HelenOS: State of the Union 2012
What's New?

- **Since October 11\(^{th}\) 2011**
  - 384 days (1.05 years) ago
  - **Latest release 0.5.0 (Fajtl)**
    - August 9\(^{th}\) 2012
    - The biggest release ever (15 months of development)
  - **On track to 0.5.1**
    - Minor release, but important improvements planned
    - Expected in Q2 2013
What's New in 0.5.0?

- **Hardware support resurrection**
  - IA-64 (on real hardware, non-SMP only)
  - PowerPC

- **Kernel memory management improvements**
  - Memory reservations
    - Prevents memory overcommitting if not desired
  - Kernel non-identity mapping support
    - Support for accessing any physical memory from the kernel
What's New in 0.5.0? (2)

• Integration of various development branches
  • USB support
    • UHCI, OHCI (USB 1.1)
    • USB HID, USB Mass Storage
  • Networking improvements
    • Intel PRO/1000 (E1000) device driver
    • Realtek RTL8139 device driver
    • NIC driver framework
    • Rewritten TCP/IP stack
Integration of various development branches

- File systems
  - Read-only ext2 driver
  - Read-only ISO 9660 driver
  - Read/write support for FAT12, FAT16, FAT32 and exFAT
    - Including LFN extension
  - Read/write support for MINIX FS
    - Migration path from MINIX 3 :-)

What's New in 0.5.0? (3)
What's New in 0.5.0? (4)

- **Infrastructure improvements**
  - **Location service**
    - Improved replacement for the Device mapper
    - Service names (instances)
    - Service categories (classes)
  - **Towards self-hosting**
    - Assembler and linker via GNU Binutils
    - C compiler via PCC
    - Virtual machine via MSIM
What's New in 0.5.0? (5)

- Miscellaneous and experimental
  - SATA (AHCI) support
  - Anticipated device removal
  - Multiple file system driver instances
  - Web server can actually serve files from file system
  - Remote network console
  - Dynamic linking production-grade on IA-32
  - GRUB 2 as preferred boot loader (on IA-32 and AMD64)
What's New Since the Release?

- **Graphical User Interface**
  - Graphics drivers as $1^{st}$ class DDF citizens
    - Proposal for hardware acceleration API
  - Display compositor
  - GUI widgets library

- **File systems**
  - Read/write ext4 driver
  - Partial read/write UDF driver
What's New Since the Release? (2)

- Structured binary data manipulation
  - Bithenge framework
- IPC improvements
  - Avoiding bookkeeping of unimportant messages
- Scalable concurrent hash table
  - User space part merged so far
- Real time clock driver
  - CMOS based (IA-32)
What's New Since the Release? (3)

Demo
History 2005 – 2012

Date

Commits
History 2005 – 2012 (2)
What's Cooking

- **IPC interfaces and ports**
  - Replacement for duck typing and “mixins”
    - Stronger run-time type checking
  - Connection to ports mediated by naming services

- **Read-copy-update**
  - Two parallel efforts (AP-RCU, A-RCU)
  - Scalable concurrent data structures (hash table)
What's Cooking (2)

- Go support
- FUSE support
- VFS 2.0
  - Capability-based private file system namespaces
- BeagleBoard, Raspberry Pi
- Audio stack
  - Low-level drivers and a sound server
What's Cooking (3)

• **Xen revival**
  - HelenOS running as a Xen domain
  - HelenOS acting as Xen hypervisor

• **System services manager and logger**
  - Think of *cgroups*, *systemd* and *journald*

• **HelenOS installer**
What's Cooking (4)

- **Self-hosting**
  - Port of GCC
  - Port of Python
  - Python-based build infrastructure (waf)

- **Continuous integration and testing**
  - Based on Hudson (but with a twist)

- **Networking features**
  - DNS, DHCP, etc.
Social Agenda

• FOSDEM 2012
  - February 4\(^{th}\) – 5\(^{th}\) 2012, Brussels, Belgium
  - Université libre de Bruxelles
  - Jakub Jermář chaired the *Microkernel OS Devroom*
    • Participation of HelenOS, Genode Labs, NOVA, MINIX, Hurd

• FOSDEM 2013
  - February 2\(^{nd}\) – 3\(^{rd}\) 2013, Brussels, Belgium
  - Genode Labs is about to chair the *Microkernel and Component-based OS Devroom*
## Microkernel OS Devroom

Room: K.3.201

### Sunday 2012-02-05

<table>
<thead>
<tr>
<th>Event</th>
<th>Speaker</th>
<th>Room</th>
<th>When</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welcome! or Why do we meet here today</td>
<td>Jakub Jermář</td>
<td>K.3.201</td>
<td>09:00-09:25</td>
</tr>
<tr>
<td>Introduction to the NOVA kernel API</td>
<td>Julian Steklina</td>
<td>K.3.201</td>
<td>09:30-10:00</td>
</tr>
<tr>
<td>Introduction to HelenOS</td>
<td>Jakub Jermář</td>
<td>K.3.201</td>
<td>11:10-11:55</td>
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<tr>
<td>The microkernel overhead</td>
<td>Martin Děcký</td>
<td>K.3.201</td>
<td>13:00-14:00</td>
</tr>
<tr>
<td>The agony of choice - the diversity of microkernels in Genode</td>
<td>Stefan Kalkowski</td>
<td>K.3.201</td>
<td>14:10-14:55</td>
</tr>
<tr>
<td>Dive into HelenOS Device Drivers</td>
<td>Jiří Svoboda</td>
<td>K.3.201</td>
<td>15:05-15:50</td>
</tr>
<tr>
<td>Panel discussion</td>
<td>Julian Steklina, Jakub Jermář, Ben Gras, Christian Helmut</td>
<td>K.3.201</td>
<td>16:00-17:00</td>
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</tbody>
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Photos
4th attempt, 2nd successful (in a row)

- [http://helenos.org/gsoc2012](http://helenos.org/gsoc2012)
  - 17 student proposals
- **Vivek Prakash:** Port GNU Compiler Collection (GCC) to HelenOS
  - Indian Institute of Technology Roorkee, India
  - Mentored by Jiří Svoboda
- **Sean Bartell:** Structured binary data tools
  - North Carolina State University at Raleigh, USA
  - Mentored by Vojtěch Horký
- **Adam Hraška:** Resizeable, scalable, concurrent hash table
  - Charles University in Prague, Czech Republic
  - Mentored by Jakub Jermář
- **Julia G. Medvedeva:** UDF file system server
  - Volgograd State Technical University, Russia
  - Mentored by Martin Děcký
- **Tobias Börtitz:** HelenOS as a Genode platform
  - Dresden University of Applied Sciences, Germany
  - Mentored by Stefan Kalkowski
Unconference

- October 20\textsuperscript{th} – 21\textsuperscript{st} 2012
- Googleplex, Mountain View, California
- Attended by Vojtěch Horký and Jakub Jermář
- Minority OS minisummit
GSoC Mentor Summit 2012 (3)

Photo by Robin Smidsrød
Bithenge

• **Aim**
  - Extensible declarative way to describe binary formats
    - Binary files (ELF headers, DWARF debugging information), on-disk file system structures, network packets

• **Components**
  - Declarative DSL for describing binary formats
  - API for accessing data based on the DSL
  - User front-ends (editors)
transform u8 = uint8;
transform u16 = uint16le;
transform u32 = uint32le;

transform fat_attributes = struct {
  .read_only <- bit;
  .hidden <- bit;
  .system <- bit;
  .volume_label <- bit;
  .subdirectory <- bit;
  .archive <- bit;
  .device <- bit;
  .reserved <- bit;
} <- bits_le <- known_length(1);
transform file_data(data, bits, fat, cluster_size, start) = (in.data) <- struct {
    .cluster <- (data[(start-2)*cluster_size, cluster_size]);
    .last_cluster_number <- switch (bits) {
        12: (488);  # 0x00000ff8
        16: (65528);  # 0x0000fff8
        32: (268435448);  # 0xffffffff8
    };
    .next <- (fat[start]);
    if (.next == 0 || .next >= .last_cluster_number) {
        .data <- (.cluster);
    } else {
        .rest <- file_data(data, bits, fat, cluster_size, .next) <- known_length(0);
        .data <- (.cluster ++ .rest);
    }
};
Possible Application of HelenOS

- Cooperation with CZ.NIC Labs
  - IPv6 support in HelenOS
  - BIRD routing daemon for HelenOS
  - Knot DNS server for HelenOS
HelenOS PhD Thesis

Work in Progress

Semantic information in source code

Architecture and behavior specification

Architecture models

Extra-functional properties
Q&A

www.helenos.org
Ὡς εἴν', ἀγγέλλειν Λακεδαιμονίοις ὅτι τῇδε κείμεθα, τοῖς κεῖνων ῥήμασι πειθόμενοι.

Go tell the Spartans, thou who passest by, that here, obedient to their laws, we lie.