
-rw------- 1 steven steven 2.1M Oct 29 20:42 nvme0n1p1.vfat-ptcl-img.zst
-rw------- 1 steven steven 4.7G Oct 29 20:45 nvme0n1p2.ext4-ptcl-img.zst
-rw-r--r-- 1 steven steven  342 Oct 29 20:45 nvme0n1-pt.parted
-rw-r--r-- 1 steven steven  294 Oct 29 20:45 nvme0n1-pt.parted.compact
-rw-r--r-- 1 steven steven  428 Oct 29 20:45 nvme0n1-pt.sf
```

Progress about Clonezilla Live for ARM

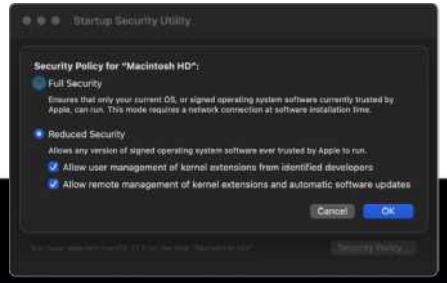
- Raspberry Pi 5
  - sudo rpi-eeprom-config --edit
  - BOOT_ORDER=0xf14
  - Try USB first, followed by SD then repeat
  - download rpi5-uefi and unzip to your USB drive's root directory with clonezilla live for ARM



Ref: https://blog.libthomas.org/article/raspberry-pi-5-clonezilla-boot-from-usb

Progress about Clonezilla Live for ARM

- Apple Mac mini - M2
  - Based on M1-debian and Asahi Linux Project
  - Install UEFI environment only (m1n1 + U-Boot + ESP) by Asahi Linux Installer
  - Use the Asahi linux kernel in clonezilla live
    - Download clonezilla live ARM image
    - Download Asahi linux kernel from m1-debian project repository
    - Remaster clonezilla live arm image by ocs-live-swap-kernel command
      - ocs-live-swap-kernel clonezilla-live-x.x.x-arm64.zip linux-image-6.5.0-asahi-xxx_arm64.deb
    - Set Reduced Security
    - The detail steps here:
      - https://blog.libthomas.org/article/apple-m2-clonezilla




1. Asahi U-boot + ESP

2. U-boot Load EFI

3. Clonezilla Boot Menu


4. Clonezilla Live Menu

Notes: Only works for Type-C Port

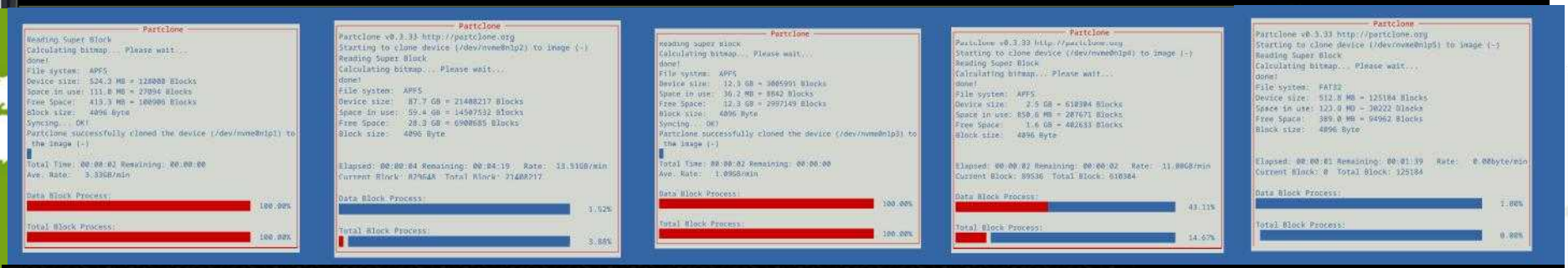
Clonezilla - Opensource Clone System (OCS) | Mode: savedisk

Choose local disk as source.
The disk name is the device name in GNU/Linux. The first disk in the system is "hda" or "sda", the 2nd disk is "hdb" or "sdb"... If multiple choices are available, press space key to mark your selection. An asterisk (*) will be shown when the selection is done

```
[*] nvme0n1  251GB|APPLE_SSD_AP0256Z_|platform-27bcc0000_nvme-nvme-1||0ba02063a0b4a829
[*] nvme0n2  3146kB|APPLE_SSD_AP0256Z_|platform-27bcc0000_nvme-nvme-2||0ba02063a0b4a829
[*] nvme0n3  134MB|APPLE_SSD_AP0256Z_|platform-27bcc0000_nvme-nvme-3||0ba02063a0b4a829
```

<Ok> <Cancel>

```
**************************************************.
The following step is to save the hard disk/partition(s) on this machine as an image:
**************************************************.
Machine: Unknown product name
nvme0n1 (251GB|APPLE_SSD_AP0256Z_|platform-27bcc0000_nvme-nvme-1||0ba02063a0b4a829)
nvme0n1p1 (500M|apfs(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
nvme0n1p2 (81.7G|apfs(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
nvme0n1p3 (11.5G|apfs(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
nvme0n1p4 (2.3G|apfs(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
nvme0n1p5 (489M|vfat|EFI_-_DEBIA(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
nvme0n1p6 (15.8G|ext4(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
nvme0n1p7 (5G|apfs(In_APPLE_SSD_AP0256Z_)|platform-27bcc0000_nvme-nvme-1|0ba02063a0b4a829)
**************************************************.
-> "/home/partimag/2025-03-06-02-img-disk".
Are you sure you want to continue? (y/n)
```



```
**************************************************.
**************************************************.
This image was saved successfully: 2025-03-06-02-img-disk
End of savedisk job for image 2025-03-06-02-img-disk.
Saving hardware info by lshw...
```

Progress about Clonezilla Live for RISC-V

- Clonezilla live riscv64 release after 2024Q4
- Current status :
  - Works well with emulator (QEMU)
  - Trying to adapt to real machine
    - DC-ROMA RISC-V LAPTOP II
    - Still cooking

Image source: store.deepcomputing.io

Demo Clonezilla Live RISC-V @ QEMU

- Version : 3.2.1-9 (Download)
- Related tools : opensbi、 u-boot-qemu 、 guestfs-tools
- Repack as a Clonezilla raw image by guestfs-tools
  - $ virt-make-fs --verbose --partition=gpt --type=vfat imagebuild/ clonezilla-rv64.img
- Startup in Qemu RISCV64 Emulator
  - $ qemu-system-riscv64 -nographic -smp cpus=4 -machine virt -m 4.0G \

```
-bios /usr/lib/riscv64-linux-gnu/opensbi/generic/fw_jump.elf \
-kernel /usr/lib/u-boot/qemu-riscv64_smode/uboot.elf \
-object rng-random,filename=/dev/urandom,id=rng0 -device virtio-rng-device,rng=rng0 \
-append "console=ttyS0 rw root=/dev/vda1" \
-drive file=clonezilla-r.img,format=raw,if=virtio \
-device virtio-net-device,netdev=usernet -netdev user,id=usernet,hostfwd=tcp::22222-:22
```

Screenshot of OCS RISC-V @ QEMU

load OpenSBI

```
OpenSBI v1.1

Platform Name             : riscv-virtio,qemu
Platform Features         : medeleg
Platform HART Count       : 4
Platform IPI Device       : aclint-mswi
Platform Timer Device     : aclint-mtimer @ 10000000Hz
Platform Console Device   : uart8250
Platform HSM Device       : ---
Platform Reboot Device    : sifive_test
Platform Shutdown Device  : sifive_test
Firmware Base             : 0x80000000
Firmware Size             : 312 KB
Runtime SBI Version       : 1.0

Domain0 Name              : root
Domain0 Boot HART         : 0
Domain0 HARTs             : 0*,1*,2*,3*
Domain0 Region00          : 0x0000000002000000-0x000000000200ffff (I)
Domain0 Region01          : 0x0000000080000000-0x0000000008007ffff ()
Domain0 Region02          : 0x0000000000000000-0xffffffffffffffff (R,W,X)
Domain0 Next Address      : 0x0000000080200000
Domain0 Next Arg1         : 0x0000000082200000
Domain0 Next Mode         : S-mode
Domain0 SysReset          : yes

Boot HART ID              : 0
Boot HART Domain          : root
Boot HART Priv Version    : v1.12
Boot HART Base ISA        : rv64imafdch
Boot HART ISA Extensions  : time,sstc
Boot HART PMP Count       : 16
Boot HART PMP Granularity : 4
Boot HART PMP Address Bits: 54
Boot HART MHPM Count      : 16
Boot HART MIDELEG         : 0x0000000000001666
Boot HART MEDELEG         : 0x0000000000f0b509
```

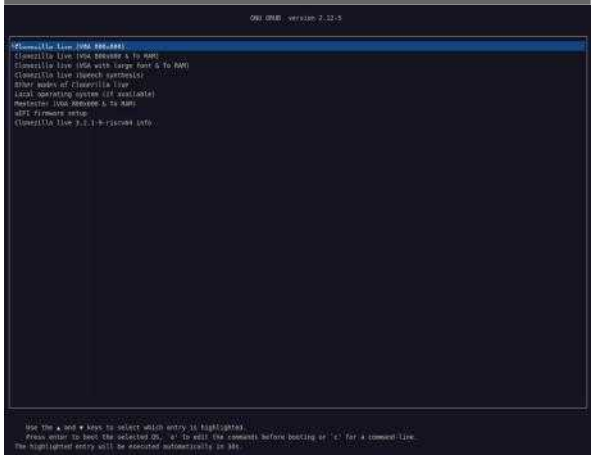
load U-boot ⇒ uEFI

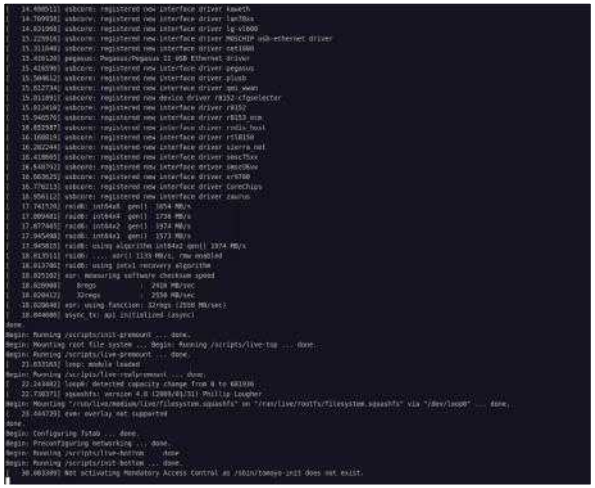
```
U-Boot 2022.01+dfsg-2ubuntu2.6 (Aug 30 2024 - 03:32:40 +0000)

CPU:   rv64imafdcsu
Model: riscv-virtio,qemu
DRAM:  6 GiB
Flash: 32 MiB
Loading Environment from nowhere... OK
In:    uart@10000000
Out:   uart@10000000
Err:   uart@10000000
Net:   eth0: virtio-net#1
Hit any key to stop autoboot:  0

Device 0: 1af4 VirtIO Block Device
          Type: Hard Disk
          Capacity: 463.5 MB = 0.4 GB (949357 x 512)
... is now current device
Scanning virtio 0:1...
** Unable to read file / **
Failed to load '/'
libfdt fdt_check_header(): FDT_ERR_BADMAGIC
Scanning disk virtio-blk#9...
Scanning disk virtio-blk#10
```

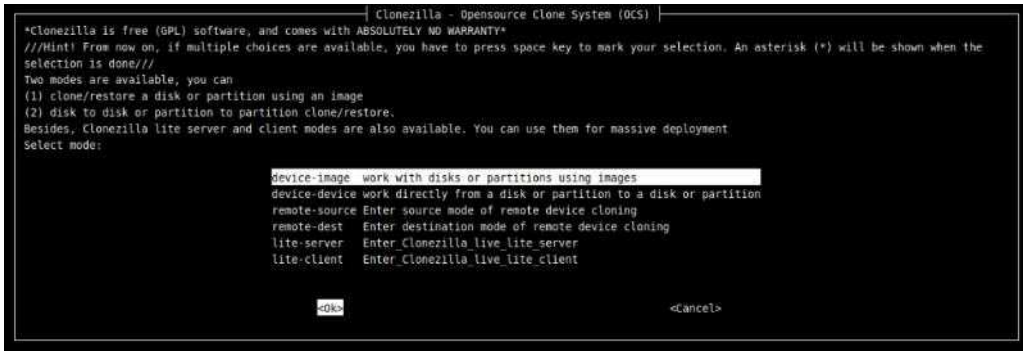
load GRMU Menu ⇒ start-up





Screenshot of OCS RISC-V @ QEMU (Continued)

Run OCS Main Procedure

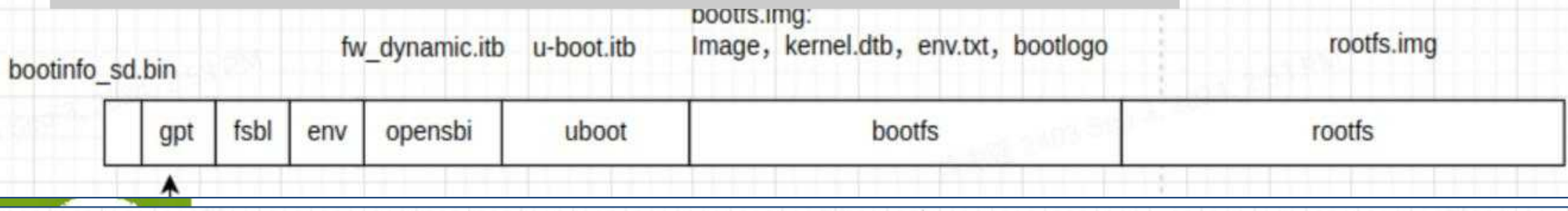


Clonezilla Live RISC-V @ Hardware

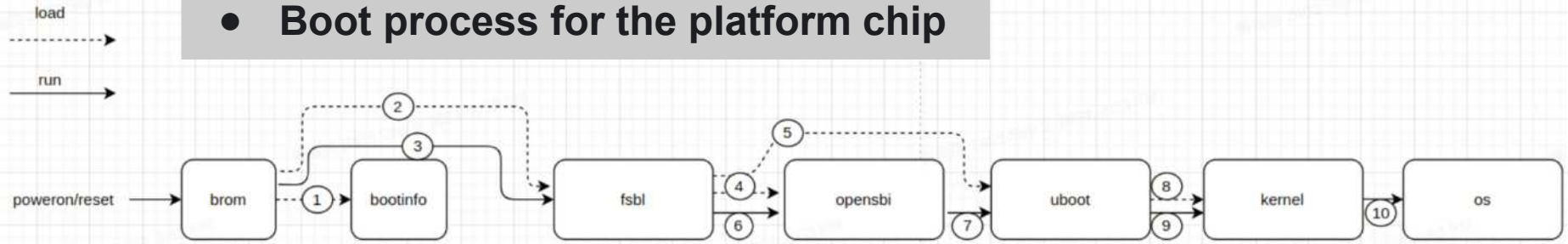
- Hardware : DC-ROMA RISC-V LAPTOP II
  - Octa-core RISC-V CPU : RISCV64 8-core CPU
  - SpacemiT K1 SoC
- Clonezilla Version : 3.2.1-9 (Download)
- Related tools/projects :
  - DC-ROMA_Gen2_LAPTOP_K1_RV-L2A
  - Bianbu Linux
  - u-boot、 opensbi (actually to use : Bianbu@gitee)
- We tried 2 booting progress to be solution :
  - W1 : u-boot → uEFI → GRUB Menu→ Boot-up
  - W2 : u-boot → direct to load kernel/initrd → Boot-up

Quick Introduction of K1 SoC Boot Procedure

- **Firmware layouts for the K1 series SoC of SD Card**



- **Boot process for the platform chip**



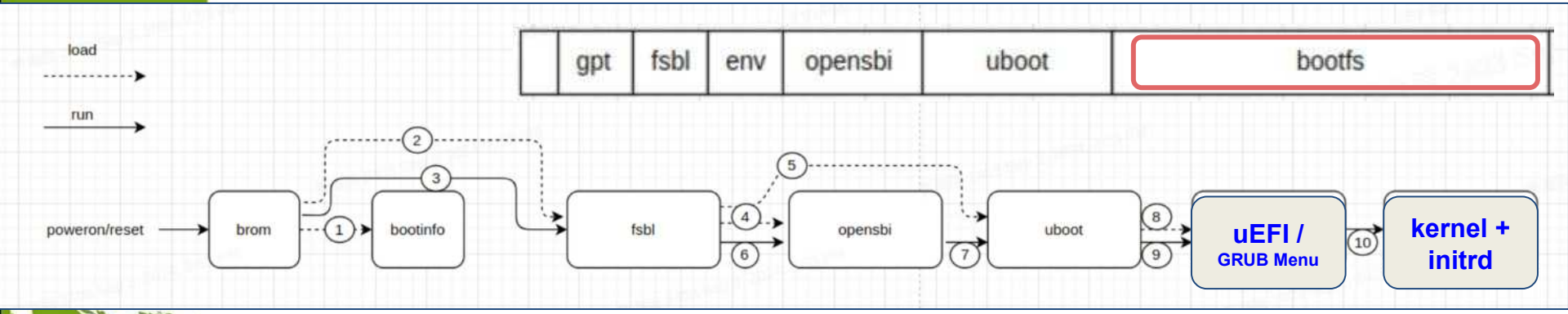
- We have to consider :
  - Rebuild u-boot / opensbi (base on : Bianbu@gitee)
  - Configure u-boot procedure to be more flexible

Reference: https://bianbu-linux.spacemit.com/en/device/boot/

Hardware :

W1 : u-boot → uEFI → GRUB Menu→ Boot-up

- Modify boot process

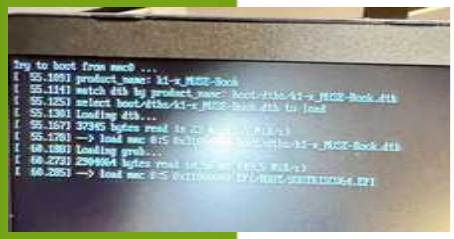


a. Rebuild u-boot / opensbi →
   - Enable uEFI related options / u-boot bootmean (*p4)
   - Enhance u-boot script (*p2) : to allow assign parameters to u-boot by configure file (plain text)
   - Use fw_dynamic.its as opensbi firmware (*p3)
     - fw_dynamic.its 、 fw_jump.bin 、 fw_payload.bin
   - Replace partition data (*p4, *p2, *p3) by dd

b. Adjust bootfs partition for EFI booting flag
   - EFI boot flag / Convert to VFAT

c. Unpack Clonezilla ZIP into bootfs

Screenshot



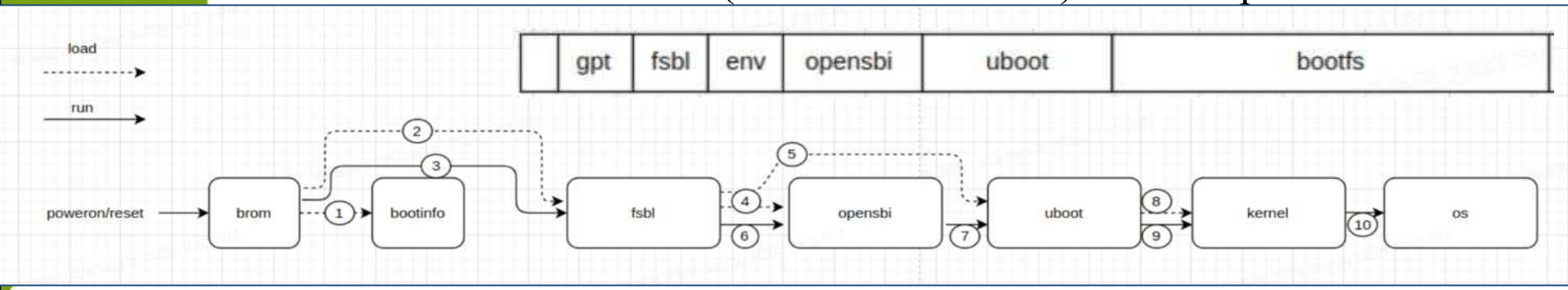
- Full record video
  - https://youtu.be/oS_XrUQVTjc

- Issue:
  - System panic at initrd run-time stage
  - /proc , /sys ,..etc can't be mounted in initrd

Hardware :

W2 : u-boot →kernel+initrd→ Boot-up

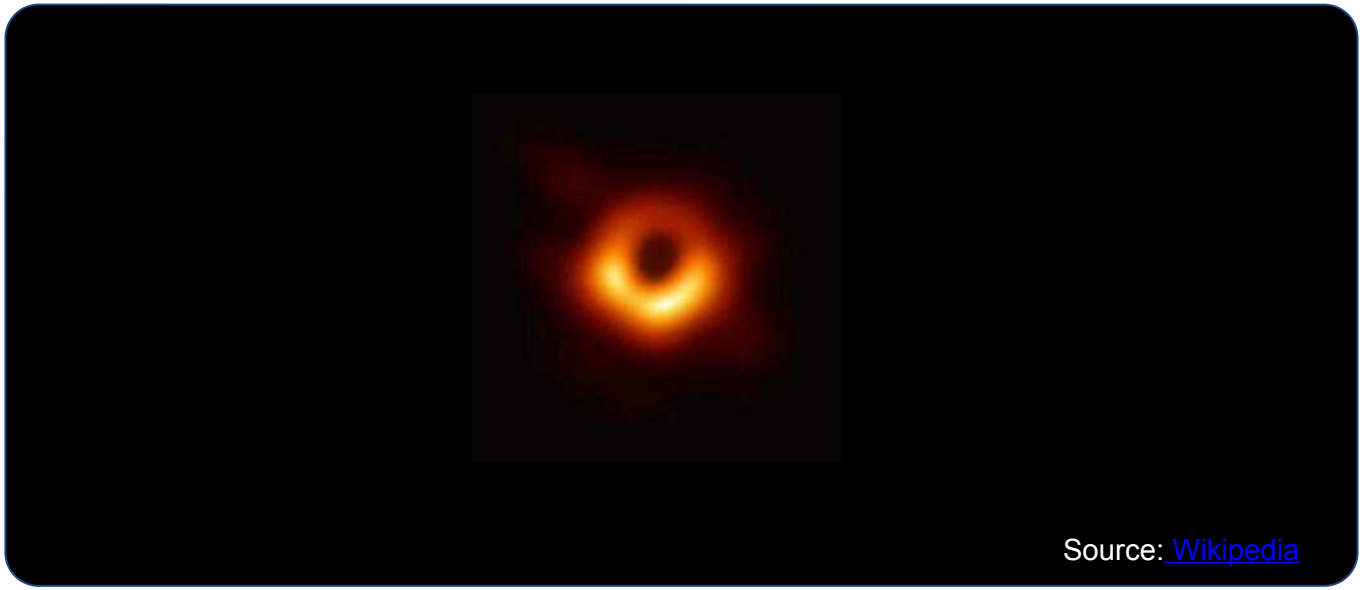
- Use u-boot → bootm (load kernel+initrd) → bootup



a. Based on Bianbu linux Project
b. Use the Bianbu linux kernel in clonezilla live
   - download clonezilla live RISC-V 64 image
   - download Spacemit-k1 linux kernel from repository
   - remaster clonezilla live image by ocs-live-swap-kernel command

c. Replace kernel / initrd / boot parameters

Screenshot



- Issue:
  - Black screen , even to break to initrd
  - Have to find a way to debug …
  - Console issue ?

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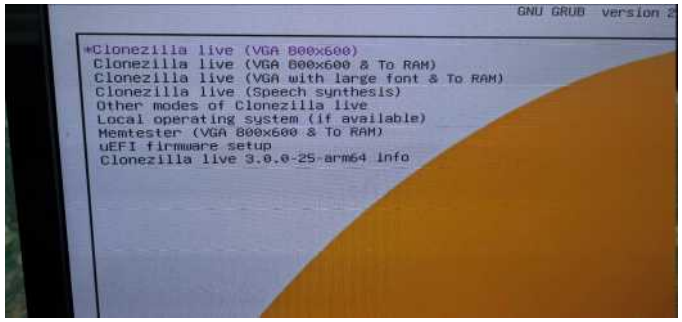
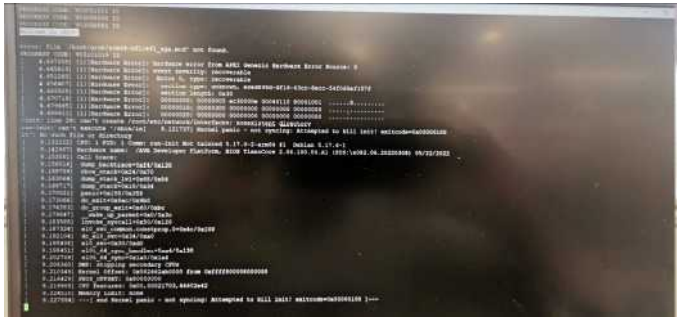
Comparative Analysis

- Clonezilla live ARM64 arch
  - More mature than RISC-V arch since live-build and Debian has supported it for more than 10 years
  - More diverse than x86-64 arch. Some system lacks uEFI boot mechanism. Others have its own mechanism, so you have to do some dirty work and might break your system (yes, like ARM-based Mac)
  - Some users have reported they can use Clonezilla live to deploy ARM64 systems, e.g., a Taiwanese company that designs and manufactures products for embedded computing:





Comparative Analysis

- Clonezilla live RISCV64 arch
  - Still in early stage
  - Emulator works well but it still lacks drivers from Debian for physical machine…
  - Customized Linux kernel might be necessary
  - Debian/Ubuntu supports RISC-V boards
    - SiFive HiFive Unleashed, Allwinner Nezha, and StarFive VisionFive…
  - Desktop and server running RISC-V are not so common as ARM64 or X86-64. Use cases for Debian/Ubuntu, hence Clonezilla live, are less



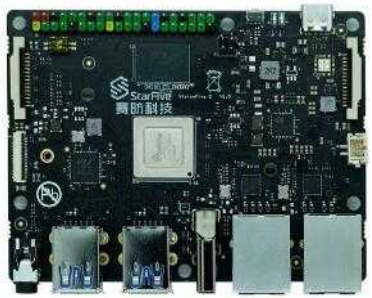


Image source: crowdsupply.com; linux-sunxi.org; starfivetech.com

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Future Outlook

- Improvements and enhancements
  - Along with the underlying OS: Debian Linux
  - Massive deployment for ARM64/RISCV64
- The rise of ARM64 and RISCV-64
  - Cost/access: RISC-V's openness lowers hardware costs , making it viable for budget-strapped schools. ARM64's maturity ensures affordable options like Raspberry Pi 4/5
  - Power efficiency: low power—ARM64 in datacenters, RISC-V in edge

Workshop

Friday, 14th March

2:35 PM (+07)

Status Updates for Clonezilla on ARM and RISC-V Architectures

12

Talk 25 min

Steven Shiau
Clonezilla project leader, Clonezilla.org

Yuchin Tsai (Thomas Tsai)
Principal Engineer, NCHC NARLABS

Chenkai Sun (Ceasar Sun)
Developer and associate researcher in Free Software Lab, NCHC

Operating System
Training Room 2
14 Mar, 2025 2:35 PM (+07)

3:25 PM (+07)

Clonezilla Hands-On: 60 Minutes of Cloning Action

12

Workshop 55 min

Yuchin Tsai (Thomas Tsai)
Principal Engineer, NCHC NARLABS

Chenkai Sun (Ceasar Sun)
Developer and associate researcher in Free Software Lab, NCHC

Steven Shiau
Clonezilla project leader, Clonezilla.org

Operating System
Training Room 2
14 Mar, 2025 3:25 PM (+07)

Questions ?

Great!

?????