

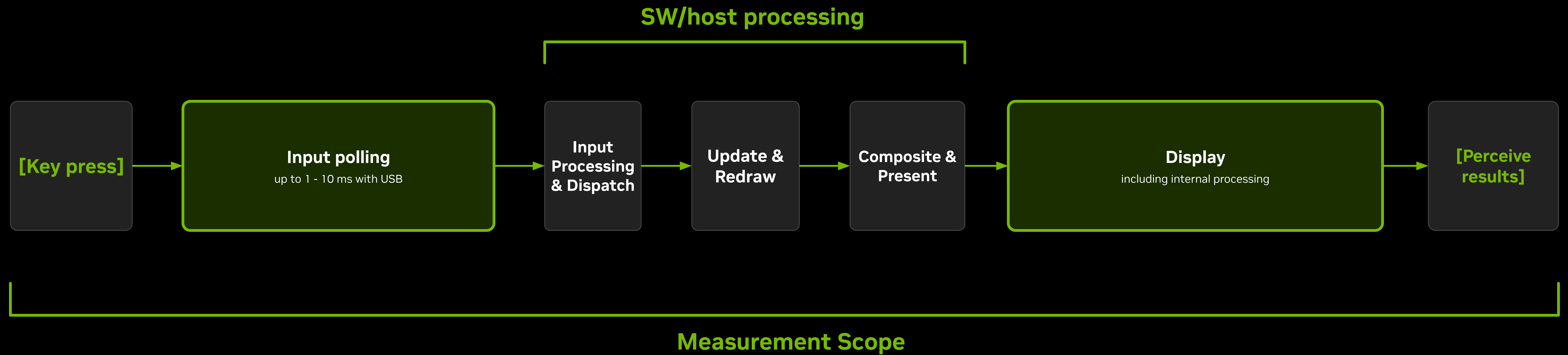


Wayland vs X.org latency comparison

End-to-end Methodology and Measurements

Kamil Łysik

Input Latency



Experimental Setup & Methodology

Approach & Test Environment

Goals:

- Use “what I can find in my drawer”
- End-to-end measurement
- Repeatable, automated method
- Reproducible results
- A/B comparison

Tooling:

- Microcontroller with:
 - ADC input
 - USB HID capability
 - Serial for communication
- Evaluated:
 - ESP32
 - Raspberry Pi Pico
 - No difference if configured properly
- Light sensor
 - Photodiode (10 μ s or faster response time)
 - Photoresistor (10 ms or worse response time)
 - Bad choice
- Software utilities
 - Synthetic benchmarks

Summary

- Custom DRM client can show capability
- Result visualization helps
 - Heat map is better for visualization than candles
- Input and monitor processing are significant factors
- All display stacks introduce a frame of delay vs custom DRM client
 - Visible for non-VRR cases
- VRR can drastically improve response
 - For low-load cases, all display stacks are roughly at limits
- XWayland no longer introduces extra frame delays
 - In past it had extra frame, now is gone
- Results are very close
 - Hard to conclude a clear winner

Test system:

Monitor: LG 27GN950

GPU: NVIDIA RTX 5070

Kernel: 7.1.7

GPU Driver: 610.57.04

kwin 6.7.4

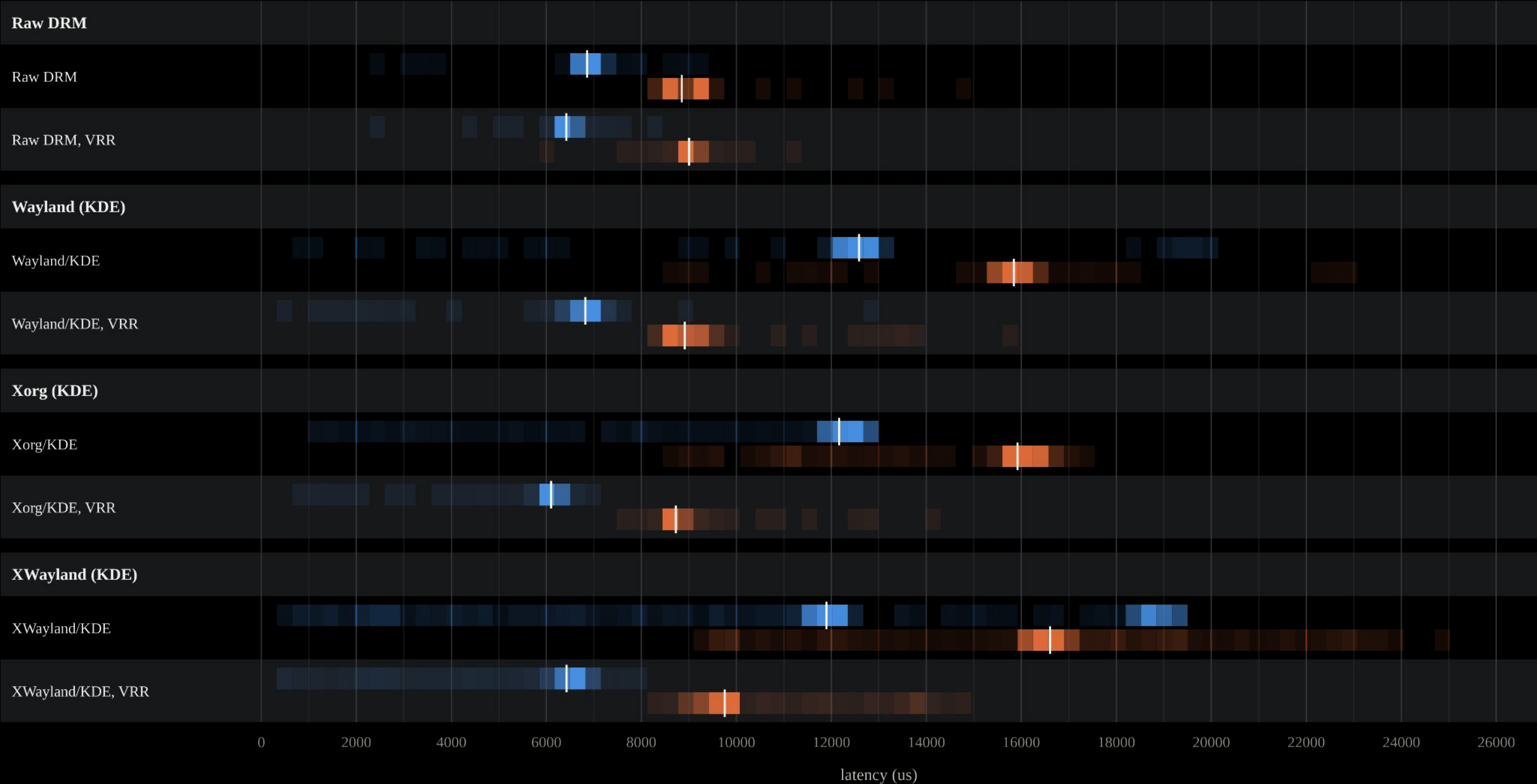
mutter 49.7

X.Org X Server 1.21.1.24

DRM, X.org, KDE - density heat strips (VRR off/on, n=1000)

Each cell's opacity = sample density in that latency bin (hotter = more samples). White tick = median. Display refresh rate: 144 Hz.

dark-to-bright bright-to-dark



References & Contact Info

Aux charts & code:

- https://gitlab.freedesktop.org/klysik_nv/xdc_2026_latency

Other measurement reports:

- <https://mort.coffee/home/wayland-input-latency/>
 - Use of camera to manually count frames
- <https://farnoy.dev/posts/linux-latency>
 - Interesting measurements but no Xorg report
- <https://marco-nett.de/blog/measuring-input-latency-on-linux-x11-vs-wayland-vrr-dxvk/>
 - 500 Hz monitor

Other measurement devices:

- <https://github.com/S4N-TOS/Open-Source-LDAT>

Questions & Comments:

- Reach out to klysik@nvidia.com, [@klysik:matrix.org](https://matrix.org/@klysik:matrix.org)

