HelenOS: 20 Years of History, 20 Years of Future Vision

Martin Decky

About the Speaker



Charles University

- Researcher at the Department of Distributed and Dependable Systems (2008 2017)
- Co-author of the HelenOS microkernel multiserver operating system (since 2004)
- Huawei Technologies
 - Principal Research Engineer and co-founder at the Dresden Research Center (2019 2021)
 - Contributing to the HarmonyOS NEXT microkernel-based operating system
- Kernkonzept GmbH
 - Senior Software Engineer (since 2021)
 - Contributing to the L4Re microkernel-based operating system framework

HelenOS in a Nutshell

- Open source operating system
 - BSD
- Microkernel-based
 - 10 classes of kernel objects
- Multiserver
 - Avoiding monolithic components also in user space
- General-purpose
 - Policy decisions distributed among user space components

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HelenOS in a Nutshell

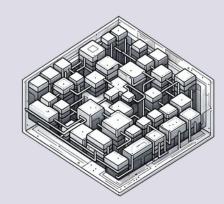
- Multiplatform
 - IA-32, AMD64, IA-64, ARM, AArch64, MIPS, PowerPC, SPARCv9
- Designed and implemented from scratch
 - Asynchronous IPC with memory sharing
 - Majority of native (non-ported) components
- Focusing on readability and maintainability
 - 30 % of comments in source code
- Integrated distribution

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What Is New since 2020

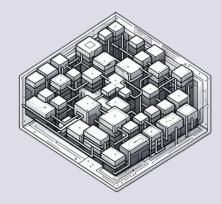
GUI reimplementation

- More flexible display server architecture
 - Support for accelerated direct and indirect rendering
 - Better performance in software rendering
 - Configurable double buffering
- Many widgets and dialogs
 - Text mode parity
 - Proportional fonts
- Text mode mouse & tablet support
- Raspberry Pi 3 HDMI support



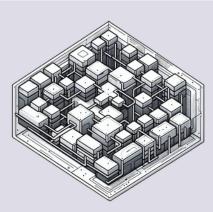
What Is New since 2020

- Usability improvements
 - Font editor
 - 2-panel file manager
 - Taskbar with start button & start menu
 - Multiseat support
 - Terminal scrolling and resizing
 - Shutdown
- Up-to-date compiler toolchain
- Improved standards compliance



What Is New since 2020

- HiKey960 support
- Block device drivers performance improvements
- Kernel streamlining
 - DWARF support for better debugging experience
 - Reduction of synchronization (e.g. CPU-local structures, atomic accesses)
 - Abstraction improvements (e.g. semaphores instead of directly using wait queues)
 - Removal of unused "extension points"
 - Clever performance optimizations
- 4 public releases, 948 commits





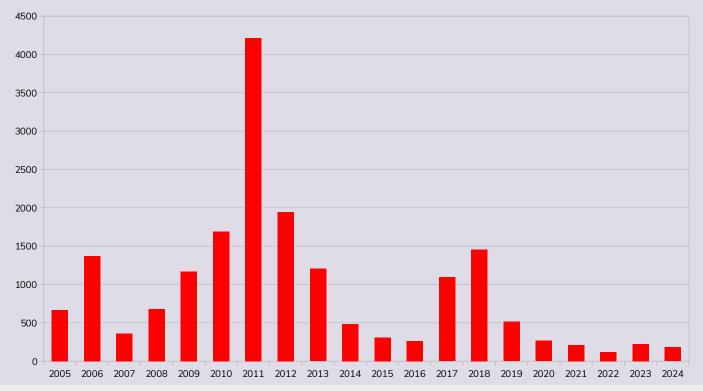
Qualitative Difference from 2004 – 2020

- We were used to news items such as ...
 - Itanium support, SPARCv9 support, AArch64 support
 - Device Driver Framework
 - Network subsystem with IPv6 support, sound subsystem
 - USB 3 support, Intel HD Audio support
 - Read-Copy-Update, lockless hash table
 - Dynamic linking
 - ext4 support, UDF support, installer



Overall Activity

Commits per year



Overall Activity



The "serene valley" of HelenOS in 2025

HelenOS is complete



Two Meanings of the Word "Complete"



This meaning **does not** apply to HelenOS



Two Meanings of the Word "Complete"



This meaning **does** apply to HelenOS

HelenOS in the Bigger Picture

- HelenOS is a "pure" open source project
 - Completely community driven
 - Individual interests
 - Academic research
 - Education (theses, etc.)
 - Some corporate sponsorship (GSoC, CZ.NIC)
 - But no real business or monetization plan
- No "major building blocks" missing anymore
 - Implementing thousands of device drivers, file systems, standard APIs and usability features is tedious and not rewarding

A Cautionary Tale?

- Do we remember MINIX 3?
- Do we remember GNU Hurd?
- Will we remember other major microkernel OS projects like this eventually?
- There is nothing wrong with the "serene valley" per se
 - Expect it and embrace it
 - If you do not like it, then have a plan to avoid it
 - Source of revenue that would cover the non-fun tasks

The Vision for HelenOS into 2030s

- Embracing the "serene valley" for now
 - Valuable tool for experimentation
 - Valuable code base to learn from
- Always on a lookout for future challenges
 - Asynchronicity more important than ever
 - Readily available functionality to be merged
 - Task checkpointing & migration
 - MMU-less operation

Summary

- HelenOS is alive and well
- HelenOS is complete
- There are still many ways to contribute
- HelenOS is here to stay
- There is nothing wrong with the "serene valley"
- If you do not like the "serene valley", have a plan



Thank you! Questions?