Display Engine Based Adaptive Sharpness Filter

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Agenda

- Introduction & Motivation
- Benefits
- Driver Implementation & the Interface
- Userspace Implementation : Plasma Kwin
- Validation Methodology
- Development Summary & References
- Call to Action

Introduction & Motivation

Image Sharpening

Technique to Enhance the edges and fine details of the image

Need For Image Sharpening

Improves Visual Quality, fine details, corrects image degradation

Traditional Methods

GPU/Shader based technique

Uniform, chances of over enhancement , power & performance overhead

Intel’s Modern Display Hardware-based Sharpness

Balanced & efficient solution

Unsharpened, Dull

Sharpened , Crispier

Sharpness in Action!!

Benefits of Display HW Engine Based Solution

over Traditional methods

Minimal latency, Power and Performance impact

Helps avoiding an extra buffer operation in GPU

Designed for gaming, but also benefits non-gaming use cases like gallery apps

Driver Implementation & Interfaces

Display engine implements the filter using scalars & enhancement blocks with HW look-up tables.

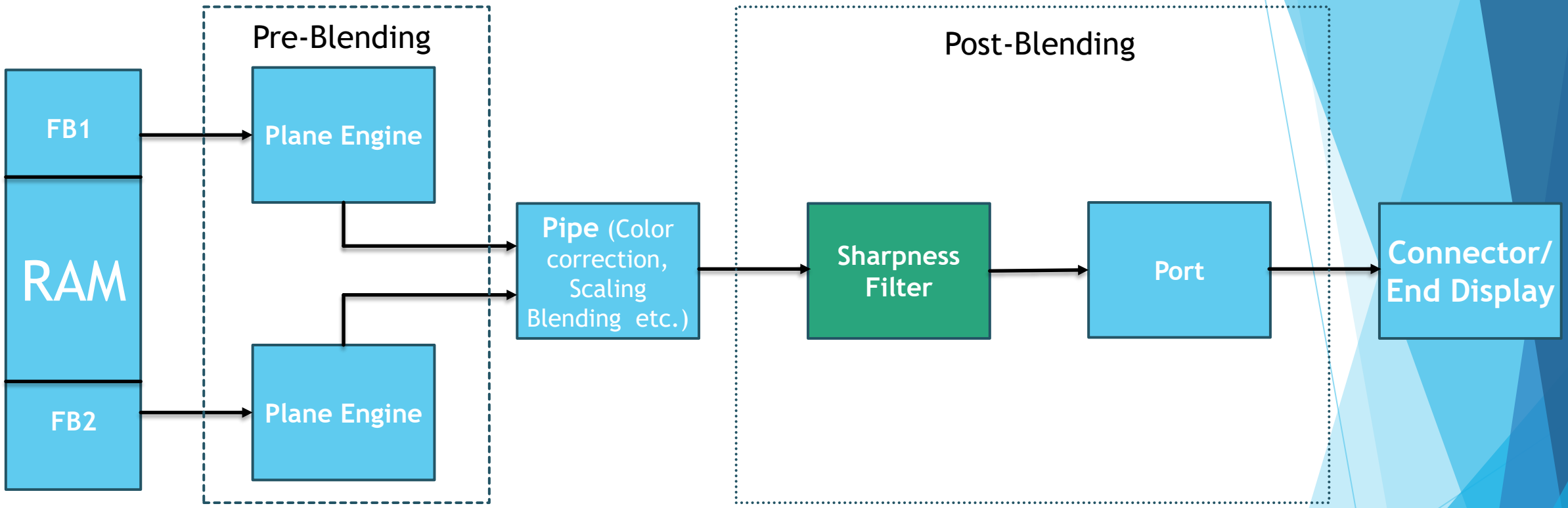
Sharpness is applied post pipe blending

Interface: CRTC Property **“SHARPNESS_STRENGTH”**

Range : 0 – 255

Same uAPI to enable/disable and to write the Filter strength value.

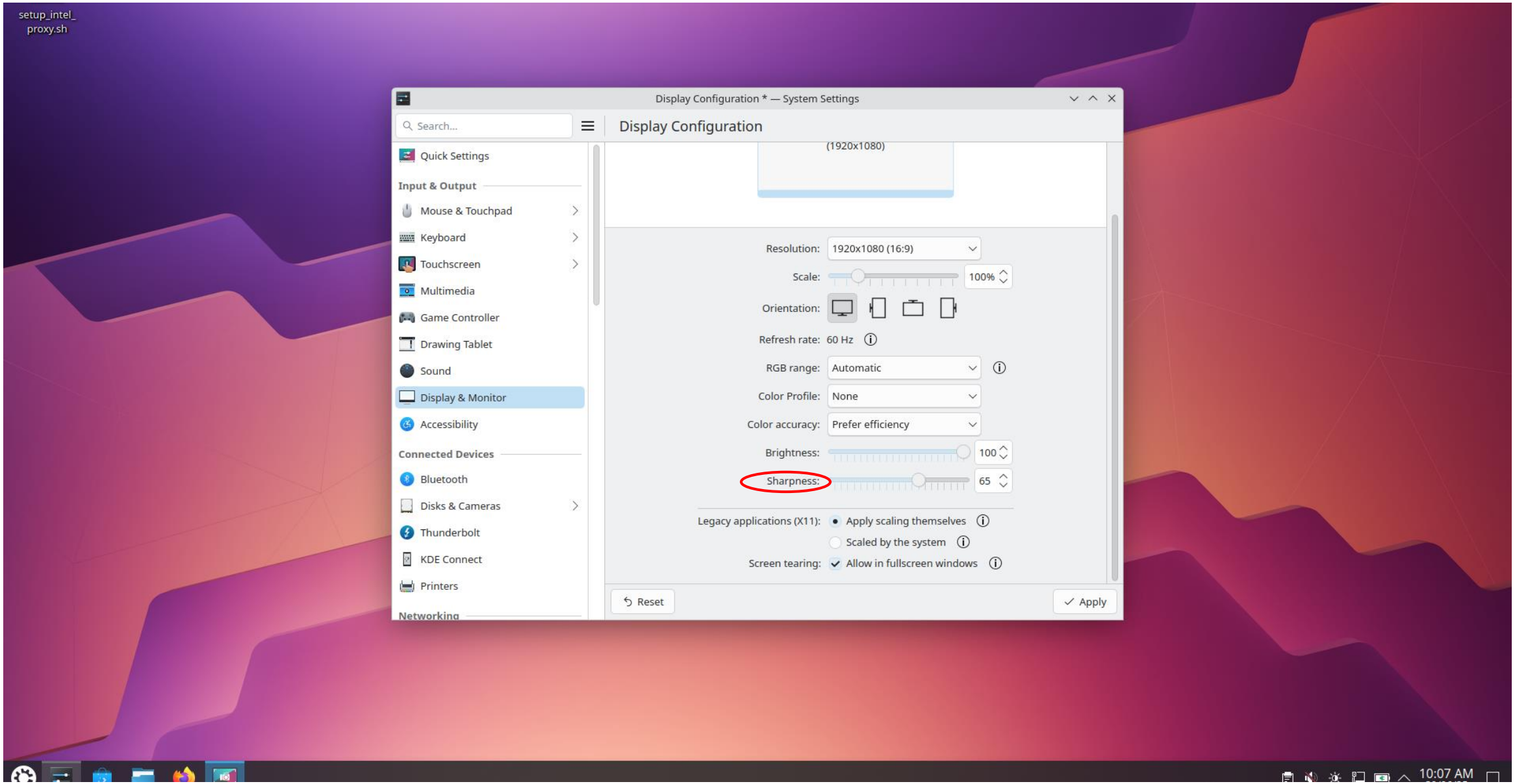
Generic uAPI, anyone can use it

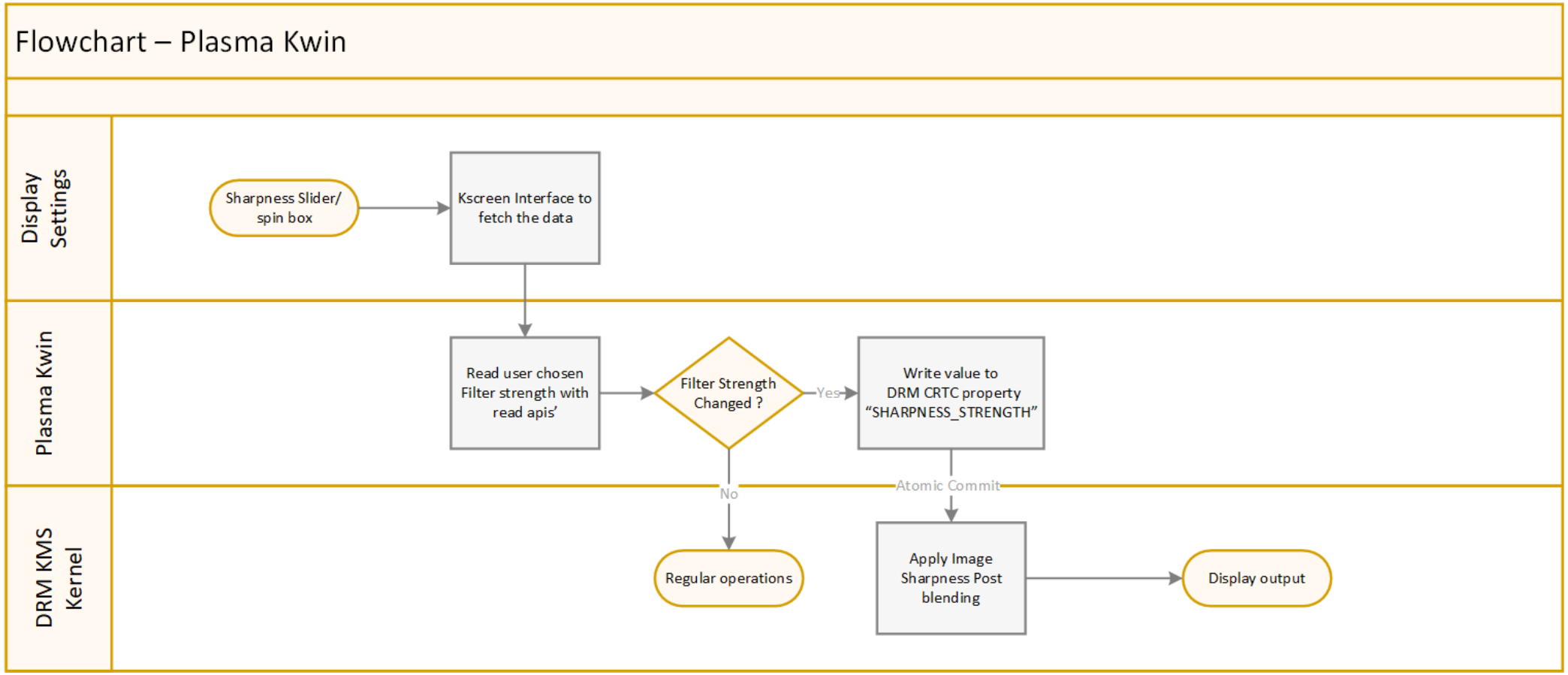


Simplified View of Display Engine Based Adaptive Sharpness Filter

Implementation In Userpace

Plasma Kwin


setup_intel_
proxy.sh
Display Configuration * — System Settings
Search...
Display Configuration
Quick Settings
Input & Output
Mouse & Touchpad
Keyboard
Touchscreen
Multimedia
Game Controller
Drawing Tablet
Sound
Display & Monitor
Accessibility
Connected Devices
Bluetooth
Disks & Cameras
Thunderbolt
KDE Connect
Printers
Networking
(1920x1080)
Resolution: 1920x1080 (16:9)
Scale: 100%
Orientation:
Refresh rate: 60 Hz
RGB range: Automatic
Color Profile: None
Color accuracy: Prefer efficiency
Brightness: 100
Sharpness: 65
Legacy applications (X11): Apply scaling themselves
Scaled by the system
Screen tearing: Allow in fullscreen windows
Reset
Apply
10:07 AM

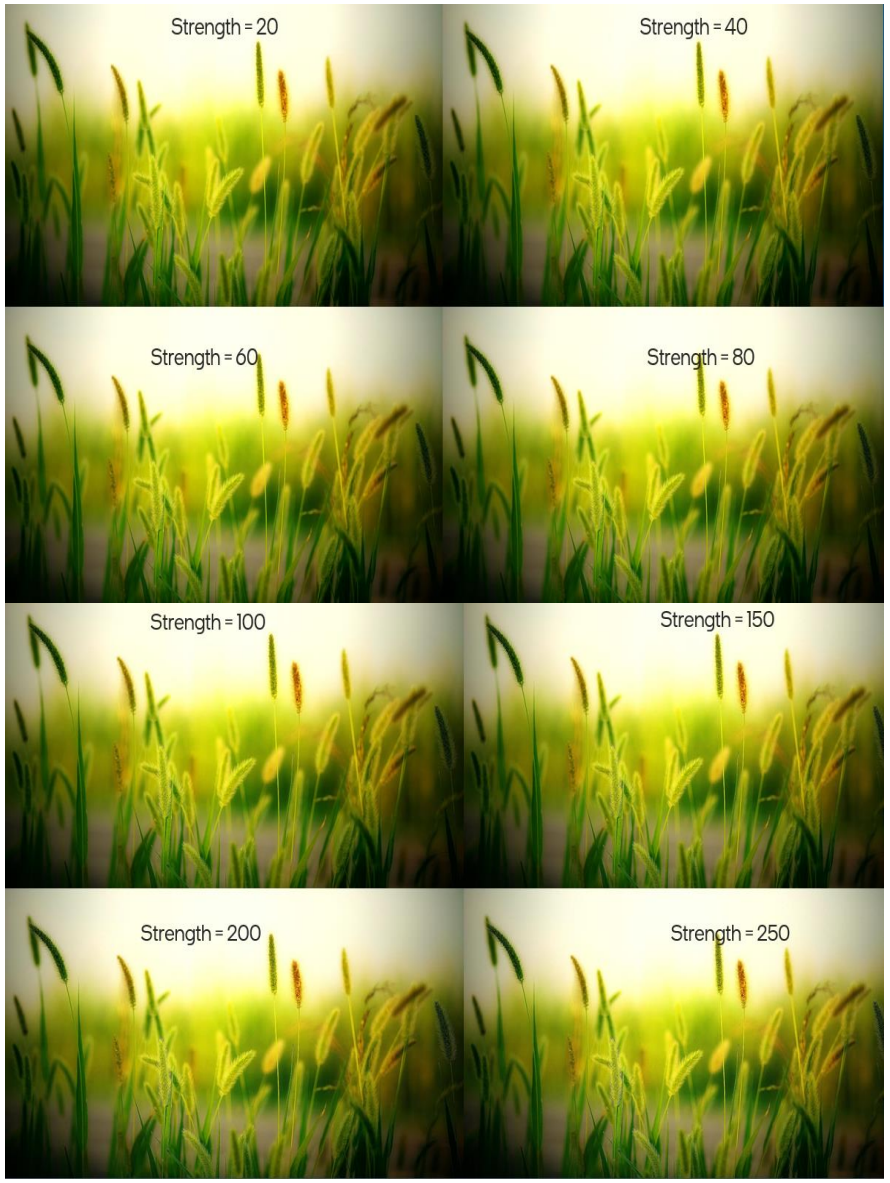

Flowchart – Plasma Kwin
Display Settings
Plasma Kwin
DRM KMS Kernel
Sharpness Slider/ spin box
Kscreen Interface to fetch the data
Read user chosen Filter strength with read apis'
Filter Strength Changed ?
Yes
No
Write value to DRM CRTC property "SHARPNESS_STRENGTH"
Atomic Commit
Regular operations
Apply Image Sharpness Post blending
Display output

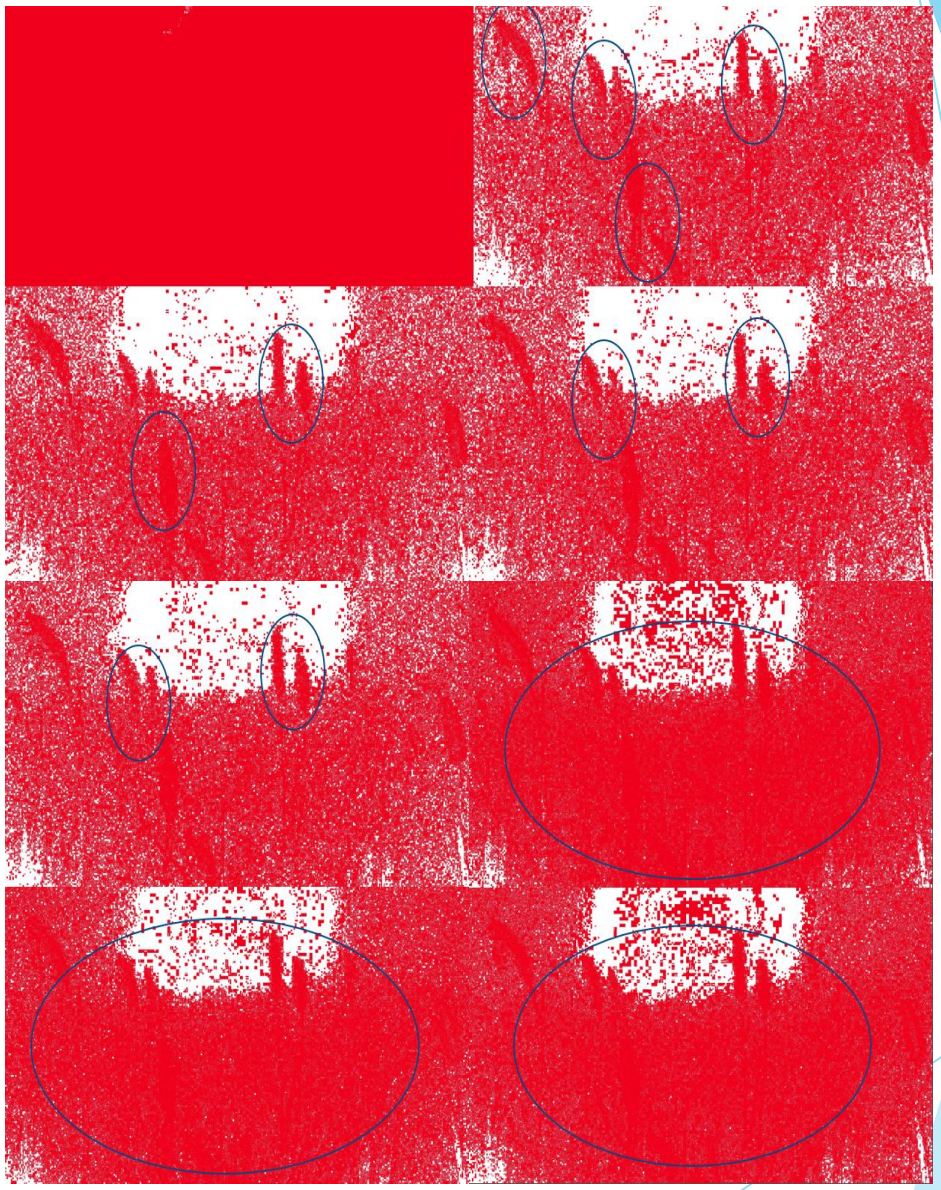
Validation Methodology

Validated using **IGT GPU Tools**

Coverage includes:

- Functional correctness
- Power state transitions
- Negative scenarios
- Visual verification through frame capture





(Left) Sharpness comparison at strength levels
(Right) ImageMagick diff comparisons between sharpness levels

Development Status & References

[1] Kernel Interface changes are floated for review:
https://patchwork.freedesktop.org/series/138754/

[2] Mutter MR is floated for review [wip] :
https://gitlab.gnome.org/GNOME/mutter/-/merge_requests/3665

[3] Plasma KWIN MR is floated for review:
https://invent.kde.org/plasma/kwin/-/merge_requests/7689

[4] IGT changes are floated for review:
https://patchwork.freedesktop.org/series/130218/

[5] The Chromium Projects https://www.chromium.org/chromium-os/developer-library/guides/hardware-schematics/chamelium/

Call to Action

- Welcoming the review & Suggestions on the Mutter MR
- Enthusiasts can try the feature on Intel platforms (Supported from LunarLake/Core™ Ultra Processor) and share the feedback on the mailing list.
- Extend the same for other open-source compositors & distributions.

THANK YOU ”