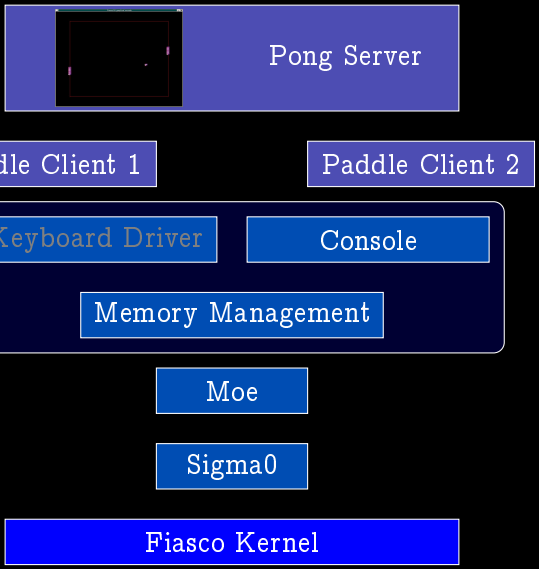
Complex Lab – Operating Systems

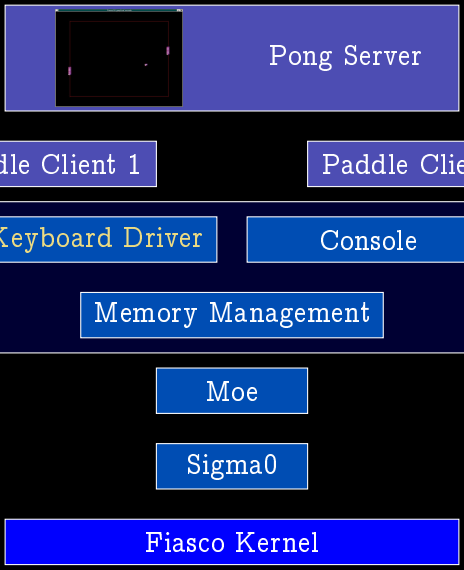
Keyboard Device Driver & Integration

Martin Küttler

We are here


Pong Server
Paddle Client 1
Paddle Client 2
Keyboard Driver
Console
Memory Management
Moe
Sigma0
Fiasco Kernel

Today's goal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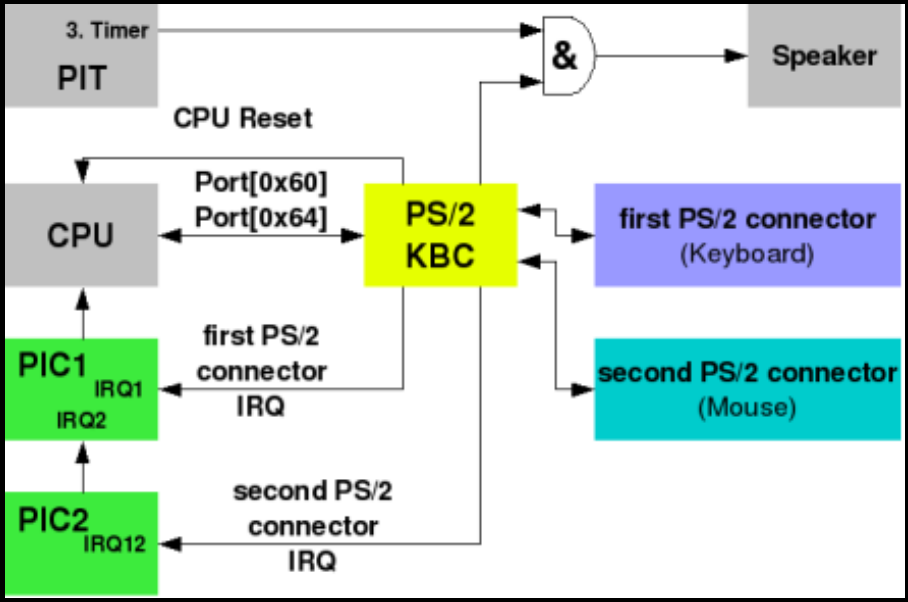
PS/2 Keyboard Controler



Source: http://wiki.osdev.org/"8042"_PS/2_Controller

Driving the keyboard

- Subscribe to interrupt 0x1.
- On interrupt:
  - Read scan code from I/O port 0x60 (`inb 0x60`)
  - Translate scan code into key code and action
- Wrap a server interface around it, and you're done.

Getting access to the IO port

Add to x86-legacy.devs (inside outer function)

```
PS2 = Hw.Device(function()
  Property.hid = "PNP0303";
  Resource.iop1 = Res.io(0x60, 0x60); -- PS/2 device 1
  Resource.iop2 = Res.io(0x64, 0x64); -- PS/2 device 2
  Resource.irq1 = Res.irq(1,  0x000000);
  Resource.irq2 = Res.irq(12, 0x000000);
end);
```

Getting access to the IO port

The following is already in x86-fb.io (and probably shouldn't be called gui, feel free to rename).

```
Io.add_vbus("gui", Io.Vi.System_bus
{
  ps2 = wrap(hw:match("PNP0[3F]??"));
})
```

Then give IO a server cap (called gui) to a gate, and give the client cap to your keyboard server (called vbus).

How to handle irqs and ioports in C

- For irqs look at `pkg/examples/sys/isr` (it's C, you can figure out the C++ interface)
- Request io port from vbus: `l4io_request_ioport(0x60, 1)`
- Read value from io port (after you received an interrupt): `l4util_in8(0x60)`

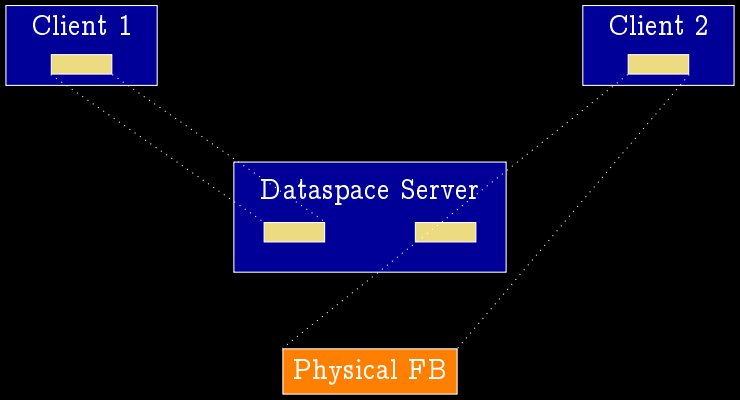
Assignment, part 1

- Build a working keyboard server.
- You already have working pong clients in src/14/pkg/pong/examples.
- Modify the pong clients to be controllable by keyboard, with different controls.

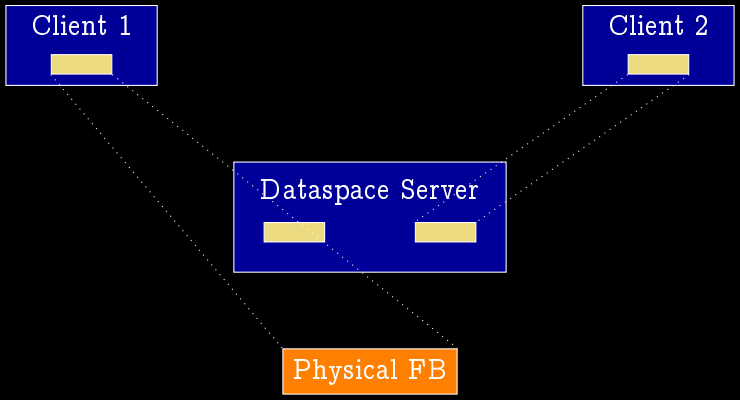
Graphical console multiplexing

- Now there are two programs that can draw: pong and the console, so we need to multiplex graphics.
- One of them should render into physical framebuffer, while the other renders into plain memory.
- You will need a dataspace server that serves both clients.
- For switching, that server will unmap both dataspaces and remapped them in reverse order.

Graphical console multiplexing



Graphical console multiplexing



Graphical console multiplexing

- Your server will need to
  - hand out two capabilities to frame buffers (i.e. to gates, that you respond on)
  - implement the frame buffer interface as defined in src/l4/pkg/l4re-core/l4re/include/video/goos,
  - implement dataspaces as defined in src/l4/pkg/l4re-core/l4re/include/dataspace
- Have a look at src/l4/pkg/l4re-core/l4re/util/include/dataspace_svr for a nearly complete dataspace implementation.

Switching Console Clients

1. User indicates a client switch.
2. Unmap physical FB from client.
3. Make client's FB point to a virtual copy.
4. Unmap new client's virtual FB.
5. Copy new client's virtual data into physical FB.
6. Make new client's FB point to physical FB.

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There is a race condition here:

- Between steps 2 and 3 the client might draw, raise a page fault, and get the physical pages mapped back.
- You will need to handle that in your implementation.

Assignment, part 2

- Implement console switching, so that the user can play pong and switch to the console at any time.
- On real hardware you can't read pong's output: Edit `send_ipc()` in `pkg/pong/include/logging.h` to send all output to your log server.
- Send in the whole thing until March 31, including some information on how to use it.