

# HelenOS

## Last Year At a Glance

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# What is HelenOS?

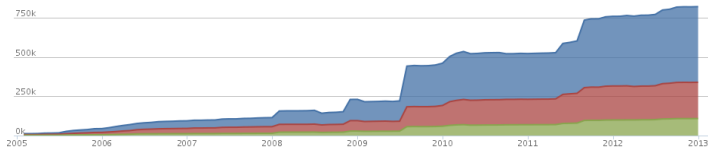
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HelenOS is a **shaping up** open-source multiplatform microkernel multiserver general-purpose operating system written from scratch. And it is not “yet another Unix clone”.

- since 2001
- over 822 thousand lines of code<sup>1</sup>
- over 40 contributors



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- `bzr://helenos.org/mainline`
- `https://code.launchpad.net/helenos`

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- PC – both 32bit and 64bit
- IA-64 (Intel Itanium)
- ARM (Neo FreeRunner<sup>2</sup>, BeagleBoard)
- MIPS (SGI Indy)
- PowerPC (Apple iMac G4)
- SPARC (Sun Ultra)



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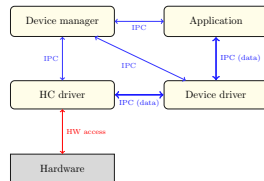
HelenOS is a shaping up open-source multiplatform **microkernel** multiserver general-purpose operating system written from scratch. And it is not “yet another Unix clone”.

- “SPARTAN”
- virtual memory
- scheduling
- IPC (mostly asynchronous)

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- separate userspace tasks
- virtual file system (VFS)
- filesystem drivers
- hardware drivers
- location service



What is HelenOS?

Last year ...

0.5.0 Fajtl

Beyond 0.5.0

GSoC 2012

Community

...



# What is HelenOS?

HelenOS is a shaping up open-source multiplatform microkernel multiserver **general-purpose operating system** written from scratch. And it is not “yet another Unix clone”.

- development is rather breadth-first than depth-first
- unfortunately, only C is available

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- SPARTAN kernel, libc
- VFS, most of filesystem drivers (+ FUSE)
- drivers, networking stack
- compositing graphical stack
- maybe, we are “reinventing” the wheel but
  - it is fun
  - ours is better ;-)

# What is HelenOS?

HelenOS is a shaping up open-source multiplatform microkernel multiserver general-purpose operating system written from scratch. And it is **not** “yet another **Unix clone**”.

- no ghosts of unsafe or “odd” APIs
  - `strcpy()`, `strncpy()`
  - signals and threads
  - `fork()` & `exec()`
- UTF-8
- `libposix` as an emulation layer

# Last year ...

# Shortly

- 0.5.0 Fajtl was released. . .
- . . . but development did not stop
- Google Summer Of Code 2012

# 0.5.0 Fajtl

# Kernel improvements

- Memory reservations
  - prevent overcommit when desired
- Non-identity mapping in kernel
  - kernel can now access memory at arbitrary physical address

- Networking stack rewritten from scratch
  - separate tasks for TCP, UDP, ...
- NIC framework for writing drivers
- Simple web server (static content only)
- netcat-like terminal emulator `nterm`
- Remote console



# Device drivers

- Improvements in device driver framework
  - command-line utilities
  - better unplug support
- USB (1.1 only): UHCI, OHCI, HID, mass-storage
- SATA
- Location service
  - device provides a service
  - unifies hardware and “artificial” drivers

- More instances of the same FS
  - e.g. task per mount-point
- exFAT, LFN, FAT32
- ISO-9960
- ext2

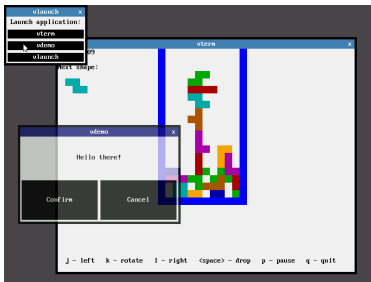
# Towards self-hosting

- GNU binutils – assembler and linker
- Portable C compiler (PCC)
- MIPS R4000 simulator MSIM

# Beyond 0.5.0

# Graphical stack

- Not based on X11 or Wayland or ...
- Three tiers
  - Graphic adapter driver
  - Compositor server
  - Widget toolkit
- Bitmap-based effects



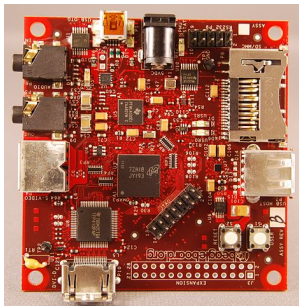
# “Invisible” changes

- Guard pages
- Large user stacks
- More benevolent IPC

- Support for “wall clock” (CMOS)
- ext4 with write support
- Projects from GSoC 2012

# Feature branches, plans

- Audio stack
- Go language support
- FUSE connector
- Capability-based private-namespace file system
- BeagleBoard<sup>3</sup>





## Feature branches, plans (cont.)

- Finish GCC porting
- IPv6 support
- Port BIRD Internet Routing Daemon<sup>4</sup>
- Port KnotDNS<sup>5</sup>
  - authoritative-only DNS server



More at <https://code.launchpad.net/helenos>

# Demo

# Google Summer of Code 2012

# What is Google Summer of Code

*... is a program that offers post-secondary student developers stipends to write code for various open source software projects ...*

*... student is paired with a mentor from the participating projects, thus gaining exposure to real-world software development scenarios ...*

*... the participating projects are able to more easily identify and bring in new developers ...*



<https://developers.google.com/open-source/soc/>

- Port GCC to HelenOS – Vivek Prakash
  - Indian Institute of Technology Roorkee, India
  - “hack“ the ./configure scripts
  - add missing functionality to libposix
- UDF file system driver – Julia G. Medvedeva
  - Volgograd State Technical University, Russia
  - DVD & Blu-Ray
  - read-only support

# Projects (cont.)

- Structured binary data tools (Bithenge) – Sean Bartell
  - North Carolina State University at Raleigh, USA
  - viewing/editing binary data

```
transform gif_image_block = struct {
  .left <- word;
  .top <- word;
  .width <- word;
  .height <- word;

  <- struct {
    .use_local_color_map <- bit;
    .interlacing <- bit;
    .reserved_bits <- uint_be(3);
    .bits_per_pixel <- (in + 1) <- uint_be(3);
  } <- bits_be <- known_length(1);

  if (.use_local_color_map) {
    .local_colors <- gif_color_map_from_bbp(.bits_per_pixel);
  }

  .lzw_initial_size <- uint8;
  .lzw_data <- generic_data_block;
};
```

# Projects (cont.)

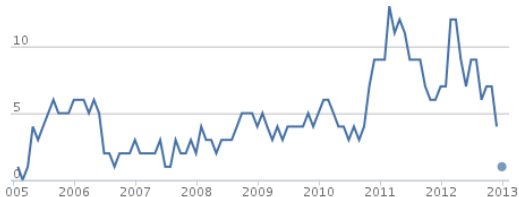
- Scalable, resizable, concurrent hash-table – Adam Hraška
  - Charles University in Prague, Czech Republic
  - RCU-based
  - for both kernel and userspace
  - continues as a master thesis
- HelenOS as a Genode platform – Tobias Börtitz
  - Dresden University of Applied Sciences, Germany
  - joint project with Genode Labs
  - continues as a master thesis

# Community



# Community

- developers-only
- over 40 contributors
  - about 20 of them active during last year<sup>6</sup>
  - but only 10 of them have at least 10 commits (counting only *mainline*)
- about half of the contributors have less than 10 commits



# Attracting new collaborators

- GSoC
  - a lot of applicants
  - 8 accepted students in 2 years
    - about half of them disappeared completely at the end of the project
- university courses
- random passers-by
  - “can I run XY on it?”
  - “so, it runs above Linux, right?”

## Learning more by programming...

- Write a device driver
  - Be modular
- Port to a new architecture
  - More low-level is only soldering
- Implement a file system driver
  - Stay in userspace
- Write user application
  - Use non-standard API
- Port application from ⟨you favourite OS⟩
  - Connect different worlds
- Implement your wild ideas ;-)

# Join us!

- `helenos-devel@lists.modry.cz`
- `#helenos` on Freenode

# Thank you!

## Q & A



<http://www.helenos.org>

# References

- [1] Ohloh.net: lines of code  
[https://www.ohloh.net/p/helenos/analyses/latest/languages\\_summary](https://www.ohloh.net/p/helenos/analyses/latest/languages_summary)
- [2] HelenOS on Neo FreeRunner  
<http://trac.helenos.org/wiki/FreeRunner>
- [3] BeagleBoard  
<http://en.wikipedia.org/wiki/BeagleBoard>
- [4] The BIRD Internet Routing Daemon  
<http://bird.network.cz/>
- [5] Knot DNS  
<https://www.knot-dns.cz/>
- [6] Ohloh.net: contributors  
<https://www.ohloh.net/p/helenos/contributors/summary>