DISPLAYPORT COMPLIANCE
Fixing Black Screens on Linux

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Every end user’s dream – no black screens

Make Intel graphics kernel driver **DisplayPort** compliant and **upstream** it.

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What happens when you connect a DP cable?

- Hot Plug Detect Signal
- DPCD Read/Write
- Serialized/Encoded Data at Link Clock
Display Port Link Training

- **Main Link Parameters:**
  - Lanes – 1, 2 or 4
  - Link Rate – 1.62, 2.7, 5.4 or 8.1 Gbps/lane

- **Link Training:**
  - DP source configures the main link through link training sequence
How to test DP compliance?

- **Device Under Test**: DP source
- **DP Monitor**: DP sink
- **DP reference sink**: Monitor Out -> DPR 120
- **Compliance Test Suite SW**: USB input

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Atomic KMS – Making Kernel and GPU play nicely

An attempt of making “Every Frame Perfect”
Finally got the ball rolling!!!

Did we fix black screens ????
“Anything that can go wrong, will go wrong”

Link Training FAILURE…
Black Screens…
Problem: Does the Atomic KMS driver handle link failures?

Link Failures, black screen…
Solution:

Stable link = Successful Modeset = Perfect frame
Failure is always an Option….

1. Atomic check guarantees the requested mode
   - Can only check GPU parameters, not the physical DP cable
   - Link training can still fail
2. Link Failure can be asynchronous
   - Link might fail after a successful modeset
3. Atomic allows non blocking commits
   - Return to userspace before modeset has completed

*Asynchronous handling of link failures extremely critical*
Entire graphics stack testing

Desktop Environment (KDE/Gnome)  ./auto-randr

X server  xf86-video-intel  xf86-video-modesetting

INTEL GRAPHICS i915

- Probe connector
- Fetch list of available modes
- Pick highest
- Redo modeset

• Checks link_status
  • If Bad, redo modeset on current mode, send xrandr event

1) Validate mode
2) Link train @ 5.4, 4 lanes
3) Link failure
4) Fallback
5) Link status = BAD
6) Uevent

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Intel GPU Tools - DP Compliance Tool

- Handle Compliance Test request
- Set compliance test_active
- Read DPCD and write to debugfs node
- Uevent on link failure

- Set up FB/video pattern, do a modeset on requested mode
- Handle uevent and redo a modeset

```
./Intel_dp_compliance
IGT
DRM Master
```

**Compliance Test Request from DPR 120**

**INTEL GRAPHICS i915**

**Debugfs/Hotplug Uevent**

DRM_IOCTL_GETCONNECTOR
DRM_IOCTL_SETCRTC

**Short Pulse**
Future steps

- Replace Unigraf’s DPR-120 with Google’s Chamelium Board
  - Allows testing all connector types (external displays)
  - Open Source HW - extend to add all corner cases

- Port the DP compliance test suite (as per VESA CTS) to Chamelium

- Port the IGT intel_dp_compliance tool to Chamelium testing tool.

- Add DP Compliance testing to Pre-merge CI systems
Thanks to Open Source Community!

- Kernel - Daniel Vetter, Jani Nikula, Ville Syrjala, Rodrigo Vivi, Jim Bride, Matt Roper, Harry Wentland, Sean Paul
- X - Martin Peres, Chris Wilson, Eric Anholt, Adam Jackson
- IGT - Petri Latvala
We are DP Compliant as of Linux Kernel 4.12 and xorg-server-1.19.3

Questions?

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What is DP Compliance?

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Kernel’s Responsibility - Mode setting

Process of setting up clocks, scanout buffers, initializing the chip and lighting up displays
Atomic KMS – Making Kernel and GPU play nicely

An attempt at making “Every Frame Perfect”

An Atomic Operation is the one that appears to take place as a single indivisible operation
“A journey of a thousand miles begins with a single step”
Upstreaming Challenge - Coordinating Compliance

- Coordinating Compliance

Both Userspace and Kernel responsible to ensure 100% DP Compliance

Handle
Uevent
Check Link
Status
Retry
Modeset

Patches

xf86-video-intel
xf86-video-modesetting

DRM
i915

- Link Train Fallback
- Set Link Status
- Send Uevent
- Link Retraining

• Old Userspace with new Kernel – Not Compliant
• New Userspace with old Kernel – Not Compliant

*Both Userspace and Kernel responsible to ensure 100% DP Compliance*
Who is responsible for DP Compliance?

- Userspace
  - Surfaceflinger/ HW Composer
  - Libdrm
  - 3D Graphics
  - Mesa (3D Graphics Driver)

- Linux Kernel
  - Intel Graphics Driver I915
  - DRM

- Intel Integrated Graphics Device - GPU

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