

Vulkan Video in GStreamer

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Agenda

1. Vulkan Video
2. GStreamer
3. Demos



What's Vulkan?

KHRONOS
GROUP
CONNECTING SOFTWARE TO SILICON



- Low-level graphics and compute API
- Under Khronos Group umbrella
- Released in 2016 as a successor to OpenGL and OpenGL ES
- Direct control over graphics hardware, allowing for better performance and more efficient multi-threading.
- Specifications licensing: Apache License 2.0



Vulkan Video TSG



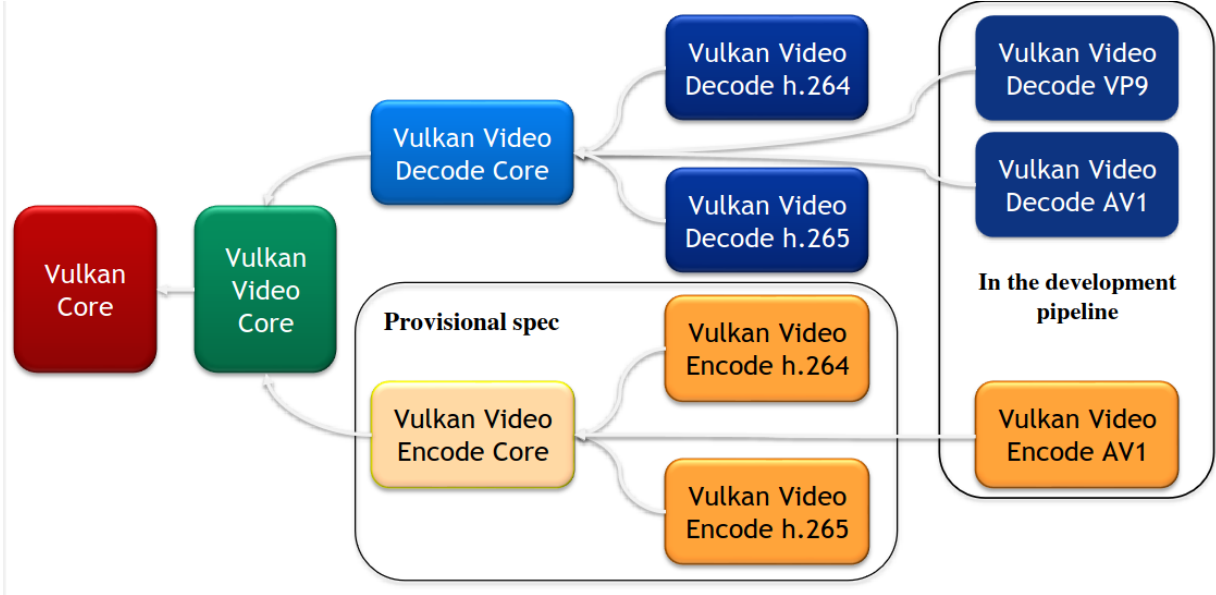
- **March 2018:** TSG initiated driven by IHV vendors such as AMD/Intel/NVidia and open source operators
- **April 2021:** **Provisional extensions released** including the Video Decode and Encode extensions
- **December 2022:** Khronos **finalized** Vulkan Video Extensions for Accelerated H.264 and H.265 Decode

Vulkan video goals



- HW acceleration for video codecs available on PC/GPU/Mobile
- Most solutions that enable access to video decode/encode HW are vendor and/or platform specific
- Existing solution would have to interop with Vulkan and it is not trivial
- Make video decode/encode a first class part of Vulkan

Architecture



API Overview



- Stateless (as VAAPI, D3D11, etc.)
- Cross-platform and vendor-neutral low-level HW state(-less) video codecs API
 - Each driver can operate differently depending on its capabilities
- Closer integration with the Graphics and Displays
- Lower processing execution overhead
- Lower CPU/GPU/ASIC and memory resource utilization
- Verbose



Codecs support



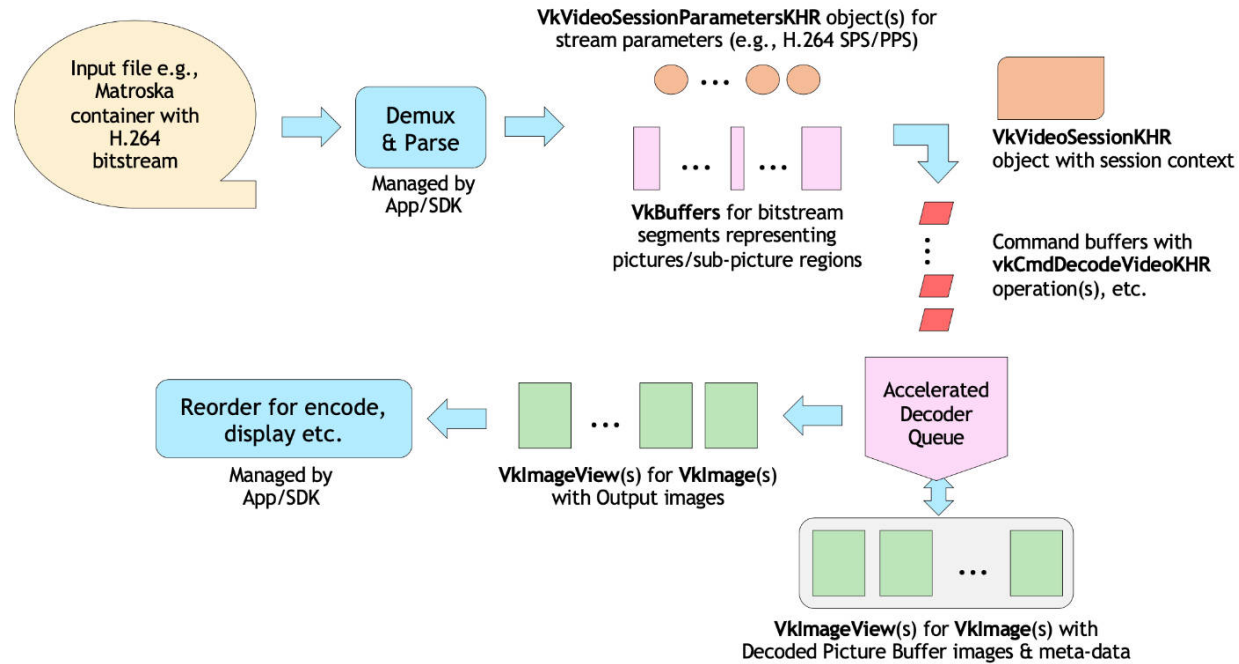
- Conditions for release: Final specifications, Vulkan validation layers and CTS ready
- Decode:
 - H264, H265: Released in Dec 2022
- Encode:
 - H264, H265: Planned for Dec 2023

Drivers

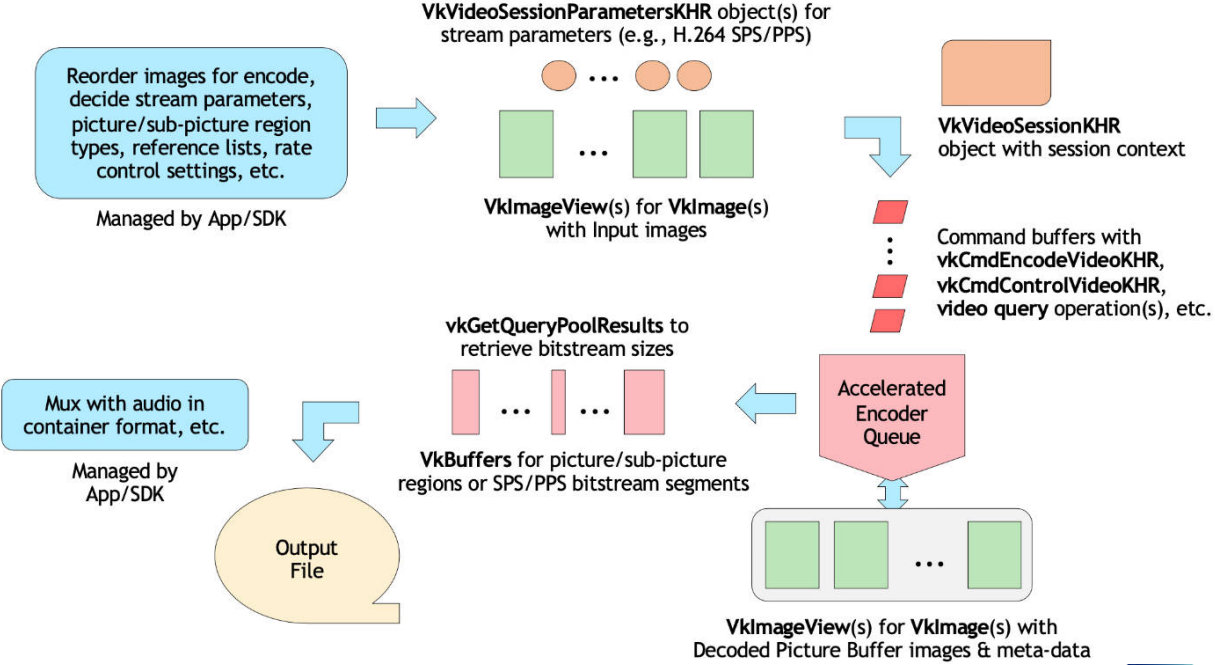


- NVidia:
 - video_decode_h264, video_decode_h265, video_encode_h264
 -  video_encode_h265
- AMD (Windows, RADV):
 - video_decode_h264, video_decode_h265
- Intel (Windows, ANV):
 - video_decode_h264, video_decode_h265
 -  video_encode_h264 (ANV)

Decoding



Encoding





First class citizen

- Igalia to implement Vulkan CTS and GStreamer elements.
- Main implementation is the official conformance test suite, **Vulkan CTS**
- FFMpeg implemented the h264/h265 codecs (Thanks Lynne!).

libgstcodecs-1.0.so



- In 2019 Seungha implemented H264, H265 & VP9 decoding state objects
- In 2020 Nicolas moved them into a shared library in -bad
- Same year, Seungha added VP8
- Same year, He Junyan added MPEG2
- In 2021, He Junyan added AV1
- H26x **encoder** coming soon ...

Decoder

- First version of H264 decoder released as a merge request in May 2023, should be supported in 1.24
- Hard times with the vulkan synchronization and reference list management
- GstVulkanDecoder to initialize the video queue and video session
- Tested with NVidia/AMD/Intel on Linux

Encoder

- First version of H264 encoder, merge request to be ready soon.
- Hard times for the vulkan synchronization and reference list management
- GstVulkanEncoder to initialize the video queue and video session
- H264 support, should be easy to add h265 (subclass).
- Support only I/P frames.
- Need more love on the quality management.
- Tested with NVidia (Linux)

Coming soon...



- H265 encoder/decoder support

Transcoding example



0:00:25/0:00:00

Untitled*

videotestsrc src_0

h264parse sink_0 src_0

vulkanh264dec sink_0 src_0

vulkanh264enc sink_0 src_0

vulkanupload sink_0 src_0

vulkandownload sink_0 src_0

autovideosink sink_0

Elements Favorites

Name
3gppmux
aacparse
ac3parse
accurip
adder
adpcmdec
adpcmenc
aesdec
aesenc
agingtv
alffmux
alffnrate

Preview0

gst_pipeline_studio

TIME	LEVEL	LOG
09:43:39	[INFO]	Received the signal deep element added xvimagesink
09:43:38	[INFO]	Found Factory: videotestsrc
09:43:38	[INFO]	Found Factory: vulkanupload
09:43:38	[INFO]	Found factory: vulkanh264enc
09:43:38	[INFO]	Found factory: h264parse
09:43:38	[INFO]	Found factory: vulkanh264dec
09:43:38	[INFO]	Found factory: vulkandownload
09:43:38	[INFO]	Found factory: fakesink
09:43:38	[INFO]	Creating pipeline videotestsrc name=videotestsrc191 vulkanupload name=vulkanupload351 vulkanh264enc name=vulkanh264enc341 h264parse name=h264parse371 vulkanh264dec name=vulkanh264dec361 vulkandownload name=vulkandownload141 autovideosink name=autovideosink15
09:43:23	[INFO]	Received the signal deep element added fakesink
09:43:13	[INFO]	Received the signal deep element added gtk4paintablesink
09:43:13	[INFO]	Found factory: videotestsrc
09:43:13	[INFO]	Found Factory: vulkanupload
09:43:13	[INFO]	Found factory: vulkanh264enc
09:43:13	[INFO]	Found factory: h264parse
09:43:13	[INFO]	Found factory: h264parse
		Playing

Thanks

Q/A



