Complex Lab – Operating Systems
Graphical Console

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Last assignment

- Any questions?
- Any bug reports, wishes, etc.?
We are here

Pong Server

Paddle Client 1

Paddle Client 2

Memory Management

Moe

Sigma0

Fiasco Kernel
Today’s goal
Graphics (VESA)

- Using VBE/XGA BIOS extension
- Put computer into XGA mode:
  - Requires evil real-mode code
  - GRUB: vbeset <mode>
  - L4 FBDRV: command line option -m <mode>
  - mode: 0x100 - 0x11F, see e.g. Wikipedia on VBE
- Get access to hardware frame buffer
- Render graphics into frame buffer
VESPA on L4Re

- IO server manages all I/O resources
- fb-dr\textit{v} server provides a frame buffer interface.
IO configuration

IO Configuration files:

- Hardware description file (src/l4/pkg/io/io/config/x86-legacy.devs)
- vbus configuration file (x86-fb.io)
Lua example

```lua
local L4 = require("L4");
local ld = L4.default_loader;
local vbus = ld:new_channel();
local fbdrv = ld:new_channel();

ld:start({cap = {fbdrv = vbus:svr(), icu = L4.Env.icu,
                 sigma0 = L4.cast(L4.Proto.Factory, L4.Env.sigma0):
create(L4.Proto.Sigma0)},
            log = {"I0", "yellow" },
            "rom/io\rom/x86-legacy.devs\rom/x86-fb.io"});

ld:start({caps = {vbus = vbus, fb=fbdrv:svr()}},
          log = {"fbdrv", "red"},
          "rom/fb-drvm0x117");

ld:start({caps = {fb = fbdrv}},
          "rom/your_fb_client")
```
L4Re Framebuffer Interface

Headers are at

- `src/l4/pkg/l4re-core/l4re/include/video/goos`, and
- `src/l4/pkg/l4re-code/l4re/util/include/video/goos_fb`

Interface to Goos_fb

- `Goos_fb(char const *name)` — Create FB using capability name (channel to fb-drv)
- `Goos_fb::view_info()` — FB information
- `Goos_fb::attach_buffer()` — Get FB data space
- `Goos_fb::refresh()` — refresh, not necessary for physical FB.
Example: Drawing Pixels

```cpp
auto base = fb.attach_buffer();

L4Re::Util::Video::View::Info info;
int r = fb.view_info(&info);
if (r != 0) error(...);

auto addr = base + y * (info.pixel_info.bytes_per_pixel() 
    * info.width) 
    + x * info.pixel_info.bytes_per_pixel();

// details about color encoding in info.pixel_info
*static_cast<unsigned*>(addr) = value;
```
Rendering Text

Use C library: libgfxbitmap

- Initialize: gfxbitmap_font_init();
- Render text:

```c
gfxbitmap_font_text
(void *fb_base, l4re_video_view_info_t *fbinfo,
 gfxbitmap_font_t font, char const *text,
 unsigned len, unsigned x, unsigned y,
 gfxbitmap_color_pix_t foreground,
 gfxbitmap_color_pix_t background);
```

- fb_base – base address of FB
- fbinfo – L4Re::Framebuffer::Info struct, cast
- Colors are unsigned int
- Useful constants: GFXBITMAP_DEFAULT_FONT, GFXBITMAP_USE_STRLEN
Drawing graphics

- There is a libpng, contact me if you need/want it.
- Consult your favorite Computer Graphics reference for drawing algorithms.
- None of these is necessary for this assignment, as Pong can already draw itself.
Assignment: Graphical text console

- Make your echo server render text into the physical framebuffer (direct access for now)
- Scroll down when the screen is full, as in a terminal.
- When we are going to have input, you might want to scroll up, so keep history.
Next meeting

- Next up: Keyboard driver, graphics multiplexing, and integration.
- We meet on 23.01. for our last meeting.