

# Complex Lab – Operating Systems

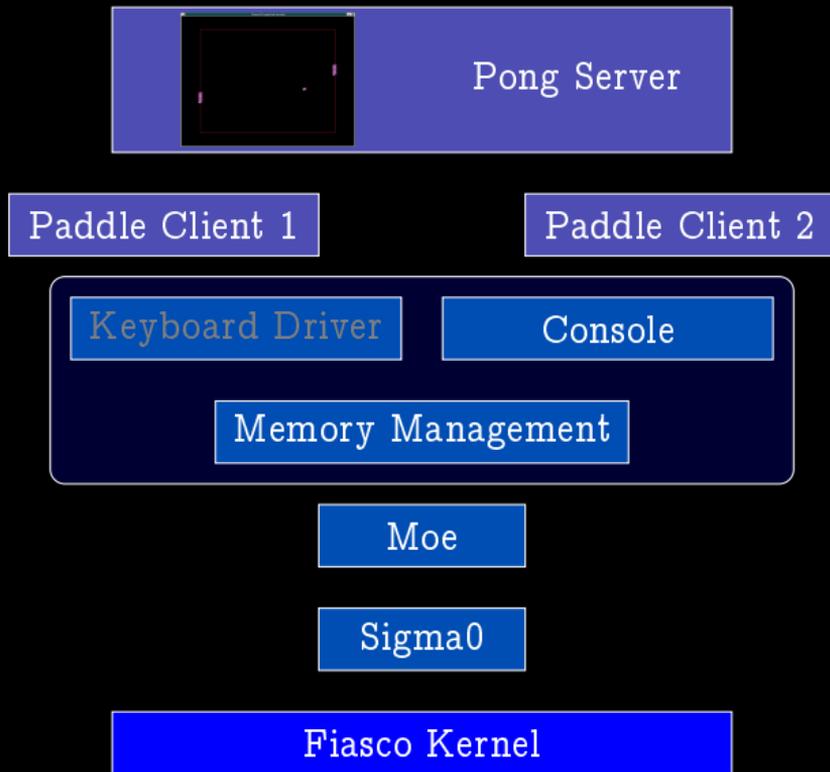
## Keyboard Device Driver & Integration

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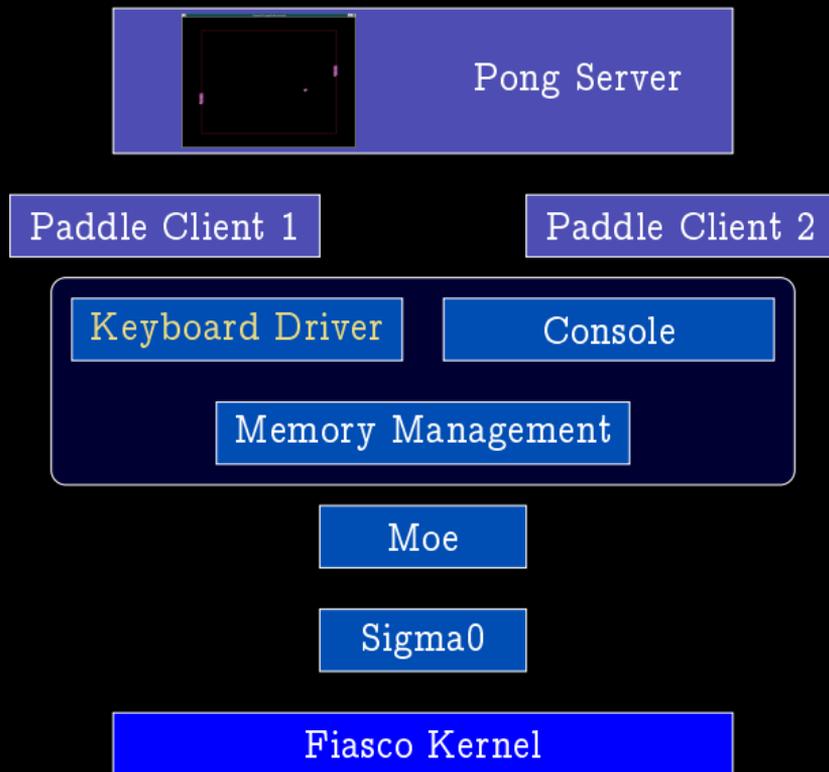
# Last assignment

Any questions?

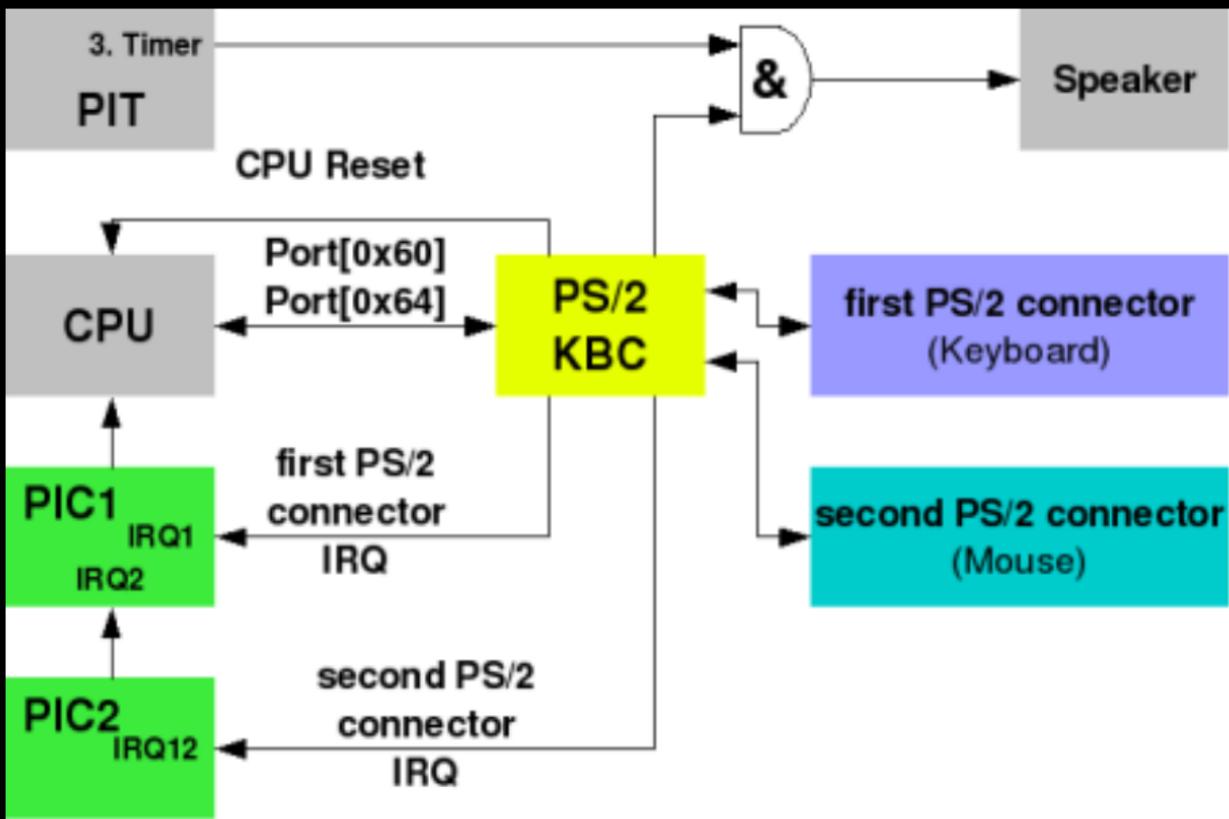
# We are here



# Today's goal



# PS/2 Keyboard Controller



Source: [http://wiki.osdev.org/"8042"\\_PS/2\\_Controller](http://wiki.osdev.org/)

## 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)`

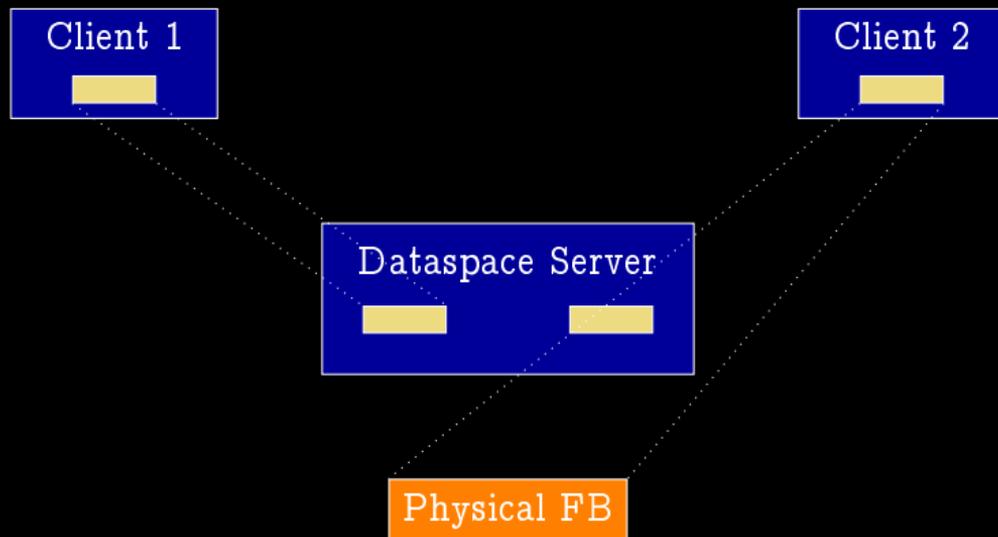
## Assignment, part 1

- ▶ Build a working keyboard server.
- ▶ You already have working pong clients in `src/l4/pkg/pong/examples`.
- ▶ Modify the pong clients to be controllable by keyboard, with different controls.

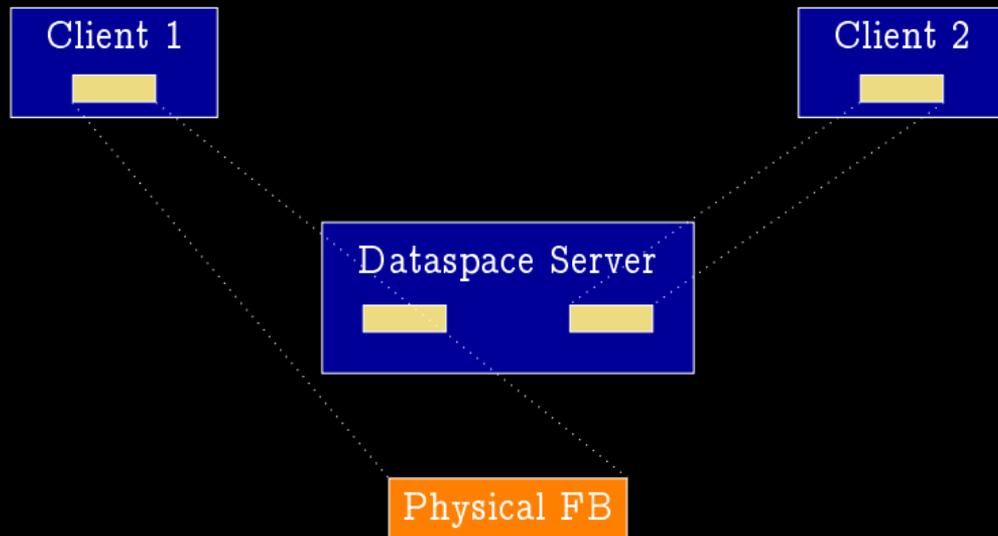
## Graphical console multiplexing

- ▶ 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/14/pkg/14re-core/14re/include/video/goos`,
  - ▶ implement dataspace as defined in `src/14/pkg/14re-core/14re/include/dataspace`
- ▶ Have a look at `src/14/pkg/14re-core/14re/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.