Agenda

• Introduction
• RISC-V support in Gentoo
• RISC-V support in other Linux distributions and mainstream applications
About

• Embedded Linux development and integration
• Open source contributions
  • Gentoo Linux
Introduction
- Open source ISA specification
- Stable (base and standard extensions are frozen)
- Modular design with extensions
- Led by RISC-V Foundation
**RISC-V ISA**

- **Base ISA:**
  - RV32I, RV32E: 32-bit
  - RV64I: 64-bit
  - RV128I: 128-bit

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV32I</td>
<td>Base Integer Instructions, 32 bit</td>
</tr>
<tr>
<td>RV32E</td>
<td>Base Integer Instructions, 32 bit, embedded</td>
</tr>
<tr>
<td>RV64I</td>
<td>Base Integer Instructions, 64 bit</td>
</tr>
<tr>
<td>RV128I</td>
<td>Base Integer Instructions, 128 bit</td>
</tr>
<tr>
<td>Q</td>
<td>Standard Extension Quad-precision Floating Point</td>
</tr>
<tr>
<td>L</td>
<td>Standard Extension Decimal Floating Point</td>
</tr>
<tr>
<td>C</td>
<td>Standard Extension Compressed Instructions</td>
</tr>
<tr>
<td>B</td>
<td>Standard Extension Bit Manipulation</td>
</tr>
<tr>
<td>M</td>
<td>Standard Extension Integer Multiply and Divide</td>
</tr>
<tr>
<td>A</td>
<td>Standard Extension Atomic Instructions</td>
</tr>
<tr>
<td>F</td>
<td>Standard Extension Single-precision Floating Point</td>
</tr>
<tr>
<td>D</td>
<td>Standard Extension Double-precision Floating Point</td>
</tr>
<tr>
<td>J</td>
<td>Standard Extension Dynamically Translated Languages</td>
</tr>
<tr>
<td>T</td>
<td>Standard Extension Transactional Memory</td>
</tr>
<tr>
<td>P</td>
<td>Standard Extension Packed SIMD Operations</td>
</tr>
<tr>
<td>V</td>
<td>Standard Extension Vector Operations</td>
</tr>
<tr>
<td>N</td>
<td>Standard Extension User Level Interrupts</td>
</tr>
</tbody>
</table>
• Extensions:
  • M: integer multiplication and division
  • A: atomic operations
  • F, D, Q: single/double/quad precision floating point
  • G: general purpose ISA, shorthand for IMAFD
  • C: compressed instructions

• Linux distributions target RV64GC
RISC-V support in Gentoo
Gentoo

- Source-based distribution
- Package manager – Portage
- Users build their own systems
- Allows fine-grained system configuration
  - Profiles
  - USE flags
Supported architectures

- Stable: amd64, arm, arm64, hppa, ppc, ppc64, sparc, x86
- Unstable: alpha, ia64, loong, riscv
- Experimental: m68k, mips, s390
RISC-V port

- First working RISC-V profiles created by Andreas K. Hüttel in 2019
- Targets:
  - RV64GC (lp64d)
  - RV64IMAC (lp64)
- Today: 8000 packages (incl. tests), 10 000 packages supported on arm64
Why Gentoo?

- High degree of freedom and flexibility
- Latest software available
- Good platform for developing
  - Cross-compilation workflow using crossdev and QEMU
RISC-V stage archives

- [https://www.gentoo.org/downloads](https://www.gentoo.org/downloads)

<table>
<thead>
<tr>
<th>ABI</th>
<th>init</th>
<th>libc</th>
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<tbody>
<tr>
<td>lp64d</td>
<td>systemd</td>
<td>glibc</td>
</tr>
<tr>
<td>lp64d</td>
<td>systemd (merged-usr)</td>
<td>glibc</td>
</tr>
<tr>
<td>lp64d</td>
<td>openrc</td>
<td>glibc</td>
</tr>
<tr>
<td>lp64d</td>
<td>systemd</td>
<td>musl</td>
</tr>
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RISC-V profiles

Attempted multilib support...

• Two level libdir paths
  • lp64d
    • -march=rv64gc -mabi=lp64d
    • libdir = lib64/lp64d
  • lp64
    • -march=rv64imac -mabi=lp64
    • libdir = lib64/lp64

Problems:

• Partially broken build systems (e.g. CMake)
• Important packages supporting only RV64GC/lp64d (e.g. Rust)
RISC-V 20.0 profile

- make.defaults

```
# Copyright 2019-2021 Gentoo Authors
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# RISC-V rv64gc/lp64d no-multilib profile

CHOST="riscv64-unknown-linux-gnu"

MULTILIB_ABI="lp64d"
DEFAULT_ABI="lp64d"
ABI="lp64d"

LIBDIR_lp64d="lib64"

CFLAGS="-O2 -pipe -march=rv64gc -mabi=lp64d"
CXXFLAGS="$CFLAGS"
FFLAGS="$CFLAGS"
FCFLAGS="$CFLAGS"
```
# Flags for lp64d
LIBDIR_lp64d="lib64/lp64d"
CFLAGS_lp64d="-mabi=lp64d"
LDFLAGS_lp64d="-m elf64lriscv"
HOST_lp64d="riscv64-unknown-linux-gnu"

# Flags for lp64
LIBDIR_lp64="lib64/lp64"
CFLAGS_lp64="-mabi=lp64"
LDFLAGS_lp64="-m elf64lriscv_lp64"
HOST_lp64="riscv64-unknown-linux-gnu"
Repositories

- Main repository
  - https://github.com/gentoo/gentoo
  - 19 000 packages

- RISC-V overlay
  - https://github.com/gentoo/riscv
  - Contains experimental packages (valgrind, qtwebengine, thunderbird)
Calculate binary repository

- Calculate Linux
  - Gentoo-based distribution (backwards compatible)
  - Optimized for fast deployment
- Unofficial repository
  - https://mirror.onfoo.top/calculate/grp/riscv64
  - https://mirror.onfoo.top/images/calculate-unmatched-2022.05.18.rootfs.wic.xz
Future work

- Provide bootable images
- Support RISC-V as a stable architecture
- RV32 support?
  - glibc-2.33 gained RV32 support in 2021
  - Y2038 problem in distros - 14:30 @ Distributions devroom
Supported platforms

- HiFive Unleashed
- HiFive Unmatched
- StarFive BeagleV
- Allwinner NeZha D1
- StarFive VisionFive 1
RISC-V support in other distributions
Debian

- Full RISC-V support
- 95% packages built for RISC-V
- Uses RV64GC as the hardware baseline and the lp64d ABI
- Supported hardware: HiFive Unleashed, HiFive Unmatched, StarFive VisionFive
- Karsten Merker - Porting Debian to RISC-V @FOSDEM 2019
• Final bootstrap in 2018
• Pre-built images for virtual and physical targets
• David Abdurachmanov - Fedora on RISC-V 64-bit @FOSDEM 2019
FreeBSD

- RISC-V port released in January 2016
- First OS to have bootable in-tree support
- Tier-2 architecture
- Supported platforms: Spike, QEMU, BeagleV, HiFive Unmatched, HiFive Unleashed
• OpenSUSE
  • Support for QEMU and physical hardware (HiFive Unmatched)
• Ubuntu
  • Supports RISC-V since 20.04 release
  • Bootable images for HiFive Unmatched, HiFive Unleashed, LicheeRV Dock and StarFive VisionFive
Desktop environments

- GNOME
- KDE
- XFCE
- Mate
- Cinnamon
- LXDE
- LXQT
- Enlightenment
Gentoo in action
dev-python/namespace-lazar
dev-python/pydevd
dev-python/untangle
dev-python/jupyterlab-lsp

Fresh documentation on the Gentoo wiki

BleedingTooth vulnerability
Rust
Fstab/ft
ULO/ta
PKGDIR

started by Whissi
started by DankDumpster
started by Gasmat
started by Kingoflove
started by Maffblaster

AWARD WINNING
MANAGED SERVERS!
DEDICATION
NOW
OSL
OPEN SOURCE LAB

DEDICATED SERVERS
COLD RENTAL
CDN
Mainstream applications

- Firefox
- OpenJDK
- Chromium
- Libreoffice
- Nodejs
Ongoing ports

- Luajit - https://github.com/LuaJIT/LuaJIT/issues/628
- Valgrind - https://github.com/petrpavlu/valgrind-riscv64
- Mono
Questions, suggestions?

- https://wiki.gentoo.org/wiki/Project:RISC-V
- riscv@gentoo.org
- jsmolic@gentoo.org
- #gentoo-riscv on libera.chat