

Brussels, FOSDEM 2023

# How to package eBPF software

presented on Gentoo Linux

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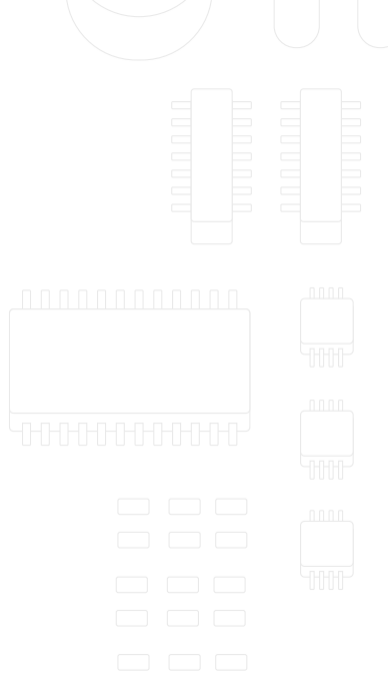


February 5th, 2023



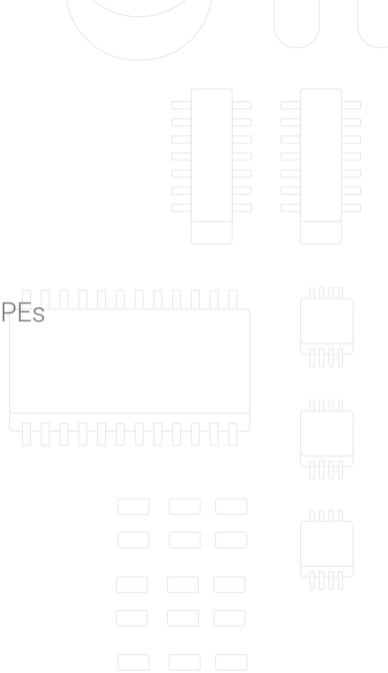
# Agenda

- Introduction
- eBPF Development ecosystem
- Packaging on Gentoo
- Challenges and solutions



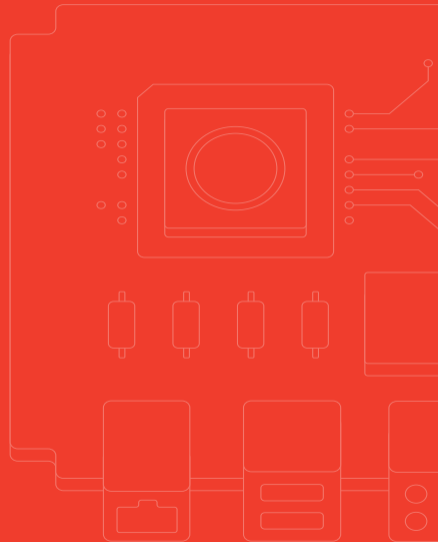
# About

- Delivering solutions based on GNU/Linux firmware
  - Focused on network edge, network switching, and CPEs
  - OpenWrt, Gentoo, Yocto, etc.
- Continuous participation in Open Source projects
  - Contributions for the Linux kernel, systemd, etc.



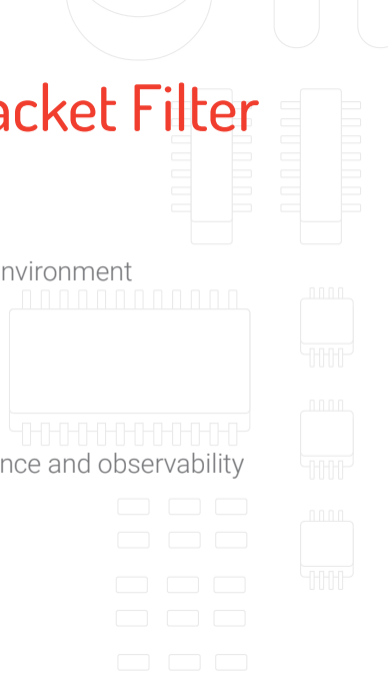
# Introduction

sartura



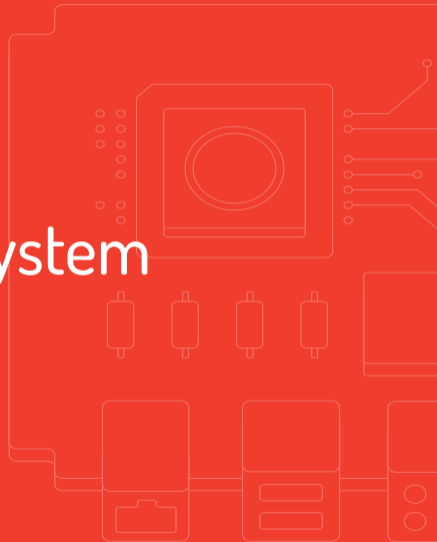
# eBPF - Extended Berkeley Packet Filter

- Linux subsystem that can run programs in a virtualized environment
- Initially - network packet filtering
- Today - event processing framework
- Applications: observability, networking, security, tracing
- Brendan Gregg - books and videos about Linux performance and observability



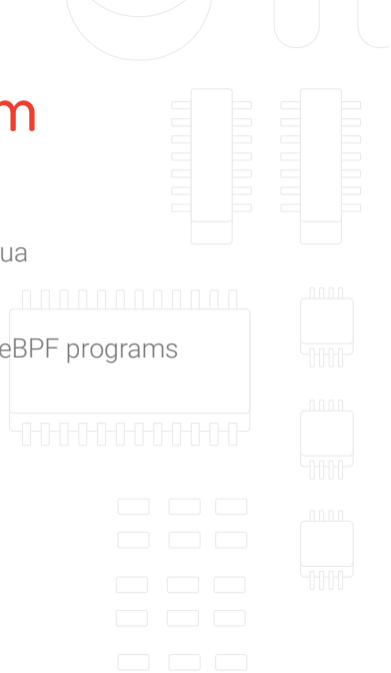
# eBPF Development ecosystem

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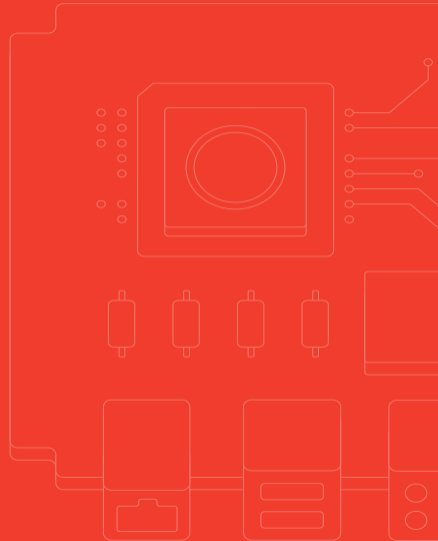
# eBPF development ecosystem

- bcc: Toolkit for writing eBPF programs using Python or Lua
- bpftrace: High level tracing language
- libbpf: Userspace library for loading and interacting with eBPF programs
- eBPF Go library
- ply: Lightweight dynamic tracing tool
- More info: <https://ebpf.io/applications>



# Packaging on Gentoo

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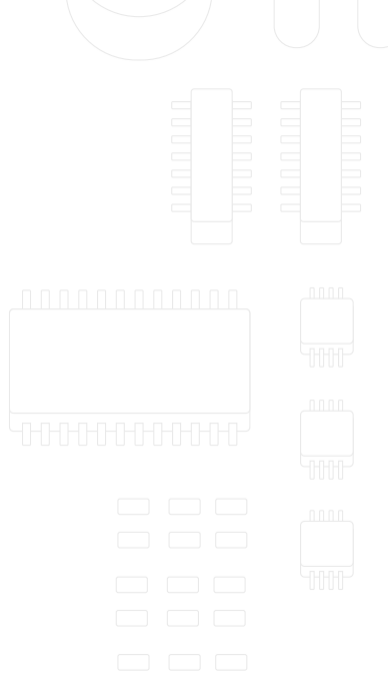
# Gentoo

- Source-based Linux distribution
- Package manager - Portage
- Allows fine-grained control over the system
  - profiles
  - USE flags



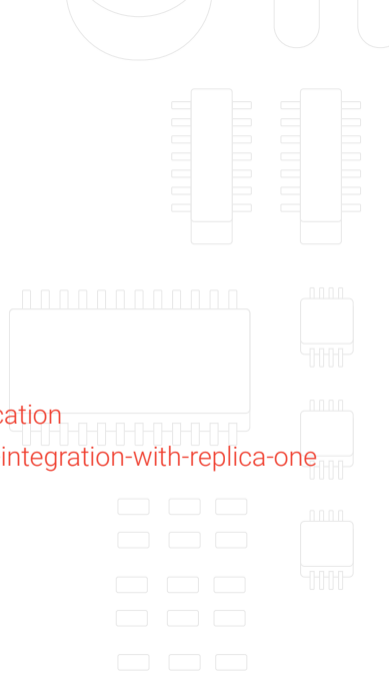
# Packaging on Gentoo

- ebuild - text file with build instructions
- eclass - common code used by ebuids
- USE flag - configuration switch



# Packaging example

- <https://github.com/sartura/ebpf-hello-world>
- CMake build system
- Blog posts
  - <https://www.sartura.hr/blog/simple-ebpf-core-application>
  - <https://www.sartura.hr/blog/ebpf-development-and-integration-with-replica-one>



## Tree

```
├── cmake
│   ├── Modules
│   │   ├── FindLIBBPF.cmake
│   │   └── UseBPF.cmake
│   └── CMakeLists.txt
├── include
│   ├── vmlinux-arm64.h
│   ├── vmlinux-arm.h
│   └── vmlinux-x86.h
├── README.md
└── src
    ├── hello.bpf.c
    ├── hello.c
    ├── maps.bpf.c
    ├── maps.c
    └── maps.h
```

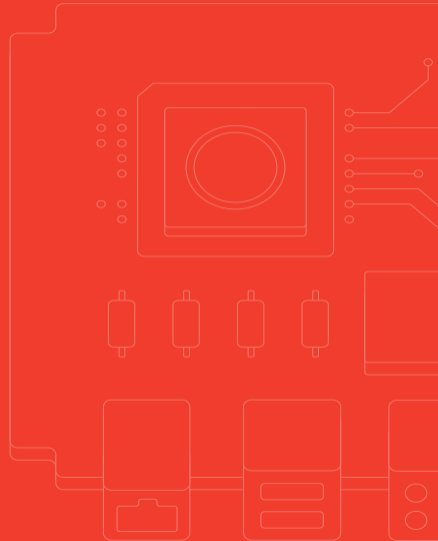
```
1  # Copyright 2023 Gentoo Authors
2  # Distributed under the terms of the GNU General Public License v2
3
4  EAPI=8
5
6  inherit cmake git-r3 linux-info llvm
7
8  DESCRIPTION="Sample eBPF CO-RE applications"
9  HOMEPAGE="https://github.com/sartura/ebpf-hello-world"
10 EGIT_REPO_URI="https://github.com/sartura/ebpf-hello-world.git"
11
12 LICENSE="MIT"
13 SLOT="0"
14 KEYWORDS="~amd64 ~arm ~arm64 ~x86"
15 IUSE="+bpfobjs vmlinux"
16 RESTRICT="strip"
```

```
1  [...]
2  DEPEND="
3      dev-libs/libbpf:=
4      virtual/libelf
5  "
6  RDEPEND="${DEPEND}"
7  BDEPEND="
8      dev-util/bpftool
9      sys-devel/clang:=[llvm_targets_BPF(+)]
10 "
11
12 CONFIG_CHECK="~BPF ~BPF_EVENTS ~BPF_JIT ~BPF_SYSCALL ~HAVE_EBPF_JIT ~↔
13     DEBUG_INFO_BTTF"
14 [...]
```

```
1  [...]
2  src_configure() {
3      local mycmakeargs=(
4          -DBPF_ARCH=$(tc-arch-kernel)
5          -DINSTALL_VMLINUX=$(usex vmlinux)
6      )
7      cmake_src_configure
8  }
9
10 src_install() {
11     cmake_src_install
12
13     if ! use bpfobjs; then
14         rm -r "${ED}"/usr/share || die
15     fi
16 }
```

# Challenges and solutions

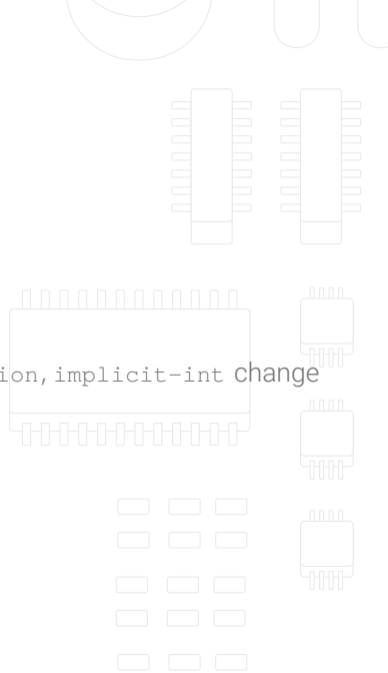
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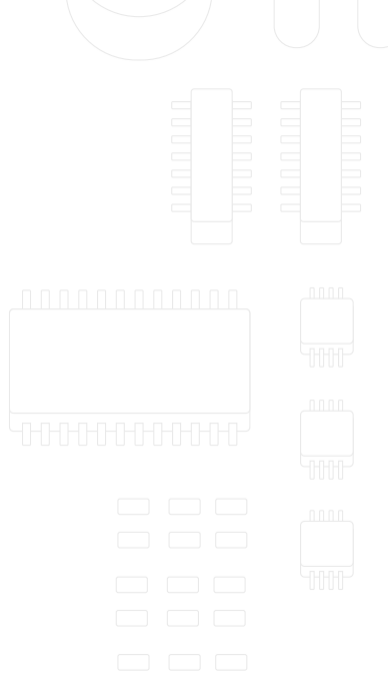
# Challenges

- Supporting different build configurations
- Compatibility with latest toolchain components
  - gcc-10 `-fno-common` change
  - clang-16 `-Werror=implicit-function-declaration, implicit-int` change
- Cross-compilation issues
- Heavy build and run time dependencies
  - Not suitable for embedded systems



# Solutions

- Proactively testing packages
- Writing and submitting patches upstream
- Packaging lightweight applications



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