



# The state of video offloading on the Linux Desktop

About convergence and longer battery life

FOSDEM<sup>'24</sup>

COLLABORA

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# What am I even talking about?

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- Hardware video decoders (VA-API, V4L2, Vulkan) decode to **YCbCr**/YUV formats
- **Display controllers** often can convert to **RGB**, scale and rotate
- Needed to get the maximum out of your hardware

# What am I even talking about?

- Embedded: apps can use KMS/DRM directly
  - Gstreamer: kmssink
  - MPV: --vo=drm
  - QT: QT\_QPA\_PLATFORM=eglfs
  - Kodi: --windowing=gbm
  - Various proprietary solutions
- X11: Xvideo
  - Never really took off

# What am I even talking about?



# What am I even talking about?

- Wayland:
  - First publicly demonstrated video offloading in 2014
  - Gstreamer: waylandsink / gtkwaylandsink
  - MPV: --vo=dmabuf-wayland
  - Limited compositor and client support, practically constrained to embedded

# What am I even talking about?

- Wayland matured on the desktop
- Apps/toolkits started to use GL/Vulkan
- Atomic-KMS:
  - `DRM_MODE_ATOMIC_TEST_ONLY`
- DMABuf:
  - Explicit modifiers (tiling/compression)



# Current state and recent developments

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- Mutter / Gnome-Shell:
  - YCbCr support (Gnome 45)
  - KMS scaling support (Gnome 46 🙌)
- GTK4:
  - GtkGraphicsOffload (GTK 4.14)
  - Light Video / livi ( 🙌 )
  - Gtk4paintablesink ( 🙌 )

# Current state and recent developments



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# Current state and recent developments

- ChromeOS
  - Is switching to Wayland (Lacros/Exo)
  - Experimental patches for non-ChromeOS Wayland backend exist
  - `--enable-hardware-overlays=single-fullscreen,single-on-top,underlay`
  - Sommelier lacking behind (Linux apps in containers)

# Current state and recent developments

- Compositors:
  - Weston: Good hardware plane support
  - Mutter: Fullscreen only
  - Kwin: NV12 support landed for Plasma 6.0 / Fullscreen only
  - wlroots:
    - Sway: scene graph API support landed
    - Wayfire, Hyprland: not using wlroots scene graph / render API

# Current state and recent developments

- Missing Wayland protocols:
  - Color representation protocol (10bit content/BT.2020)
  - Color management protocol (HDR)
  - 2024?

# Current state and recent developments

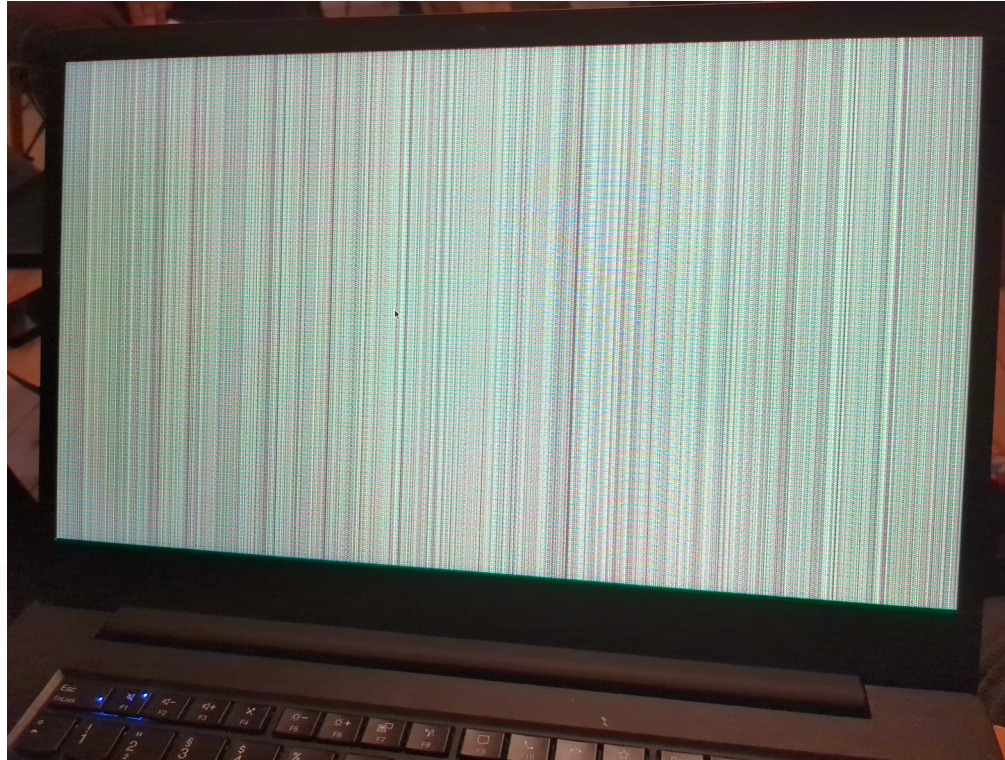


- Most compositors have at least basic support for YCbCr formats and fullscreen playback
- Lots of positive dynamics
- Some features still missing
- Good moment to join the effort!



# Demos and benchmarks

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# Demos and benchmarks

```
intel-gpu-top: Intel Skylake (Gen9) @ /dev/dri/card1 - 565/ 580 MHz; 15% RC6; 4.56/10.27 W; 073 frq/s
IMC reads: 5938 MiB/s
IMC writes: 3810 MiB/s

ENGINES BUSY
Render/3D 55.20%
Blitter 9.99%
Video 45.99%
VideoEnhance 9.99%

PID NAME
57182 dash |
1 systemd |
2802 nextcloud |
32075 xps |
46965 XwayLand |
46974 gdm-settings |
47607 mutter-x11-fram |
49724 firefox |
54839 nautilus |
```

# Demos and benchmarks

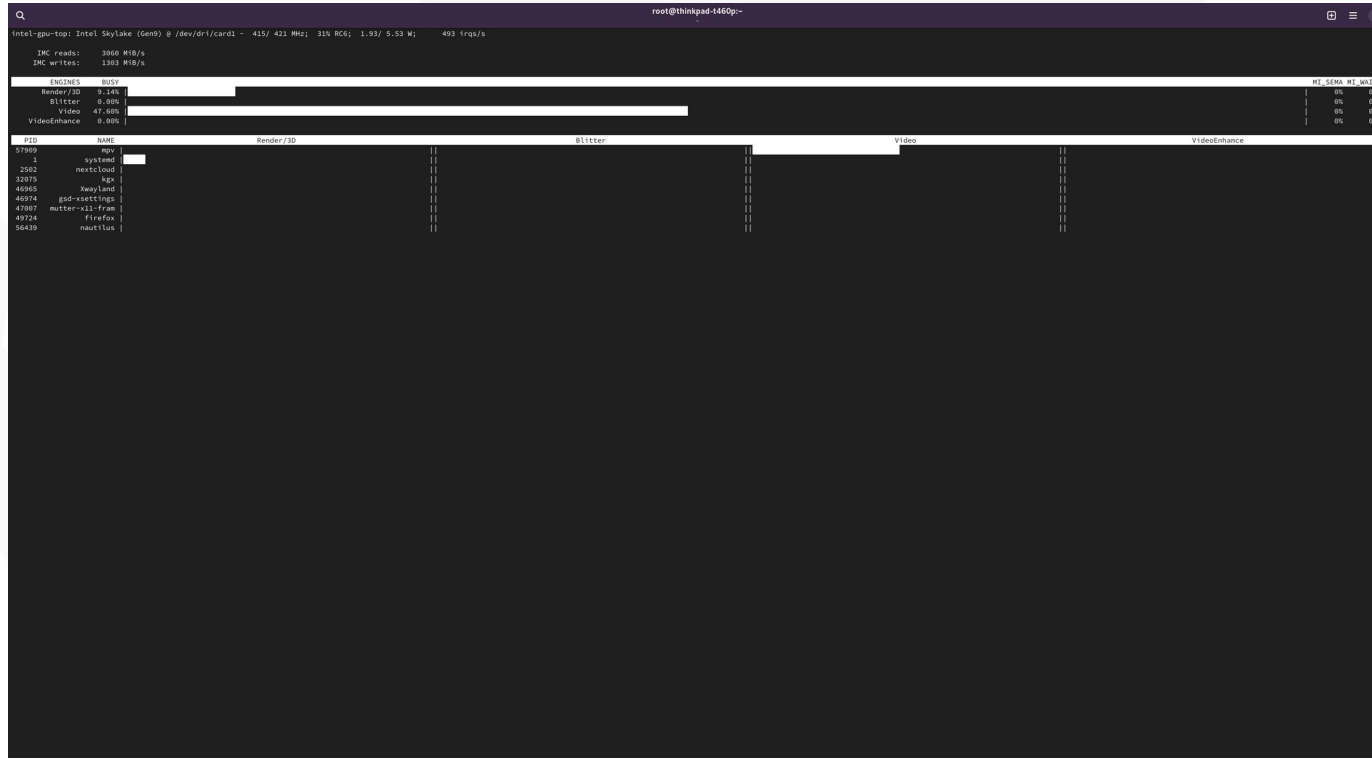
```
intel-gpu-top: Intel Skylake (Gen9) @ /dev/dri/card1 - 898/ 947 MHz; 0% RC6; 9.74/15.78 W; 327 frq/s
IMC reads: 9474 MiB/s
IMC writes: 7071 MiB/s

ENGINES  BUSY
Render/3D 99.30%
Blitter 9.50%
Video 48.56%
VideoEnhance 9.00%

MT_SEMA  MT_WAIT
| 0% 0%
| 0% 0%
| 14% 0%
| 8% 0%
```

PID	NAME	Render/3D	Blitter	Video	VideoEnhance
15266	xpp				
1	systemd				
2802	nextcloud				
32075	xpp				
46965	xwayland				
46974	gdm-settings				
47607	mutter-x11-fram				
49724	firefox				
94839	nautilus				

# Demos and benchmarks



# Demos and benchmarks

```
intel-gpu-top: Intel Skylake (Gen9) 0 /dev/dri/card1 - 433/ 437 MHz; 25% RC6; 1.84/ 5.68 W; 466 frq/s
IMC reads: 3141 MiB/s
IMC writes: 1380 MiB/s

ENGINES  BUSY
Render/3D  9.10%
Bltitter   9.80%
Video     53.17%
VideoEnhance  9.90%

PID  NAME  Render/3D  Bltitter  Video  VideoEnhance
57892  Xfs  ||
1  systemd  ||
2802  nextcloud  ||
32875  Xps  ||
46965  Xwayland  ||
46974  gdm-session  ||
47807  mutter-x11-fram  ||
49724  firefox  ||
54839  nautilus  ||
```

# Demos and benchmarks

- Current GTK4 players: > 10W
- MPV default: > 15W
- MPV `-vo=dmabuf-wayland`: ~5.5W
- Livi / upcoming GTK4 players: ~5.5W

# Demos and benchmarks



- Offloading has significant resource consumption advantages on most hardware
- Complex toolkits and apps can be best in class
- Linux Desktop users help with finding bugs and improving quality!



# Notes

# Notes

- DRM. That other one. **Digital Rights Management.**
- Technically becomes easy: just another modifier
- When not possible: place-holder

# Notes

- Experimental patches for V4L2 stateless:
  - Gstreamer
  - Chromium
- Experimental patches for V4L2 stateful:
  - Gstreamer (Raspberry Pi 4)

# Notes

- Upcoming hardware will benefit both **more and less** than current generations
  - More powerful/efficient hardware → less impact
  - More independent hardware blocks → turn off parts completely → more impact

# Notes

- Mesa:
  - OES\_EGL\_image\_external only on GLES → Gstreamer + GTK4 switched
  - OpenGL only inofficially supported
  - Vulkan will make things better
- Nvidia
  - 550.40.07: "Added support for R8, GR88 and YCbCr GBM formats."

# Questions?

# Thank you!

# Contact

- <https://www.collabora.com/news-and-blog/>
- Follow me on Mastodon: <https://floss.social/@rmader>



# Sources

- <https://en.wikipedia.org/wiki/YCbCr#/media/File:CCD.png>
- <https://www.youtube.com/watch?v=GtXQJ0c5q0k>
- <https://blog.gtk.org/2023/11/15/introducing-graphics-offload/>