



# HelenOS

CHARLES UNIVERSITY PRAGUE

faculty of mathematics and physics



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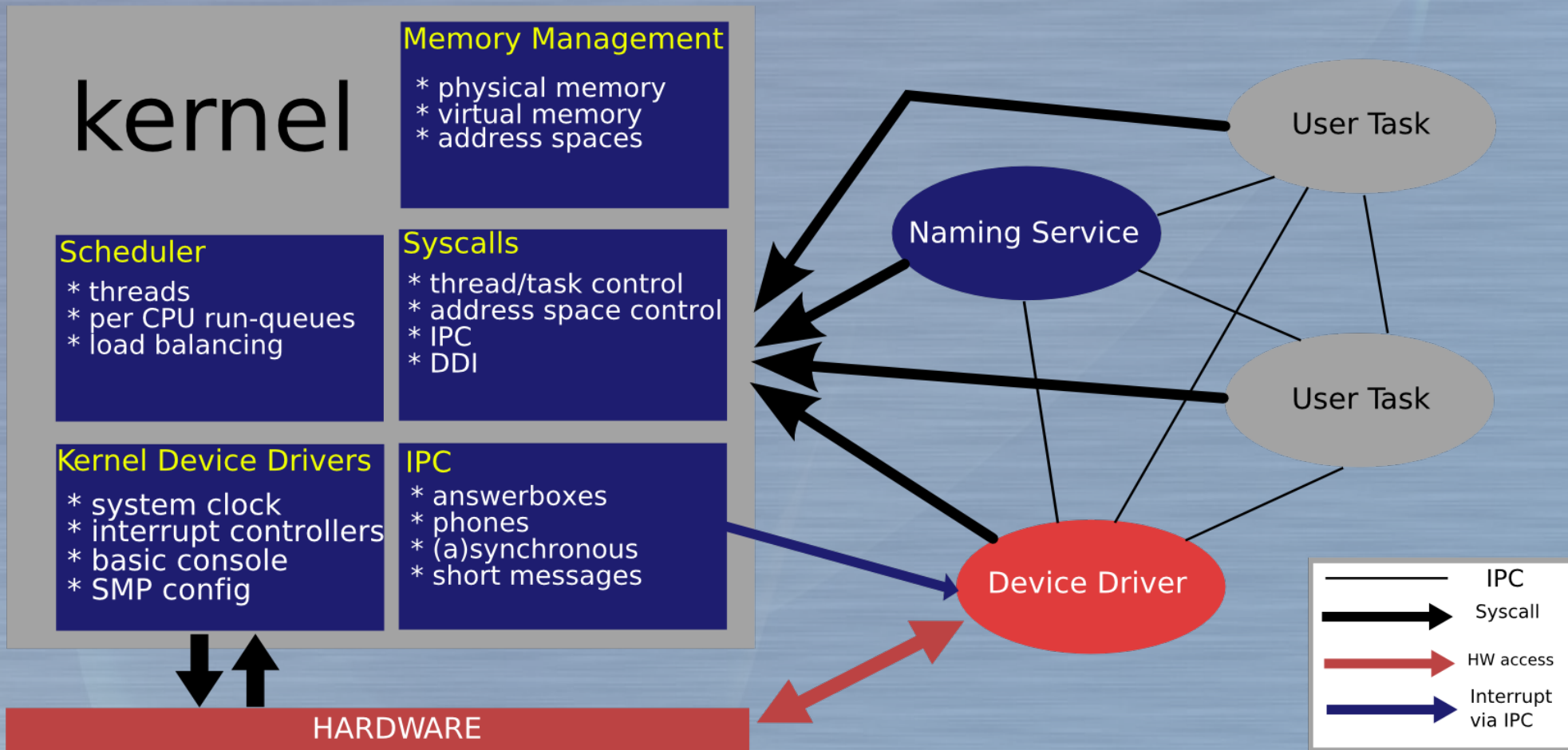
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# HelenOS Project

**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 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



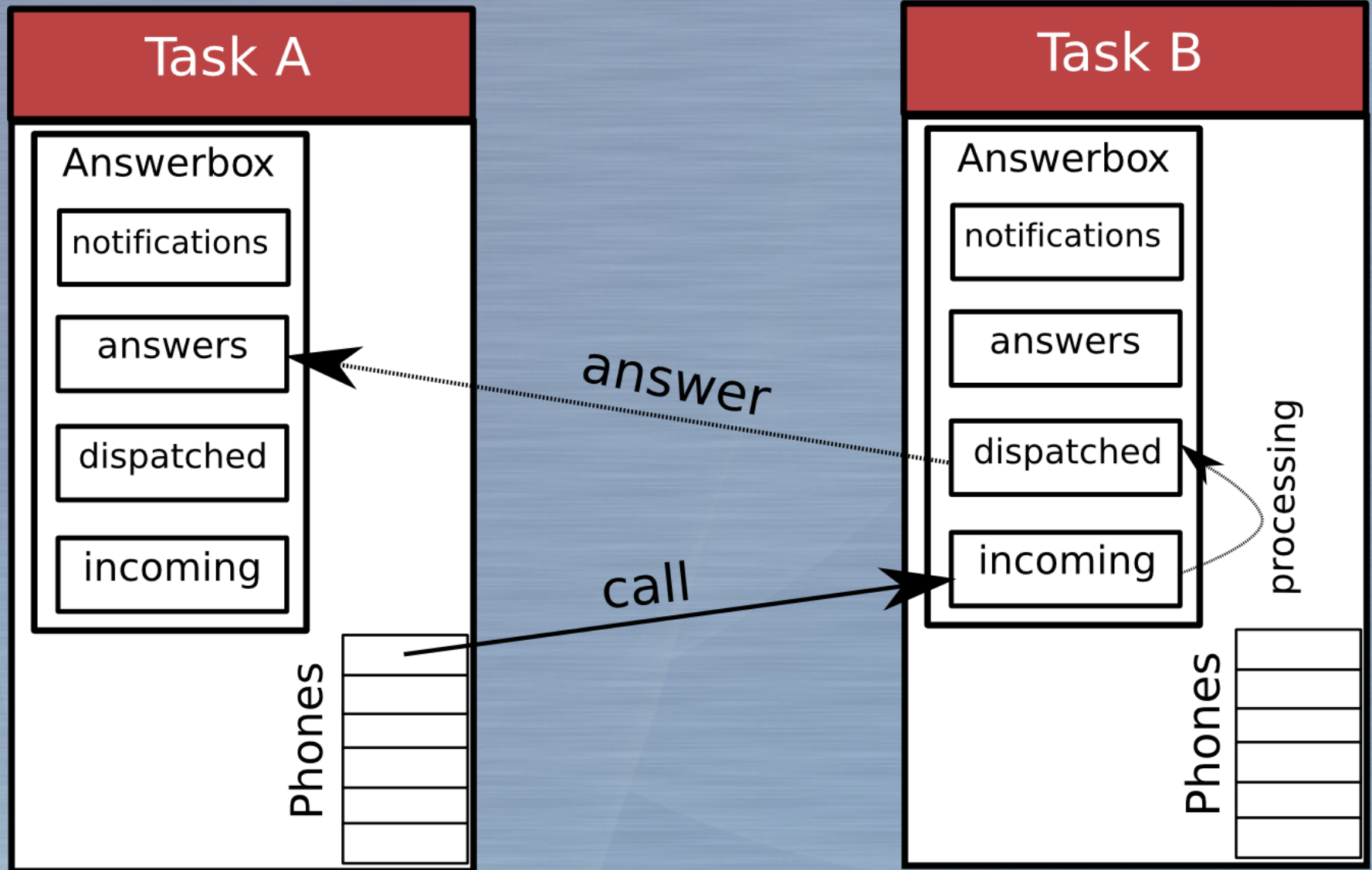
# User Space Features

- ❑ 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

# IPC

- 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)



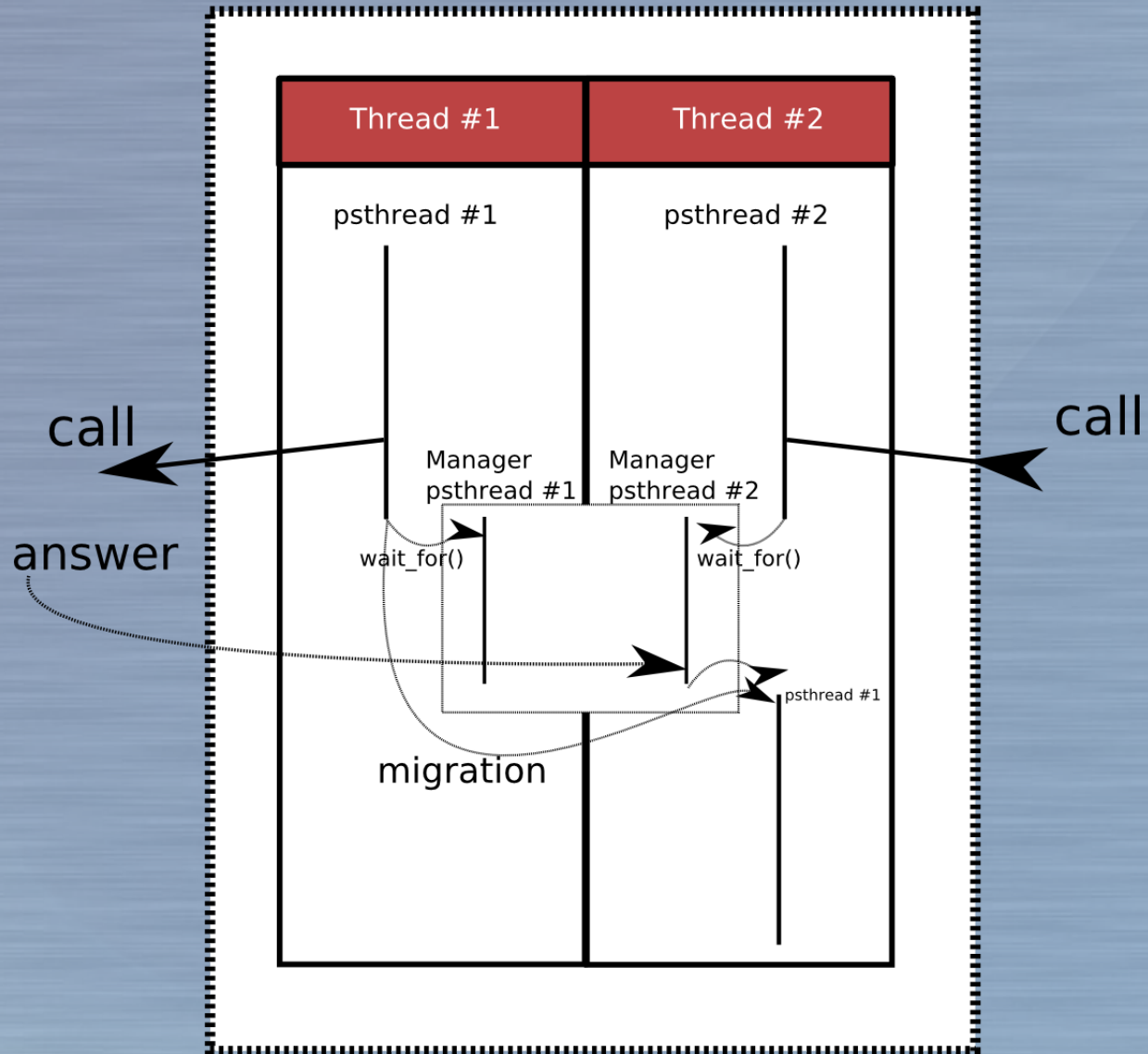


# IPC (3)

- ❑ 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)



# DDI

- 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