Linux Distro on RISC-V

Linux Distro in practice

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Sep 18th 2020, RISC-V Day 2020 Vietnam
AGENDA

- Distro: What is Linux Distro
- Status: Linux Distro on RISC-V
- Practice: Try Linux Distro on QEMU user-mode
Part I

What is Linux Distro
Linux is everywhere
All the top supercomputers run Linux

"Every single supercomputer—at least every one that broke the speed barrier and made it into the top 500 list—is running Linux. Every one. 100% market share of the current fastest computers the world has ever seen."

RHEL -- 20
CentOS -- 132

Info Source:
https://www.linuxjournal.com/content/linux-and-supercomputers
https://www.top500.org/
A Linux distribution is usually built around a package (RPM, DEB, IPK) management system, which puts together the Linux kernel, free and open-source software, and occasionally some proprietary software.
Part II

Linux Distro on RISC-V
The Status of Fedora on RISC-V

Fedora
Bootable: Yes, OpenSBI + U-Boot on QEMU and Hardware package management: dnf + rpm
Build system: Koji
Status: In maintenance, Fedora 33/Rawhide

Repositories
https://dl.fedoraproject.org/pub/alt/risc-v/
https://mirror.math.princeton.edu/pub/alt/risc-v/
https://isrc.iscas.ac.cn/mirror/fedora-riscv/
Koji Build System for Fedora

Koji builds RPMs for the Fedora Project and EPEL.

3 HiFive Unleashed

One of them connects with SSD.

160+ QEMU VMs (on x86_64)

fedora-riscv-x.gcc1xx.osuosl.org

managed by libvirt

(will add more by adding more servers)

An x86_64 server for all central infrastructure

Main server, repository creation and VMs with backup (separate NVMe).

We are working on a Koji server in China, we call it "oe pkg".
The Status of Linux Distro on RISC-V

### Debian
- Bootable: Yes, BBL on QEMU and Hardware
- Package management: apt + deb
- Build system: buildd
- Status: In maintenance, need more packages

### Slackware
- Bootable: No, chroot for Fedora Image
- Package management: slackpkg+pkgtools
- Status: under development

Info Source:
- Slackware: https://github.com/fede2cr/slackware_riscv
- Debian: https://wiki.debian.org/RISC-V
- https://riscv.org/exchange/software/
The Status of Linux Distro on RISC-V

**Gentoo**
- Bootable: No, need to build OpenSBI and U-boot manually
- Package management: emerge + portage
- Build system: portage
- Status: under development

**Arch-Linux**
- Bootable: No, only boot from qemu user-mode
- Package management: pacman + bsdtar
- Build system: Arch Build System(ABS), but currently using devtools (systemd-nspawn)
- Status: under development, waiting for a good firmware

**Info Source:**
Gentoo: https://github.com/dian17
Arch: Felix Yan
The Status of Embedded Linux on RISC-V

OpenWRT
Buildroot
Yocto/OpenEmbedded

Bootable: yes, BBL or U-boot, and package management: builddtime or Opkg
Build system: Cross-compilation
Status: In maintenance

Info Source:
https://riscv.org/exchange/software/
The Status of RISC-V Firmware

U-boot
The upstream u-boot can boot Fedora image, works WELL.

OpenSBI + U-Boot + Linux
For now, it has become a standard boot flow for Fedora on RISC-V

GRUB2
The RISC-V support has been merged, the rpm package is built in Koji, and it is already available in Fedora. But we still miss the EFI support in kernel.
The good progress of RISC-V Firmware

2018, HPE engineers have made Tianocore successfully boot on SiFive Freedom U500 VC707 FPGA Dev Kit with OpenSBI integrated in edk2 RISC-V port.

HPE is also working on standardizing firmware spec:
- **SMBIOS** 3.3.0 with new record type (type 44)
- **CIM** with RISC-V processor definitions
- **UEFI** spec

HPE has upstreamed most of patches, EDK2 support is almost ready.
For Now, EDK2 with edk2-platform(+ OpenSBI) can run on QEMU( >V4.1.5, -machine sifive_u -cpu sifive-u54 ) and **Real Hardware SiFive Unleashed.**
Linux distribution on RISC-V

We would like to support more targets based on standard RISC-V Spec.

From www.codasip.com
Part III

Try Linux on QEMU user-mode
Install qemu-user-static packages

“sudo dnf install qemu-user-static”

But please install the latest version of them by

“sudo dnf copr enable @virtmaint-sig/virt-preview”

Build QEMU from source code

The upstream QEMU has supported most of latest RISC-V spec:

```
#we need *--static*
./configure --target-list=riscv64-linux-user \
--disable-werror --disable-glusterfs \
--disable-tools --disable-capstone --disable-tools \
--static
```

Enable binfmts
(Tested on F31/F32)
Enable binfmts
(Tested on F31/F32)

systemd-binfmt.service has been included in systemd package

```
sudo systemctl start systemd-binfmt.service
```

Start systemd-binfmt Service

Verify binfmt support status

```
ls /proc/sys/fs/binfmt_misc/
```

#The binfmt of RISC-V 64 is ready, if qemu-riscv64 is listed.
Prepare Linux Distro rootfs(dir) (Fedora, for example)

Get Fedora Image for RISC-V
1. fedoraproject website
2. Koji for RISC-V
Please download the latest Fedora-Developer-Rawhide Image

Extract or Mount on a dir

guestfish -a $FEDORA_IMAGE run : download /dev/sda2
$FEDORA_IMAGE_ROOTFS
mkdir Fedora_rootfs
sudo mount -o loop ./FEDORA_IMAGE_ROOTFS ./Fedora_rootfs
Try systemd-nspawn for RISC-V

Try QEMU user mode by `systemd-nspawn`

```
RV64_ROOTFS=Fedora_rootfs
sudo systemd-nspawn -bD ${RV64_ROOTFS}
```

For `-b` option

For some distro, the `systemd` package is still masked, and the OpenRC cannot finish the boot flow in LXC, so we cannot use `-b` option currently.
Acknowledgments

Abner Chang
Gilbert Chen

Al Stone
Andrea Bolognani
DJ Delorie
John Feeney
Richard Jones
Yang Liu

David Abdurachmanov

Alistair Francis
Anup Patel
Atish Kumar Patra

Felix Yan
Mikael Frykholm
Stefan O'Rear
Yixun Lan

... and countless other individuals and companies, who have contributed to RISC-V specifications and software eco-system!
Thank you

Red Hat is the world’s leading provider of enterprise open source software solutions. Award-winning support, training, and consulting services make Red Hat a trusted adviser to the Fortune 500.