Vulkanised 2025

The 7th Vulkan Developer Conference
Cambridge, UK | February 11-13, 2025

Vulkan Video is Open: Application showcase

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About me

- Part of the Multimedia team at Igalia since 2022 😊
- Dedicated to Vulkan Video including CTS and GStreamer support.

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Agenda

1. Vulkan Video
2. Mesa
3. GStreamer
4. FFMPEG
5. Vulkan-Video-Samples

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Vulkan Video

- Stateless codecs using GPU hardware acceleration
- Supported codecs: H.264, H.265, AV1
- Closer integration with Graphics and Displays.
- Cross-platform and vendor-neutral low-level HW state(-less) video codecs API
  - Each driver can operate differently depending on its capabilities with a common API.

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Vulkan Video Timeline

- **March 2018**: TSG was created and driven by IHVs such as AMD/Intel/Nvidia and open source operators
- **April 2021**: **Provisional extensions released**
- ...
- **February 2024**: Video Extensions for Accelerated AV1 Decode **released** (SDK 1.3.277).
- **November 2024**: Khronos **released** Vulkan Video Extensions for Accelerated AV1 Encode(SDK 1.3.302).

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Application Showcase

Vulkan Video in Mesa

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What is Mesa?

- Low level **graphics library**.
- Began as an open source implementation of the OpenGL.
- Now actively implementing Vulkan specification on various GPUs.
  - Intel, AMD, NVIDIA, Raspberry PI, etc..
- Contributors: Igalia, AMD, Intel, Google, Collabora, Mesa community.
- **8 years of open drivers Vulkan in Mesa**

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Vulkan Video History

- Dave Airlie started in 2022 on AMD (RADV) and Intel GPU(ANV)
  - **Dave's blog post**
  - With **Lynne** on FFmpeg.
  - **Igalia** joined on GStreamer side.
- Hyunjun Ko from **Igalia** started working on Intel GPU(ANV) in 2023.
- So Dave moved to work only on AMD GPU(RADV).

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Vulkan Video Status 2025

- Implemented encoder for h264 and h265.
  - **AMD RADV**
  - **Intel ANV**
- Implemented AV1 decode
  - **AMD RADV**
  - **Intel ANV**
- Implemented AV1 encode
  - **AMD RADV**

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Vulkan Status: 2025

- Implemented `video_maintenance1`
  - **AMD RADV**
  - **Intel ANV**
- Other implementations:
  - **Nouveau NVK H26x, AV1 decoder**
  - **ZINK H264 decoder**

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Video extensions

GPU	H264 decoder	H265 decoder	AV1 decoder	H264 encoder	H265 encoder	AV1 encoder
Intel(ANV)	✅	✅	✅	✅	✅	❌
AMD(RADV)	✅	✅	✅	✅	✅	🚧
Nouveau(NVK)	🚧	🚧	🚧	❌	❌	❌
Zink	🚧	❌	❌	❌	❌	❌

Challenges

- GPU hang.
  - Not enough useful tools to investigate...
- Lots of generations of GPUs.
  - Different commands, parameters, memory size, alignment, etc...

Plans for 2025

- AV1 full support in both RADV, ANV and NVK.
- Support other GPUs?

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Open applications collaboration

- Open source applications:
  - GStreamer, FFMpeg, Vulkan-Video-Samples

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Presentation

- a 25-years-old framework for streaming media applications.
- Black boxes/elements interconnection system
- Native, multiplatform, highly-optimized framework

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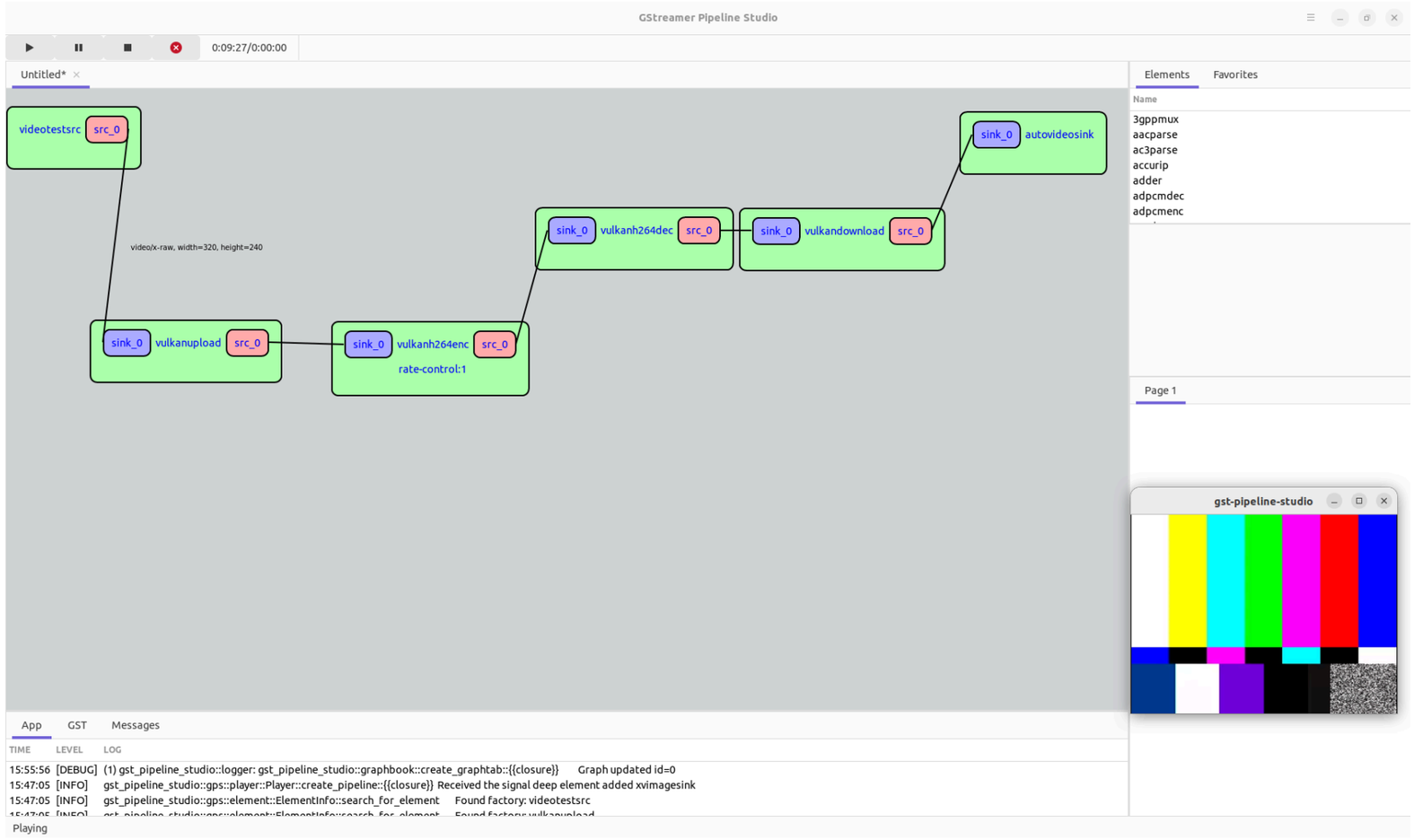
Pipeline


GStreamer Pipeline Studio
0:09:27/0:00:00
Untitled*
videotestsrc
src_0
video/x-raw, width=320, height=240
sink_0
vulkanupload
src_0
sink_0
vulkanh264enc
src_0
rate-control:1
sink_0
vulkanh264dec
src_0
sink_0
vulkandownload
src_0
sink_0
autovideosink
Elements
Favorites
Name
3gppmux
aacparse
ac3parse
accurip
adder
adpcmdec
adpcmenc
Page 1
gst-pipeline-studio
App
GST
Messages
TIME LEVEL LOG
15:55:56 [DEBUG] (1) gst_pipeline_studio::logger: gst_pipeline_studio::graphbook::create_graphtab::{{closure}} Graph updated id=0
15:47:05 [INFO] gst_pipeline_studio::gps::player::Player::create_pipeline::{{closure}} Received the signal deep element added xvimagesink
15:47:05 [INFO] gst_pipeline_studio::gps::element::ElementInfo::search_for_element Found factory: videotestsrc
Playing

Vulkan Video support

Operation	H264	H265	AV1
decode	✅	✅	🚧
encode	✅	✅	🚧

- Follow **Vulkan Video Status** for more updates.

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Linux fluster status

Driver	JVT-AVC_V1	JCT-VC-HEVC_V1
NVIDIA (RTX 4060)	112/135	126/147
RADV(AMD RX7600)	102/135	118/147
ANV(INTEL)	107/135	103/147
VA-API	130/135	146/147

- See **complete results**

Windows Fluster status

Driver	JVT-AVC_V1	JCT-VC-HEVC_V1
AMD	102/135	108/147
NVIDIA	109/135	112/147

- See **complete results**

Challenges

- Different behavior from hardware vendor, handling vendor caps properly.
- Hardware crashes, thanks Validation Layer for catching most problems!
- Still some crashes in drivers not detected by the layers.
  - standard codec parameters (SPS, slice header etc.) not filled properly for example.

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What's next ?

- H.26x encoders **review and merge**.
- AV1 codec **review and merge**.
- `video_maintenance2` support
- Other codec support

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Presentation 

- a 25-years-old multimedia framework for streaming media applications.
- Library/CLI oriented framework
- Native, multiplatform, low level and highly-optimized framework

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Vulkan Video support 

Operation	H264	H265	AV1
decode	✅	✅	✅
encode	✅	✅	❌
video_maintenance1	✅	✅	✅

- Follow **Vulkan Video Status** for latest updates.

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Linux fluster status

Driver	JVT-AVC_V1 (H.264)	JCT-VC-HEVC_V1 (H.265)	AV1-TEST-VECTORS
NVIDIA(RTX4060)	116/135	133/147	22/242
RADV(RX7600)	123/135	143/147	238/242
ANV(INTEL)	118/135	103/147	228/242

- See **complete results**

Windows fluster status 

Driver	JVT-AVC_V1 (H.264)	JCT-VC-HEVC_V1 (H.265)	AV1-TEST-VECTORS
NVIDIA(RTX4060)	116/135	133/147	172/242
AMD(RX7600)	120/135	141/147	231/242
INTEL	40/135	81/147	0/242

- See **complete results**

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What's next ? 

- `av1_encode` in a future release.
- `video_maintenance2` support.

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Vulkan Video Samples

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Presentation

- Official CLI applications (decode and encode) to demonstrate Vulkan Video usage
- Main implementation for video extensions release.
- Encoder library used internally by CTS.
- Native and multiplatform (Linux and Windows).

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Vulkan Video support

Operation	H264	H265	AV1
decode	✅	✅	✅
encode	✅	✅	✅
video_maintenance1	✅	✅	✅

- Follow **Vulkan Video Status** for latest updates.

Fluster status

Driver	JVT-AVC_V1 (H.264)	JCT-VC-HEVC_V1 (H.265)	AV1-TEST-VECTORS
NVIDIA(RTX4060)	117/135	129/147	137/242
RADV(RX7600)	0/135	0/147	0/242
ANV(INTEL)	0/135	0/147	0/242

- See **complete results**

What's next ?

- First release: 1.0.0
- decoder library along the encoder library
- `video_maintenance2` support
- better support of mesa drivers
- new codecs

Thanks! Questions ? 😊

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