TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Systems Architecture, Operating Systems Group

COMPLEX LAB: MICROKERNEL-BASED SYSTEMS

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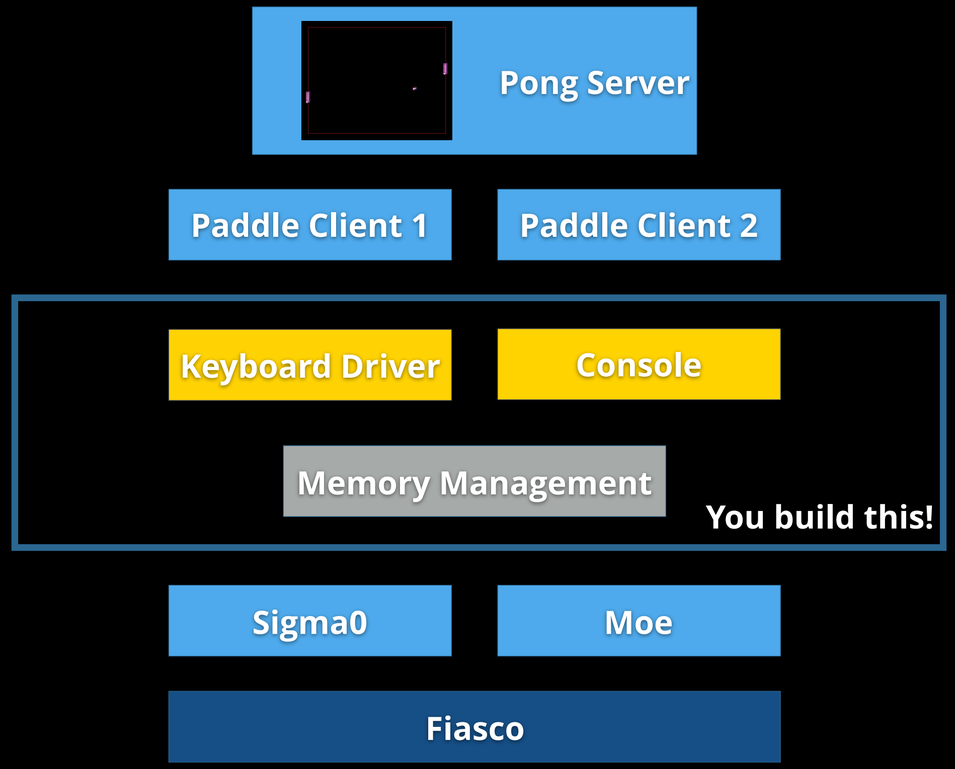
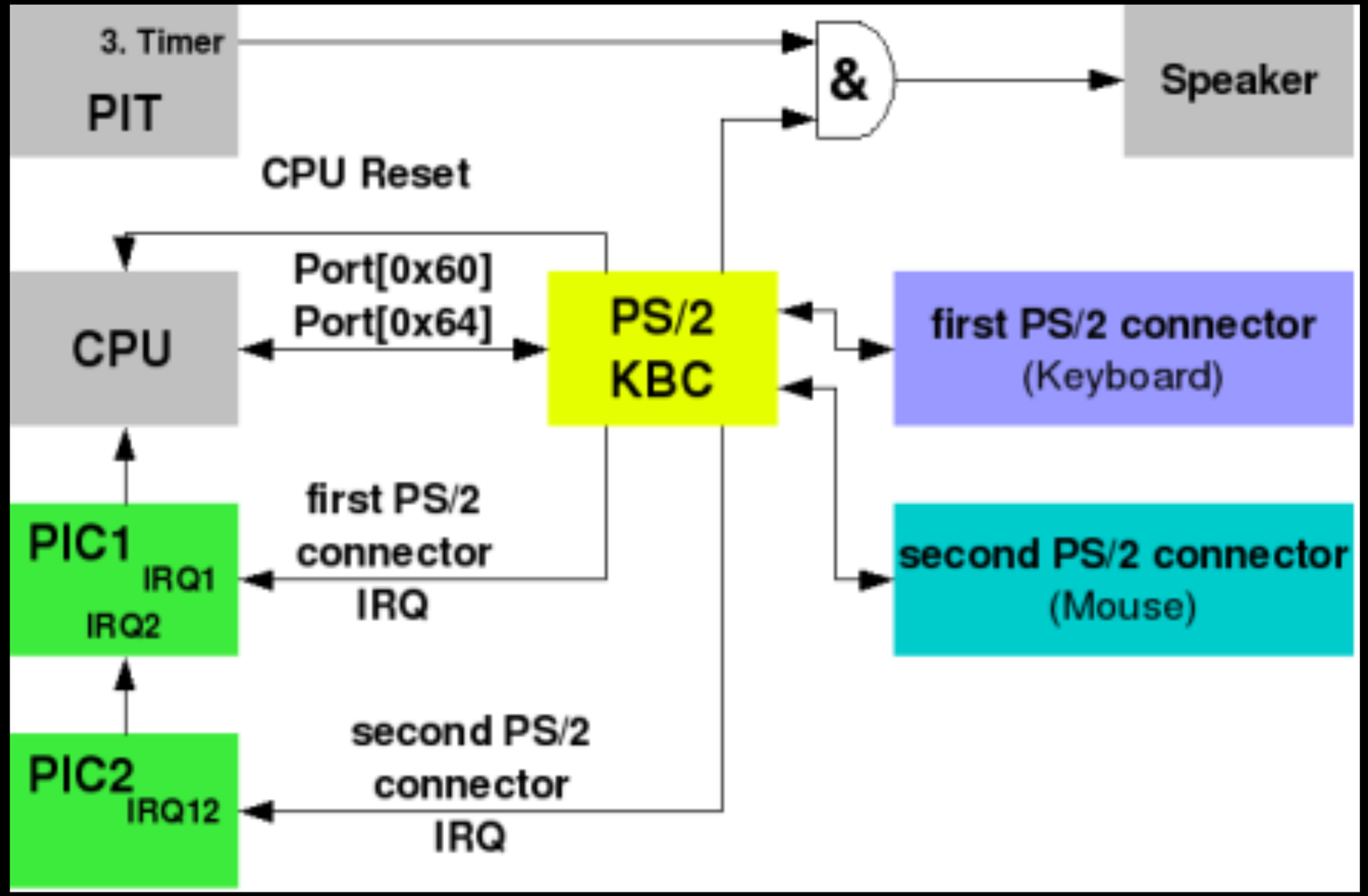
Today’s Goal


Pong Server
Paddle Client 1
Paddle Client 2
Keyboard Driver
Console
Memory Management
You build this!
Sigma0
Moe
Fiasco

PS/2 Keyboard Controller



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 to key code and action
- Wrap a server around it
- Connect your clients

Getting Access to the I/O 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 I/O 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)

Getting Access to the I/O Port

- For interrupts, look at pkg/examples/sys/isr
  (it's C, you can figure out the C++ interface)
- Request I/O port from vbus: l4io_request_ioport(0x60, 1)
- After you received an interrupt, read value from I/O port:
  l4util_in8(0x60)

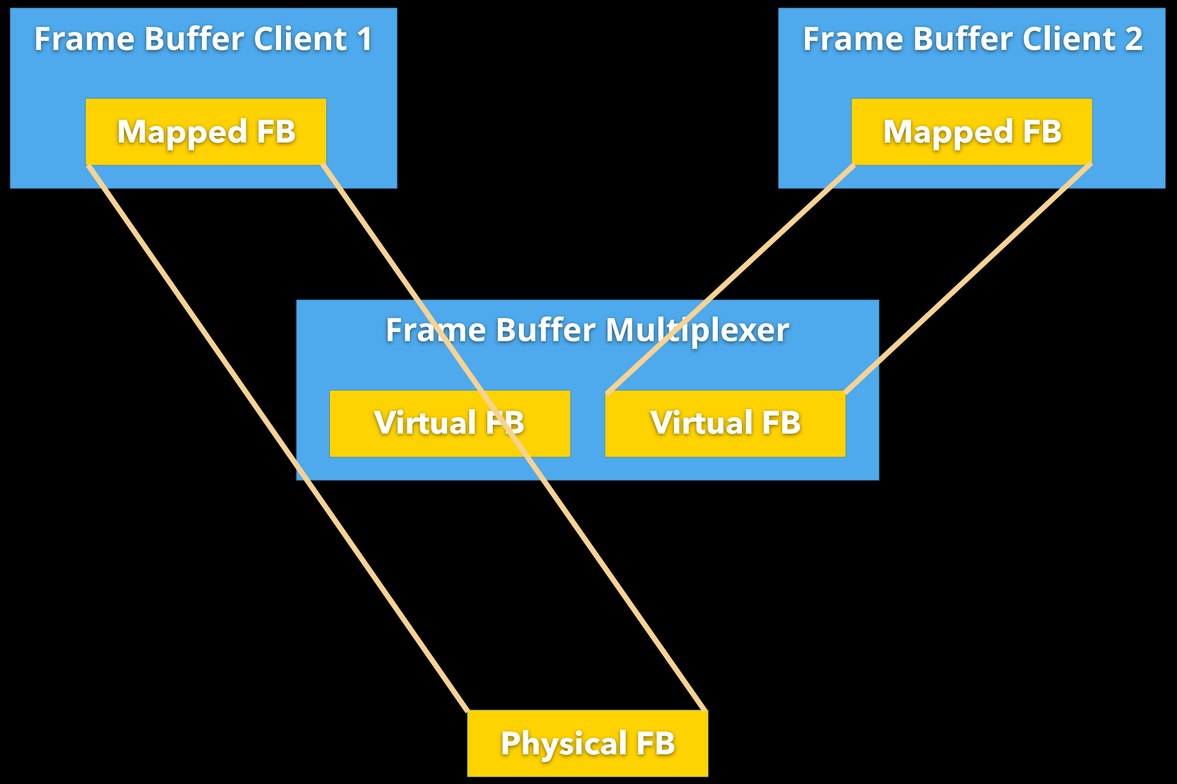
Assignment 1: Keyboard Driver

- 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

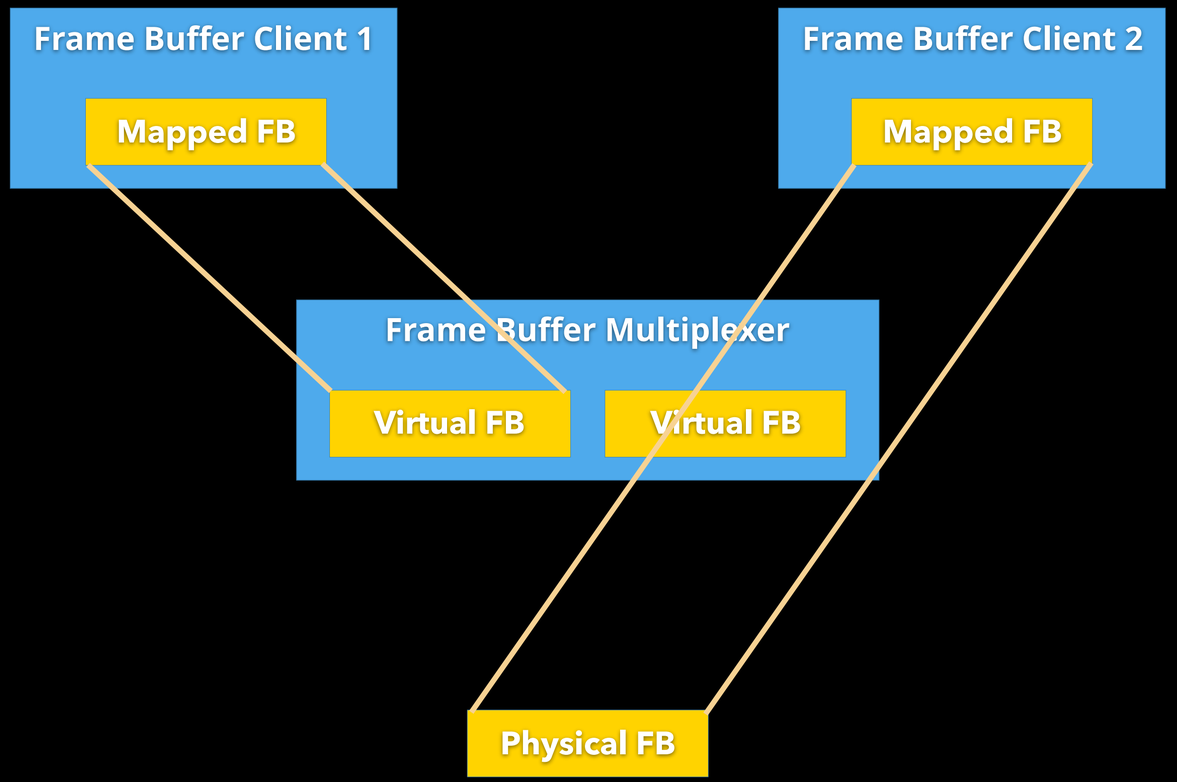
Frame Buffer Multiplexing

- Now there are two programs that can draw:
  - The pong game server
  - The console
- We need to multiplex graphics between the two programs
- One of them should render into physical frame buffer, while the other renders into a virtual frame buffer in memory
- You will need a Dataspace server that serves both clients

Frame Buffer Multiplexing



Frame Buffer Multiplexing



How to Switch Between Console Clients

1. User indicates a client switch
2. Unmap physical frame buffer from foreground client
3. Make this client's frame buffer point to a virtual copy
4. Unmap previously backgrounded client's virtual frame buffer
5. Copy this client's virtual screen into physical frame buffer
6. Make new foreground client use the physical frame buffer

- There is a race condition here:
  - Between steps 2+3 and 4+5, clients might draw, raise a page fault, and request the previously unmapped pages be mapped again
  - You will need to handle that in a sensible way

Handling Client State

- Your server will need to:
  - Hand out two capabilities to frame buffers (i.e., IPC gates that your server will listen 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

Assignment 2: Console Multiplexer

- 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

Final Deadline

- Hand in full solution by 31.03.2019
- Include information on how to use it (keyboard controls, etc.)