# Open Source Software and RISC-V

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# RISC-V

- Started at UC Berkeley in 2010
  - Open Instruction Set Architecture
  - Frozen base user specification released in May 2014
- Four base integer ISAs
  - RV32E, RV32I, RV64I, RV128I
- 64-bit variant makes it way more interesting
  - Linux-based 64-bit devices
  - High performance computing
- Real ASIC Implementations available
  - SiFive "Freedom U540" SoC (quad-core RV64GC) / "HiFive Unleashed"
    - 4x U54 RV64GC Application Cores
    - 8GB 64-Bit DDR4 with ECC
    - Gigabit Ethernet Port

# RISC-V: Software

- Binutils: upstreamed (2.28 is the first release with RISC-V support)
- GCC: upstreamed (7.1 is the first release with RISC-V support)
- GLIBC: upstreamed (2.27 is the first release with RISC-V support)
- Linux Kernel: upstreamed (arch code in 4.15; 4.19 most drivers for "virt")
- Gdb: not upstreamed yet, WIP
- QEMU: upstreamed (2.12 is the first release with RISC-V support)
- Major distributions bootstrap already in progress
  - Debian: https://wiki.debian.org/RISC-V
  - Fedora: https://fedoraproject.org/wiki/Architectures/RISC-V
  - OE / Yocto: https://github.com/riscv/meta-riscv

```
sh-3.2$ qemu-system-riscv64 -machine virt -smp 2 -m 512 -serial mon:stdio -serial null -kernel bbl -append 'root=/dev/vda rw console=ttyS0' --dri
ve file=lmp-mini-image-qemuriscv64.otaimg,format=raw,id=hd0 -device virtio-blk-device,drive=hd0 -device virtio-net-device,netdev=usernet -netdev
user,id=usernet,hostfwd=tcp::22222-:22 -nographic
bbl loader
             vvvvvvvvvvvvvvvvvvvvvvvvvvvvvv
                vvvvvvvvvvvvvvvvvvvvvvvvvvvv
rrrrrrrrrrrrr       vvvvvvvvvvvvvvvvvvvvvvvv
rrrrrrrrrrrrrrrr      vvvvvvvvvvvvvvvvvvvvvv
rrrrrrrrrrrrrrrrr     vvvvvvvvvvvvvvvvvvvvvv
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       INSTRUCTION SETS WANT TO BE FREE
[    0.000000] OF: fdt: Ignoring memory range 0x80000000 - 0x80200000
[    0.000000] Linux version 4.16.18 (oe-user@oe-host) (gcc version 8.2.0 (GCC)) #1 SMP Wed Aug 22 18:04:18 UTC 2018
[    0.000000] bootconsole [early0] enabled
[    0.000000] Initial ramdisk at: 0x       (ptrval) (6971904 bytes)
[    0.000000] Zone ranges:
[    0.000000]   DMA32    [mem 0x0000000080200000-0x000000009fffffff]
[    0.000000]   Normal   [mem 0x00000000a0000000-0x000009ffffffffff]
```

```
[    3.755978] This architecture does not have kernel memory protection.
starting version 239
[   19.202730] EXT4-fs (vda): recovery complete
[   19.208157] EXT4-fs (vda): mounted filesystem with ordered data mode. Opts: (null)
Resolved OSTree target to: /rootfs/ostree/deploy/lmp/deploy/7e44882d2f75874556560cd73d57cdd727bfe13b0906e9a08d665883a2f4feb3.0
[   21.638781] systemd[1]: System time before build time, advancing clock.
[   21.990920] systemd[1]: systemd 239 running in system mode. (+PAM -AUDIT -SELINUX +IMA -APPARMOR +SMACK +SYSVINIT +UTMP -LIBCRYPTSETUP -GCRYPT
 -GNUTLS +ACL +XZ -LZ4 -SECCOMP +BLKID -ELFUTILS +KMOD +IDN2 -IDN -PCRE2 default-hierarchy=hybrid)
[   21.995649] systemd[1]: Detected architecture riscv64.

Welcome to Linux-microPlatform 2.5-417!

[   22.359161] systemd[1]: Set hostname to <qemuriscv64>.
[   23.969317] random: fast init done
[   32.201211] systemd[1]: Unnecessary job for /sys/devices/platform/10000000.uart/tty/ttyS0 was removed.
[   32.203834] systemd[1]: Unnecessary job for /sys/devices/virtual/tty/hvc0 was removed.
[   32.326262] random: systemd: uninitialized urandom read (16 bytes read)
[   32.329923] systemd[1]: Reached target Swap.
[  OK  ] Reached target Swap.
[   32.344724] random: systemd: uninitialized urandom read (16 bytes read)
[   32.385280] systemd[1]: Listening on udev Kernel Socket.
[  OK  ] Listening on udev Kernel Socket.
[   32.485012] random: systemd: uninitialized urandom read (16 bytes read)
[   32.510882] systemd[1]: Listening on initctl Compatibility Named Pipe.
[  OK  ] Listening on initctl Compatibility Named Pipe.
[   32.526628] systemd[1]: Reached target Remote File Systems.
[  OK  ] Reached target Remote File Systems.
[   32.688151] systemd[1]: Created slice system-getty.slice.
[  OK  ] Created slice system-getty.slice.
[   32.726970] systemd[1]: Created slice system-serial\x2dgetty.slice.
[  OK  ] Created slice system-serial\x2dgetty.slice.
[   32.890008] systemd[1]: Listening on udev Control Socket.
[  OK  ] Listening on udev Control Socket.
[   32.899608] systemd[1]: Listening on Network Service Netlink Socket.
```

# RISC-V: A lot more to be done

- Finalize and upstream ports for Clang, Golang, OpenJDK
- Bootloader for generic distro support (e.g. UEFI)
  - CoreBoot in early stages
  - TianoCore port exists, but not yet upstream
- Latest Software Status
  - https://riscv.org/software-status/
  - Huge opportunity to have fun working on a new architecture while doing Open Source!
- Get involved!
  - Work in progress ports: https://github.com/riscv
  - sw-dev@groups.riscv.org: Software discussion ML
  - linux-riscv@lists.infradead.org: RISC-V linux port
  - FreeNode: #riscv

# Thank You!

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