HelenOS Project

Experimental development operating system

- [ ] http://www.helenos.eu/
- [ ] C, assembly (using GNU toolchain)
- [ ] Multiplatform
  - IA-32, IA-64, AMD64, MIPS (32), Sparc V9 (64), PowerPC (32, 64)
- [ ] SMP support
- [ ] “Millikernel”
- [ ] BSD license
Architecture

kernel

Scheduler
* threads
* per CPU run-queues
* load balancing

Syscalls
* thread/task control
* address space control
* IPC
* DDI

Memory Management
* physical memory
* virtual memory
* address spaces

Kernel Device Drivers
* system clock
* interrupt controllers
* basic console
* SMP config

IPC
* answerboxes
* phones
* (a)synchronous
* short messages

Device Driver

Naming Service

User Task

IPC
SySCALL
HW access
Interrupt via IPC

HARDWARE
Kernel Features

- Slab allocator (frame zones, buddy system)
- Generic interface for address space management
  - Page table (4-level) instance, Global hash table instance; TLB interface; address space areas; shared memory
- Spin-locks; wait queues, semaphores, mutexes, condition variables, RW locks
- CPU-bound threads (1:1:n), SMP load balancing
- Interrupt/Exception handling mechanism
- Syscalls, IPC
- Device driver interface
  - Simple hardware access language, logic in uspace
User Space Features

- Standard interfaces: libc, softint, softfloat, libpci
- Obligatory thread local storage
- Futexes
- Kernel threads management
- User space threads (pseudo threads)
  - Used extensively by IPC
- IPC
  - Message loop paradigm
  - Pseudo threads management
- Drivers
  - Framebuffer, keyboard, PCI
Short IPC messages

- Initial connection to Naming Service
  - Allows to connect to other tasks
  - Await incoming connections
- Asynchronous
  - 4 native integers
  - Message forwarding
  - Must be answered
  - Fixed buffer in kernel, variable in user space library
- Synchronous
  - Single message
- Notifications
  - Subscription to kernel notification channels
  - IRQ events
IPC (2)
System call IPC layer
- Create new outgoing connection
- Create new callback connection
- Send address space area
- Ask address space area
- Send message
  - Fast syscall register transfer

Pseudo threads
- Manager pseudo threads
  - Waiting for a message/answer, putting the messages to queues of other threads, buffering messages
- Worker pseudo threads
  - Processing messages
IPC (4)
User space hardware drivers
- Task needs special capabilities
- Map physical memory into AS
- Map I/O space (mostly IA-32 specific)
- Control preemption
- Receive notification upon interrupt
  - Simple stateless language for handling level-triggered interrupts in kernel
- Drivers and clients communicate using IPC
  - Keyboard driver
  - Framebuffer driver
  - PCI driver