Architecture for Lightweight Graphics

Applications

ioctl   Framebuffer pointer   ioctl   Framebuffer pointer

Framebuffer Character driver	Software Framebuffer	LCD Framebuffer Character Driver

Framebuffer Driver	Hardware Framebuffer	LCD Driver

Framebuffer Graphics Hardware		Serial/Parallel LCD Hardware
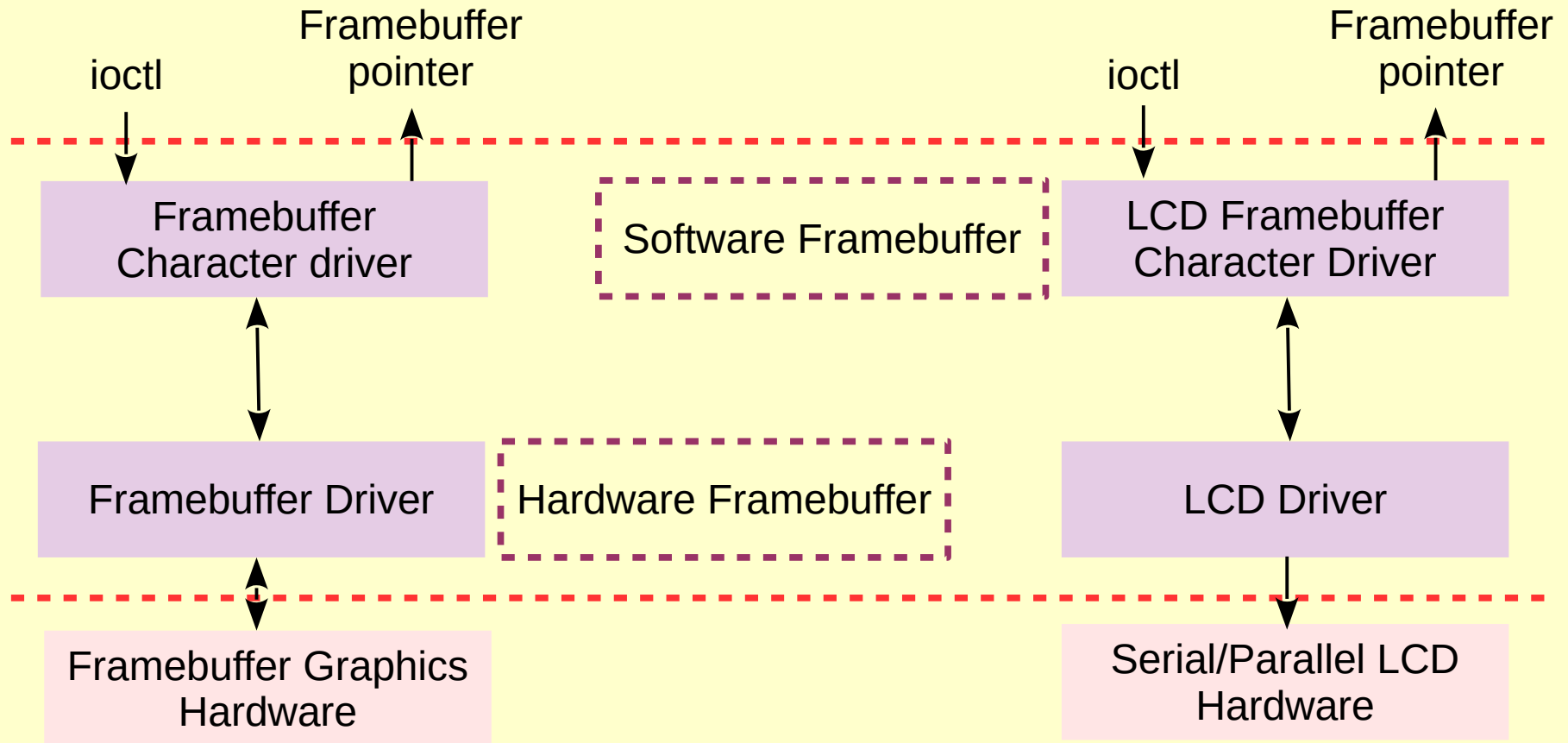
Framebuffer access via read() and write()
IOCTL supports direct memory-mapped framebuffer access

Framebuffer Driver Graphics Applications


```
                    kpettit@grosseto: ~ — ssh -i ~/.ssh/iqanet kpettit@iqnet.iqanalog.com -Y — 111x36
File
┌Source: /mnt/merlin/rx.asm───────────────────────────────────┐  ┌Watch─────────────┐
  145   // =======================================================      PC          0x00A
  146   // This is our main loop.  We we arrive here, we should be at the first    DPTR        0x03
  147   // frame of the multiframe.                                     dptr_addr   0
  148   // =======================================================      dptr_mode   nop
  149   main_loop:                                                      data0_shift 0
  150                                                                   data1_shift 0
  151       // =================================================        data1_width 0
  152       //                                                          oobmode     1
  153       // FRAME 1: CONTROL FRAME                                   samp_sel    0
  154       //                                                          dac1_en     1
  155       // =================================================        dac2_en     0
  156       // The first frame is always a control frame.  This is a 24-byte frame  dsp_write   1
  157       // we simply save to the OOB registers.                     dsp_data    0
  158       // =================================================        ll_read     1
  159       set   dptr_mode=nop            // We don't increment dptr that way it w
  160                                      // a zero, allowing subsequent OOB data
  161                                      // start writing from DPTR=0 also.
  162
  163       set   oobmode = wr_passthru_data  // Default to save oob data every cl
  164       set   linklayer_read = read   // Read data from link layer            ┌─ Key Debug ──┐
  165       data  6                        // Receive 12 of the 24 OOB bytes       Key = 259 (0x103)
  166
  167       set   oobmode = nop            // Turn off OOB data write
┌Command──────────────────────────────────────────────────────┐
merlin> load /mnt/merlin/rx.asm
Loading /mnt/merlin/rx.asm ...
merlin> □
```
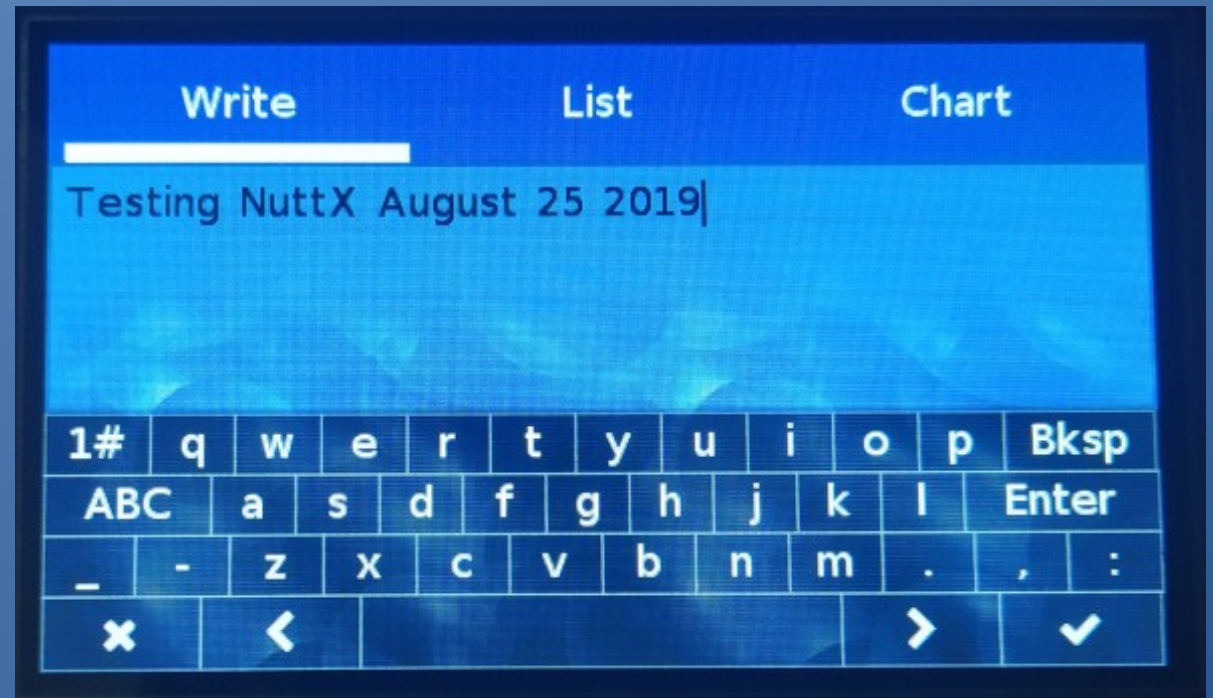
Pdcurses

- Public domain implementation of ncurses ported to NuttX
- Operates on Framebuffer Driver
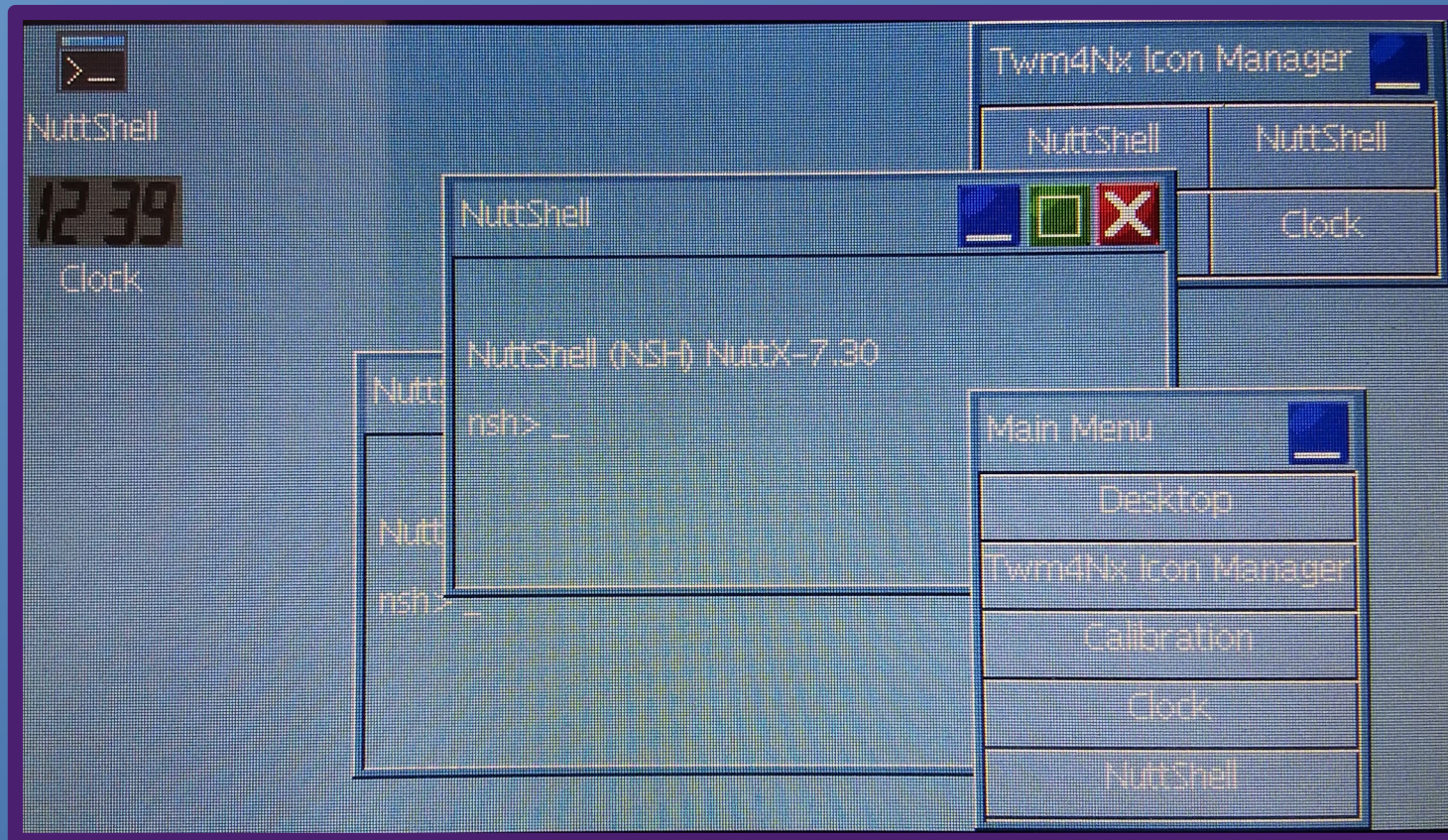- Also over Serial or Telnet

Framebuffer Driver Graphics Applications

LittlevGL

- Developed by Gábor Kiss-Vámosi https://littlevgl.com/
- Uses framebuffer character driver
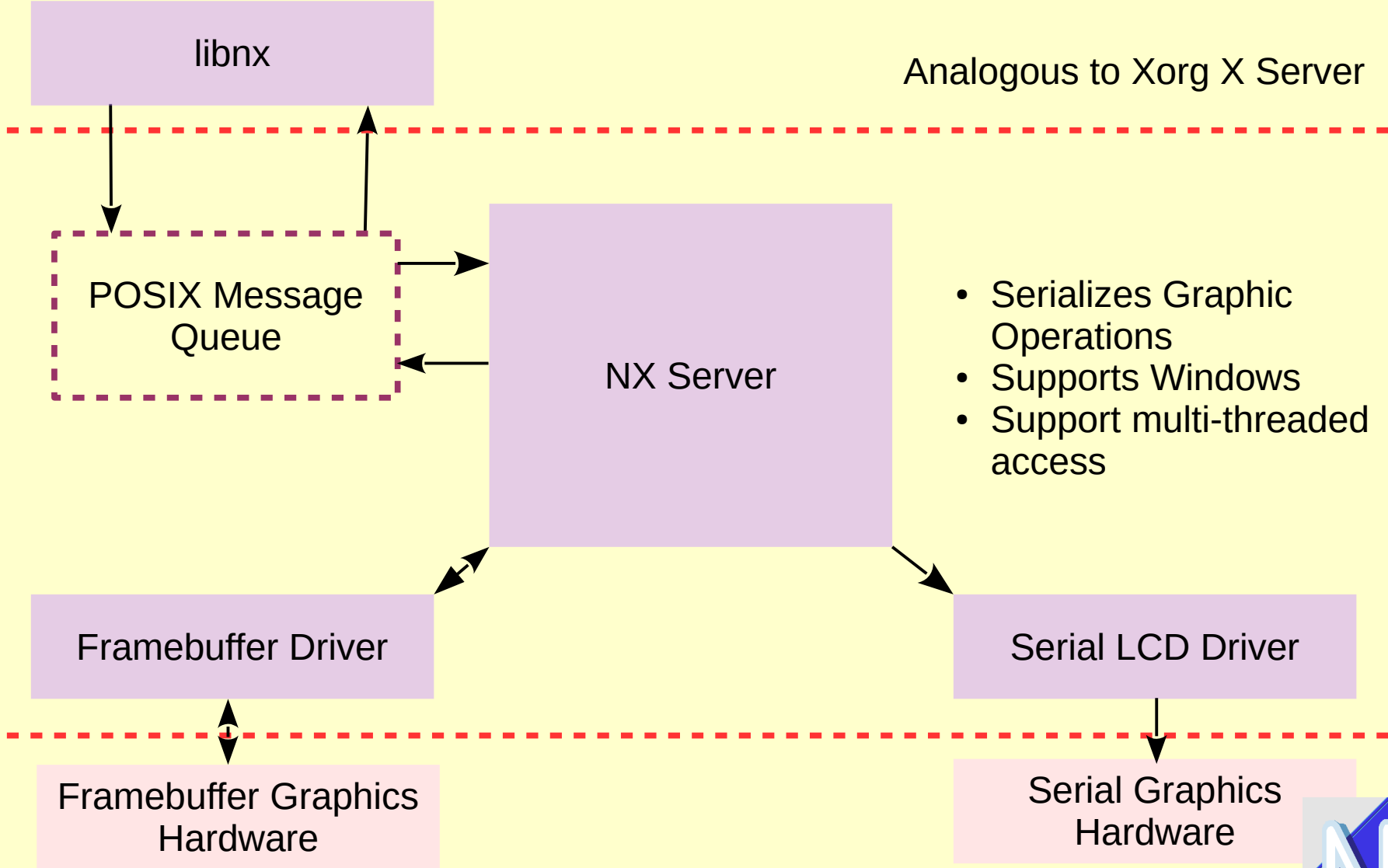- Great color effects!
- Single user task only

Windows

Twm4Nx on 480x272 LCD

- Adds *vertical* Z dimension
- Supports *multi-threaded* displays: One thread per window

NX Graphics Server

Applications

libnx

Analogous to Xorg X Server

POSIX Message Queue

NX Server

- Serializes Graphic Operations
- Supports Windows
- Support multi-threaded access

Framebuffer Driver

Serial LCD Driver

Framebuffer Graphics Hardware

Serial Graphics Hardware

NX Graphics Libraries

- **NxWidgets**

  Provides C++ library of *widgets*

  Buttons, radio buttons, keypads, images, text boxes, sliders, scrollbars, progress bars, keypads, etc.

  Very extensive.. based on Whoopsi

  Implemented as a user space library

- ***NxTerm***

  Provides a text-based terminal window

  Analogous to Xterms

  Implemented as a OS character driver

NX Graphics Applications

Screenshot
  Capture current framebuffer display in TIFF file

Two Window Managers:

- **Tmx4Nx** (see above)
  Port of Tom's Window Manager (TWM) to NX Server and NxWidgets
  Converted to C++
  Full desktop window system
  Best for larger displays

- **NxWM** (next slide)

Graphics Applications (Cont'd)

- **NxWM**
  Tiny window manager intended for very small displays

  Focused windows
  Built on top of the NX Server

  Toolbar + Start Window + Focused Windows