

# Graphics beyond the main compositor

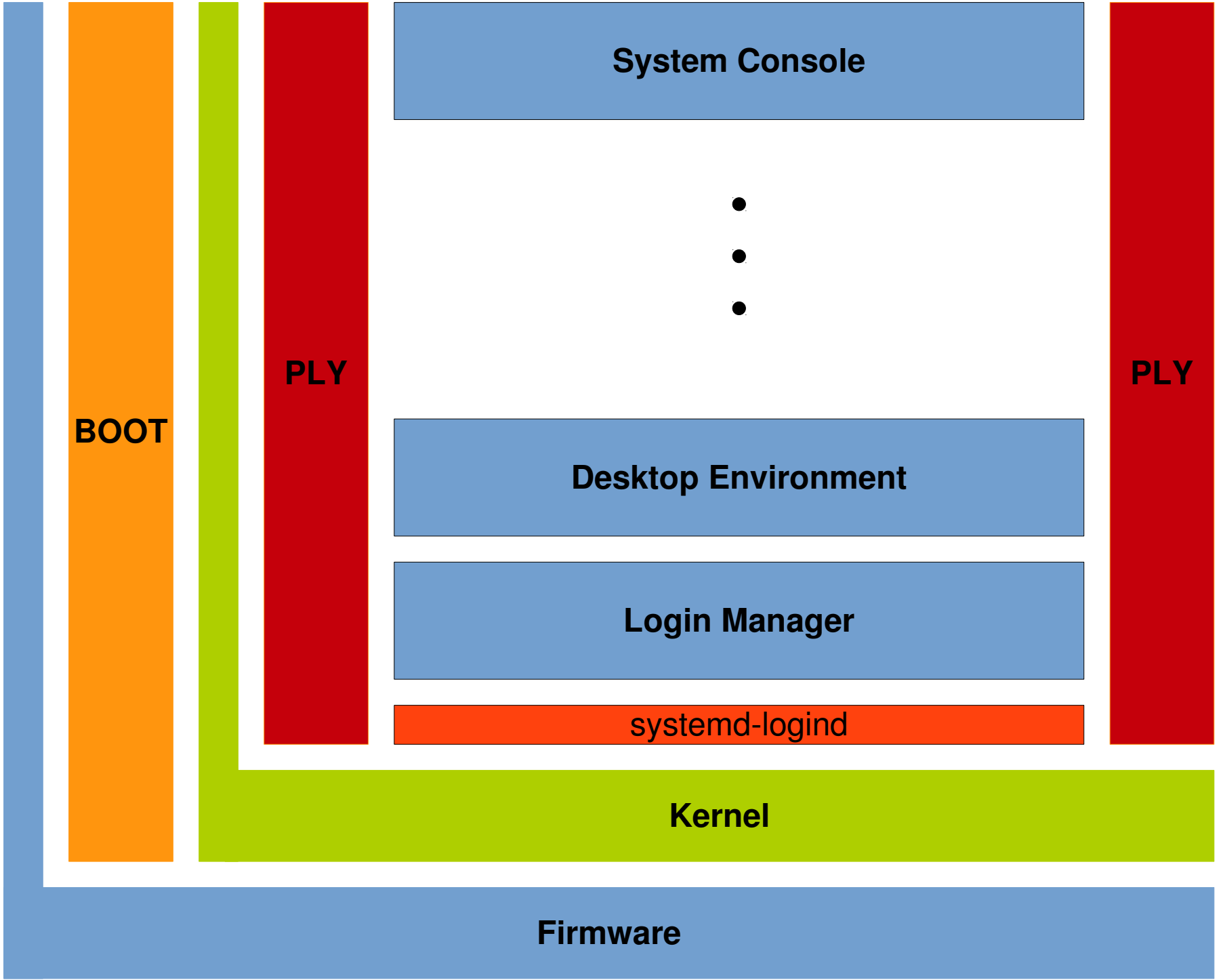
# “Happy Place”

- no complex hardware
- trivial software rendering
- no external vendor libraries
- no timing issues

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*..so I was told.*



**BOOT**

**PLY**

**PLY**

**System Console**

•  
•  
•

**Desktop Environment**

**Login Manager**

**systemd-logind**

**Kernel**

**Firmware**



System Console

•  
•  
•

**Desktop Environment**

Login Manager

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Firmware

BOOT

PLY

PLY



**Hide!**

Functionality vs. Eye-candy

- “Branding” / eye-candy
- Passwords / Options
- Debugging / Error handling



# Branding

- Distraction, not attraction

# Branding

- Distraction, not attraction
- Branding is crucial

# Debugging / Error-Handling

- Universal Console + System-log

# Debugging / Error-Handling

- Universal Console + System-log
  - drmlog

```
[ 3 18:18] Initializing cgroup subsys cpuset
[ +0.000000] Initializing cgroup subsys cpuset
[ +0.000000] Initializing cgroup subsys cpuct
[ +0.000000] Linux version 3.14.0-rc4-ARCH-00003-g8553bac-dirty (david@david-tp) (gcc version 4.8.2 20140206 (prerelea
se) (GCC) ) #13 SMP PREEMPT Mon Mar 3 18:14:11 CET 2014
[ +0.000000] Command line: root=/dev/sda3 rw
[ +0.000000] e820: BIOS-provided physical RAM map:
[ +0.000000] BIOS-e820: [mem 0x0000000000000000-0x00000000000057ffff] usable
[ +0.000000] BIOS-e820: [mem 0x000000000058000-0x00000000000058ffff] reserved
[ +0.000000] BIOS-e820: [mem 0x00000000000059000-0x0000000000009bffff] usable
[ +0.000000] BIOS-e820: [mem 0x0000000000009c000-0x0000000000009cffff] reserved
[ +0.000000] BIOS-e820: [mem 0x0000000000009d000-0x0000000000009dffff] usable
[ +0.000000] BIOS-e820: [mem 0x0000000000009e000-0x000000000000bffff] reserved
[ +0.000000] BIOS-e820: [mem 0x000000000100000-0x000000000cf55ffff] usable
[ +0.000000] BIOS-e820: [mem 0x000000000cf56000-0x000000000cff57fff] reserved
[ +0.000000] BIOS-e820: [mem 0x000000000cff58000-0x000000000da3e8fff] usable
[ +0.000000] BIOS-e820: [mem 0x000000000da3e9000-0x000000000dcd3efff] reserved
[ +0.000000] BIOS-e820: [mem 0x000000000dcd3f000-0x000000000dce7efff] ACPI NVS
[ +0.000000] BIOS-e820: [mem 0x000000000dce7f000-0x000000000dceffff] ACPI data
[ +0.000000] BIOS-e820: [mem 0x000000000dcefff000-0x000000000dceffff] usable
[ +0.000000] BIOS-e820: [mem 0x000000000df00000-0x000000000df9ffff] reserved
[ +0.000000] BIOS-e820: [mem 0x000000000df0f8000-0x000000000df8f8fff] reserved
[ +0.000000] BIOS-e820: [mem 0x000000000fed1c000-0x000000000fed1ffff] reserved
[ +0.000000] BIOS-e820: [mem 0x0000000100000000-0x000000041e5ffff] usable
[ +0.000000] NX (Execute Disable) protection: active
[ +0.000000] e820: update [mem 0xd11d0018-0xd11e0057] usable ==> usable
[ +0.000000] e820: update [mem 0xd11bf018-0xd11cf857] usable ==> usable
[ +0.000000] extended physical RAM map:
[ +0.000000] reserve setup_data: [mem 0x0000000000000000-0x00000000000057ffff] usable
[ +0.000000] reserve setup_data: [mem 0x00000000000058000-0x00000000000058ffff] reserved
[ +0.000000] reserve setup_data: [mem 0x00000000000059000-0x0000000000009bffff] usable
[ +0.000000] reserve setup_data: [mem 0x0000000000009c000-0x0000000000009cffff] reserved
[ +0.000000] reserve setup_data: [mem 0x0000000000009d000-0x0000000000009dffff] usable
[ +0.000000] reserve setup_data: [mem 0x0000000000009e000-0x000000000000bffff] reserved
[ +0.000000] reserve setup_data: [mem 0x000000000100000-0x000000000cf55ffff] usable
[ +0.000000] reserve setup_data: [mem 0x000000000cf56000-0x000000000cff57fff] reserved
[ +0.000000] reserve setup_data: [mem 0x000000000cff58000-0x000000000d11bf017] usable
[ +0.000000] reserve setup_data: [mem 0x000000000d11bf018-0x000000000d11cf857] usable
[ +0.000000] reserve setup_data: [mem 0x000000000d11cf858-0x000000000d11d0017] usable
[ +0.000000] reserve setup_data: [mem 0x000000000d11d0018-0x000000000d11e0057] usable
[ +0.000000] reserve setup_data: [mem 0x000000000d11e0058-0x000000000da3e8fff] usable
[ +0.000000] reserve setup_data: [mem 0x000000000da3e9000-0x000000000dcd3efff] reserved
[ +0.000000] reserve setup_data: [mem 0x000000000dcd3f000-0x000000000dce7efff] ACPI NVS
[ +0.000000] reserve setup_data: [mem 0x000000000dce7f000-0x000000000dceffff] ACPI data
[ +0.000000] reserve setup_data: [mem 0x000000000dcefff000-0x000000000dceffff] usable
[ +0.000000] reserve setup_data: [mem 0x000000000df00000-0x000000000df9ffff] reserved
[ +0.000000] reserve setup_data: [mem 0x000000000df0f8000-0x000000000df8f8fff] reserved
[ +0.000000] reserve setup_data: [mem 0x000000000fed1c000-0x000000000fed1ffff] reserved
[ +0.000000] reserve setup_data: [mem 0x0000000100000000-0x000000041e5ffff] usable
[ +0.000000] efi: EFI v2.31 by Lenovo
[ +0.000000] efi: ACPI=0xdcdfe000 ACPI 2.0=0xdcdfe014 SMBIOS=0xdcd3e000
[ +0.000000] efi: mem00: type=7, attr=0xf, range=[0x0000000000000000-0x0000000000001000] (0MB)
[ +0.000000] efi: mem01: type=2, attr=0xf, range=[0x0000000000001000-0x0000000000007000] (0MB)
[ +0.000000] efi: mem02: type=7, attr=0xf, range=[0x0000000000007000-0x00000000000058000] (0MB)
[ +0.000000] efi: mem03: type=0, attr=0xf, range=[0x00000000000058000-0x00000000000059000] (0MB)
[ +0.000000] efi: mem04: type=7, attr=0xf, range=[0x00000000000059000-0x0000000000009c000] (0MB)
[ +0.000000] efi: mem05: type=0, attr=0xf, range=[0x0000000000009c000-0x0000000000009d000] (0MB)
[ +0.000000] efi: mem06: type=4, attr=0xf, range=[0x0000000000009d000-0x0000000000009e000] (0MB)
[ +0.000000] efi: mem07: type=0, attr=0xf, range=[0x0000000000009e000-0x000000000000a0000] (0MB)
[ +0.000000] efi: mem08: type=7, attr=0xf, range=[0x000000000000a0000-0x0000000001000000] (15MB)
[ +0.000000] efi: mem09: type=2, attr=0xf, range=[0x0000000001000000-0x00000000025fe000] (3259MB)
[ +0.000000] efi: mem10: type=7, attr=0xf, range=[0x00000000025fe000-0x000000000ce1ba000] (0MB)
[ +0.000000] efi: mem11: type=4, attr=0xf, range=[0x000000000ce1ba000-0x000000000ce1da000] (0MB)
[ +0.000000] efi: mem12: type=7, attr=0xf, range=[0x000000000ce1da000-0x000000000cf6b7000] (20MB)
[ +0.000000] efi: mem13: type=1, attr=0xf, range=[0x000000000cf6b7000-0x000000000cf6f3000] (6MB)
[ +0.000000] efi: mem14: type=4, attr=0xf, range=[0x000000000cf6f3000-0x000000000cf560000] (0MB)
[ +0.000000] efi: mem15: type=0, attr=0xf, range=[0x000000000cf560000-0x000000000cff58000] (2MB)
[ +0.000000] efi: mem16: type=4, attr=0xf, range=[0x000000000cff58000-0x000000000d11aa000] (18MB)
[ +0.000000] efi: mem17: type=7, attr=0xf, range=[0x000000000d11aa000-0x000000000d11bf000] (0MB)
[ +0.000000] efi: mem18: type=2, attr=0xf, range=[0x000000000d11bf000-0x000000000d11e9000] (0MB)
[ +0.000000] efi: mem19: type=7, attr=0xf, range=[0x000000000d11e9000-0x000000000d13d2000] (1MB)
[ +0.000000] efi: mem20: type=1, attr=0xf, range=[0x000000000d13d2000-0x000000000d13e9000] (0MB)
[ +0.000000] efi: mem21: type=7, attr=0xf, range=[0x000000000d13e9000-0x000000000d1a7000] (13MB)
[ +0.000000] efi: mem22: type=4, attr=0xf, range=[0x000000000d1a7000-0x000000000d2b2f000] (6MB)
[ +0.000000] efi: mem23: type=7, attr=0xf, range=[0x000000000d2b2f000-0x000000000d2eb7000] (6MB)
[ +0.000000] efi: mem24: type=4, attr=0xf, range=[0x000000000d2eb7000-0x000000000d4d9f000] (30MB)
[ +0.000000] efi: mem25: type=7, attr=0xf, range=[0x000000000d4d9f000-0x000000000d4da1000] (0MB)
[ +0.000000] efi: mem26: type=4, attr=0xf, range=[0x000000000d4da1000-0x000000000d63e9000] (22MB)
[ +0.000000] efi: mem27: type=7, attr=0xf, range=[0x000000000d63e9000-0x000000000d9e0c000] (58MB)
[ +0.000000] efi: mem28: type=3, attr=0xf, range=[0x000000000d9e0c000-0x000000000da3e9000] (5MB)
[ +0.000000] efi: mem29: type=5, attr=0x800000000000000f, range=[0x000000000da3e9000-0x000000000da5e9000] (2MB)
[ +0.000000] efi: mem30: type=6, attr=0x800000000000000f, range=[0x000000000da5e9000-0x000000000db3e8000] (13MB)
[ +0.000000] efi: mem31: type=0, attr=0xf, range=[0x000000000db3e8000-0x000000000dcd3f000] (25MB)
[ +0.000000] efi: mem32: type=10, attr=0xf, range=[0x000000000dcd3f000-0x000000000dce7f000] (1MB)
[ +0.000000] efi: mem33: type=9, attr=0xf, range=[0x000000000dce7f000-0x000000000dcefff000] (0MB)
[ +0.000000] efi: mem34: type=4, attr=0xf, range=[0x000000000dcefff000-0x000000000df00000] (0MB)
[ +0.000000] efi: mem35: type=7, attr=0xf, range=[0x000000000df000000-0x000000000d11e60000] (12774MB)
[ +0.000000] efi: mem36: type=0, attr=0x0, range=[0x000000000d11e60000-0x000000000d11e90000] (0MB)
[ +0.000000] efi: mem37: type=0, attr=0x0, range=[0x000000000d11e90000-0x000000000da3e9000] (43MB)
[ +0.000000] efi: mem38: type=11, attr=0x8000000000000001, range=[0x000000000da3e9000-0x000000000df0f9000] (0MB)
[ +0.000000] efi: mem39: type=11, attr=0x8000000000000001, range=[0x000000000df0f9000-0x000000000fed20000] (0MB)
[ +0.000000] efi: mem40: type=0, attr=0x0, range=[0x000000000fed20000-0x0000000000000000] (0MB)
[ +0.000000] efi: mem41: type=0, attr=0x0, range=[0x0000000000000000-0x0000000000000000] (0MB)
[ +0.000000] efi: mem42: type=0, attr=0x0, range=[0x0000000000000000-0x0000000000000000] (0MB)
[ +0.000000] efi: mem43: type=0, attr=0x0, range=[0x0000000000000000-0x0000000000000000] (0MB)
[ +0.000000] efi: mem44: type=0, attr=0x0, range=[0x0000000000000000-0x0000000000000000] (0MB)
[ +0.000000] efi: mem45: type=0, attr=0x0, range=[0x0000000000000000-0x0000000000000000] (0MB)
[ +0.000000] efi: mem46: type=0, attr=0x0, range=[0x0000000000000000-0x0000000000000000] (0MB)
[ +0.000000] SMBIOS 2.7 present.
[ +0.000000] DMI: LENOVO 20ANCTO1UW/20ANCTO1UW, BIOS GLET43WU (1.18) 12/04/2013
[ +0.000000] e820: update [mem 0x00000000-0x00000fff] usable ==> reserved
[ +0.000000] e820: remove [mem 0x000a0000-0x000ffff] usable
[ +0.000000] No AGP bridge found
[ +0.000000] e820: last_pfn = 0x41e600 max_arch_pfn = 0x400000000
[ +0.000000] MTRR default type: write-back
[ +0.000000] MTRR fixed ranges enabled:
[ +0.000000] 00000-9FFFF write-back
[ +0.000000] A0000-BFFFF uncachable
[ +0.000000] C0000-FFFFFF write-protect
[ +0.000000] MTRR variable ranges enabled:
[ +0.000000] 0 base 00E000000 mask 7FE000000 uncachable
[ +0.000000] 1 base 00DE00000 mask 7FFE00000 uncachable
[ +0.000000] 2 base 00DD00000 mask 7FFF00000 uncachable
[ +0.000000] 3 base 00DCF0000 mask 7FFF00000 uncachable
[ +0.000000] 4 disabled
[ +0.000000] 5 disabled
[ +0.000000] 6 disabled
[ +0.000000] 7 disabled
[ +0.000000] 8 disabled
[ +0.000000] 9 disabled
[ +0.000000] x86 PAT enabled: cpu 0, old 0x7040600070406, new 0x7010600070106
[ +0.000000] e820: last_pfn = 0xdcd00 max_arch_pfn = 0x400000000
[ +0.000000] Scanning 1 areas for low memory corruption
[ +0.000000] Base memory trampoline at [ffff880000096000] 96000 size 24576
[ +0.000000] Using 6B pages for direct mapping
[ +0.000000] init_memory_mapping: [mem 0x00000000-0x000ffff]
[ +0.000000] [mem 0x00000000-0x000ffff] page 4k
[ +0.000000] BRK [0x031dc000, 0x031dcfff] PGTABLE
[ +0.000000] BRK [0x031dd000, 0x031ddfff] PGTABLE
[ +0.000000] BRK [0x031de000, 0x031defff] PGTABLE
[ +0.000000] init_memory_mapping: [mem 0x41e400000-0x41e5ffff]
[ +0.000000] [mem 0x41e400000-0x41e5ffff] page 2M
[ +0.000000] BRK [0x031df000, 0x031dffff] PGTABLE
[ +0.000000] init_memory_mapping: [mem 0x41c000000-0x41c3ffff]
[ +0.000000] [mem 0x41c000000-0x41c3ffff] page 2M
```

- Multi-column
- Integer scaling
- Atomic modesetting

# Debugging / Error-Handling

- Universal Console + System-log
  - drmlog
  - systemd-emergencyd
  - systemd-consoled

# User-Interaction

- polkit et. al.

# User-Interaction

- polkit et. al.
  - SAK



# **Challenges**

“Every frame is perfect”  
*(wayland style)*

“Every frame is perfect”  
(*wavland style*)

**BROKEN**

software-rendering

software-rendering

**DONE**

hardware-handover

hardware handover

**DONE**

# Multi GPU



Multi GPU

**DONE**

# Internationalization and Accessibility

Internationalization  
and  
Accessibility

**PARTLY**

# Global Hotkeys

Global Hotkeys

**BROKEN**

Non KMS?

