

Vulkanised 2026

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Power Friendly Vulkan – QCOM Extensions (Qualcomm Sponsored Talk)

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Agenda

- VK_QCOM_tile_memory_heap
- VK_QCOM_image_processing*
- VK_QCOM_render_pass_shader_resolve

Outside today's scope. However, below insights are still

Caching

- Pipeline Cache
- Object Caching
- Descriptor Set Caching

Memory

- Allocate in Large Chunks,
- Suballocate, Use Ring Buffer mechanism for data changing every frame

Command Buffers

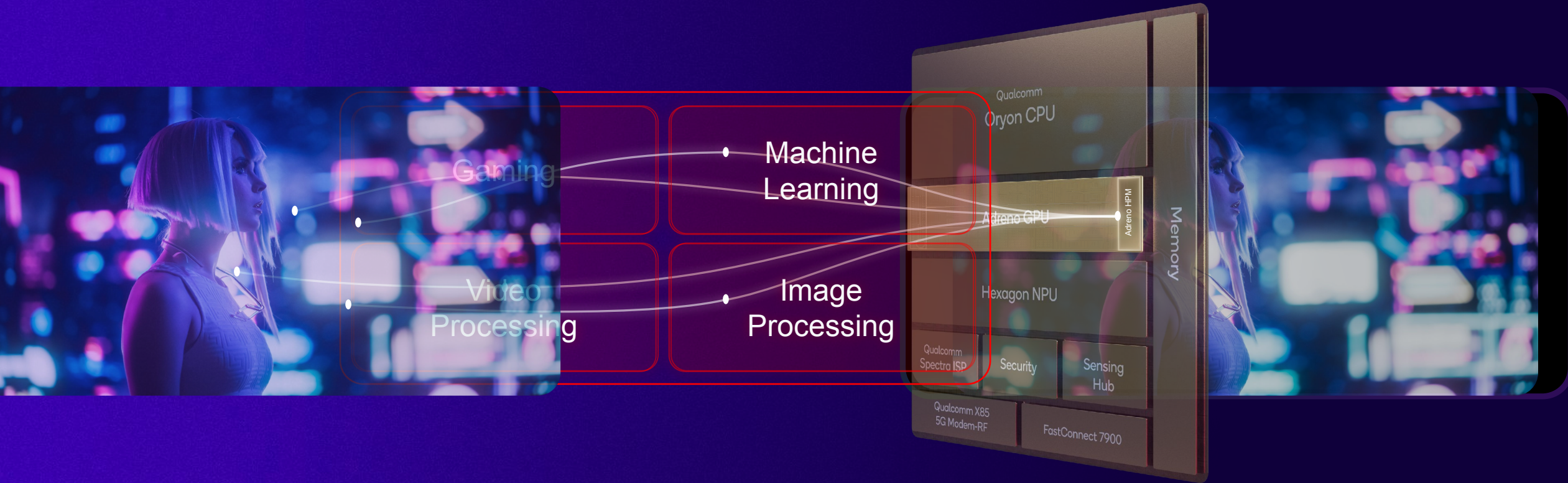
- Pre-recorded command buffers where possible
- No Redundant states.
- Use Proper pipeline barriers

Render Passes

- No Render Pass Splits
- No Empty Render Passes
- Optimize Load / Store
- Use Sub-Passes

**VK_QCOM_tile_memory_hea
p**

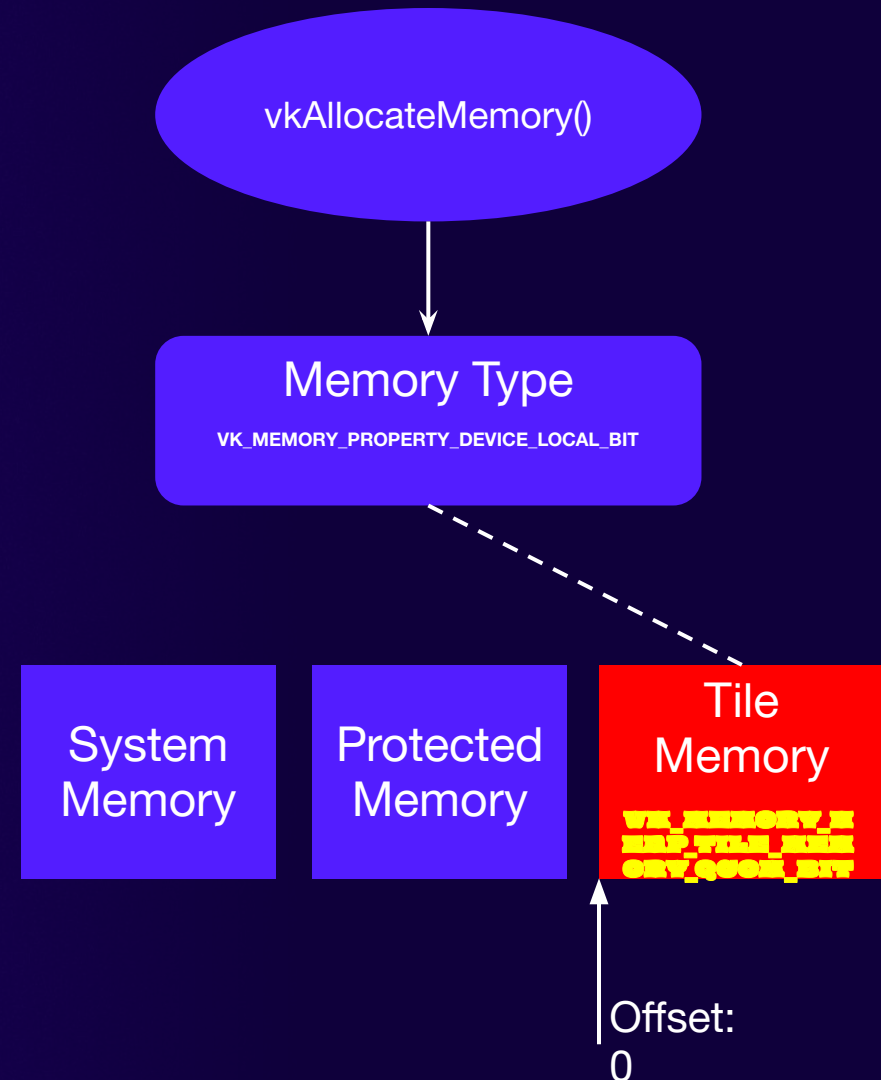
Adreno High Performance Memory



Adreno HPM improves power savings by up to 10% in your favorite games and enhances performance across key rendering technologies.

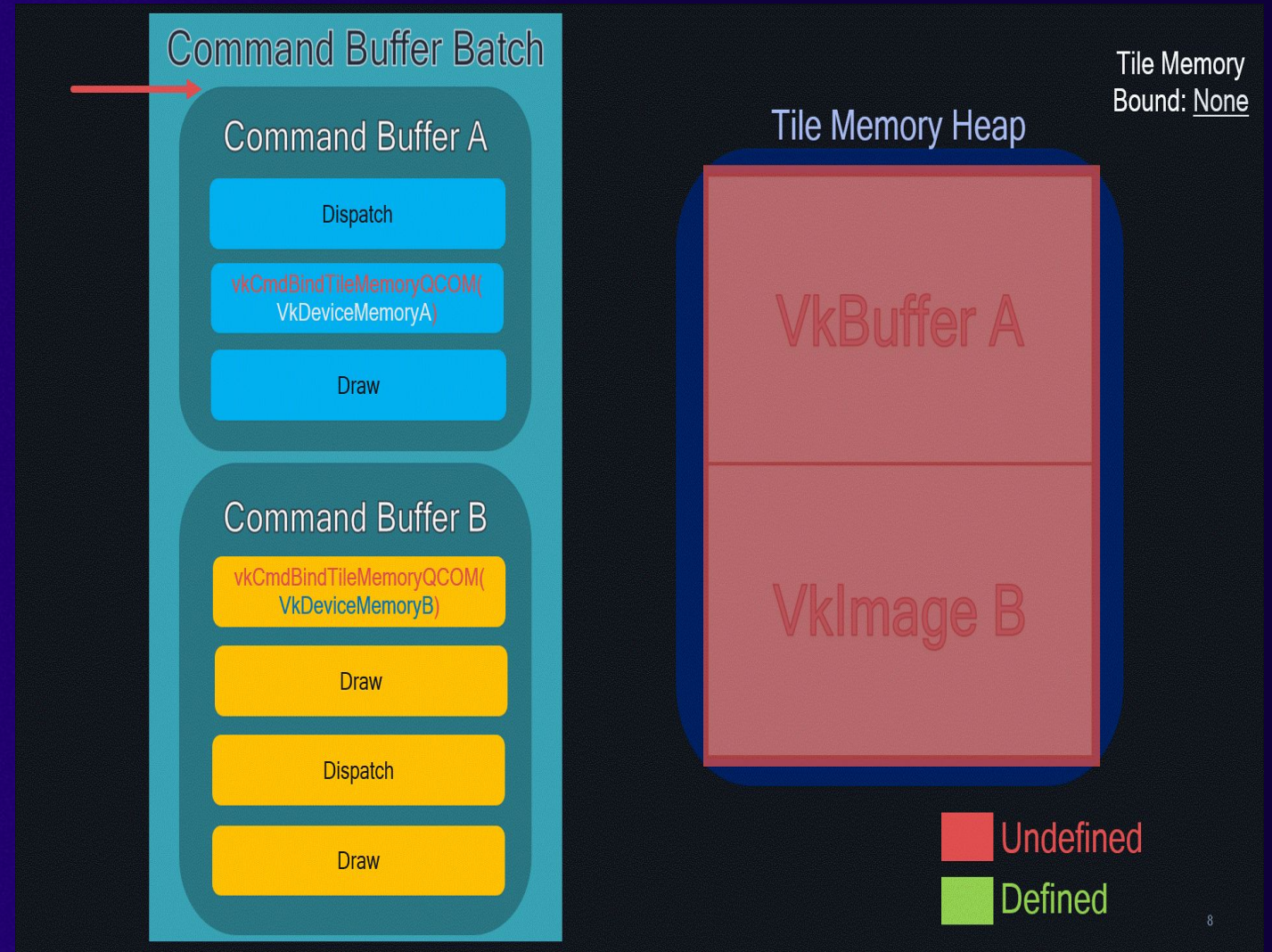
VK_QCOM_tile_memory_heap

- Tile Memory is exposed as new VkMemoryHeap
 - VK_MEMORY_HEAP_TILE_MEMORY_QCOM_BIT
- Query vkGetPhysicalDeviceMemoryProperties()
 - Tile Memory Heap size to be 8MB/14MB/etc.
- New usage flags
 - VK_IMAGE_USAGE_TILE_MEMORY_QCOM
 - VK_BUFFER_USAGE_TILE_MEMORY_QCOM
- vkAllocateMemory() always returns offset 0
 - Applications must sub allocate
 - Aliasing allowed
- Bind memory to your Image/Buffers
 - vkBindImageMemory / vkBindBufferMemory

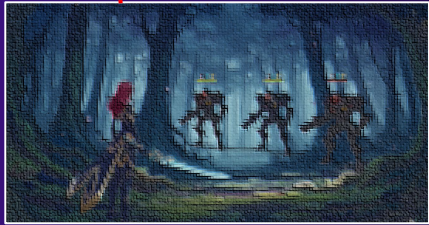
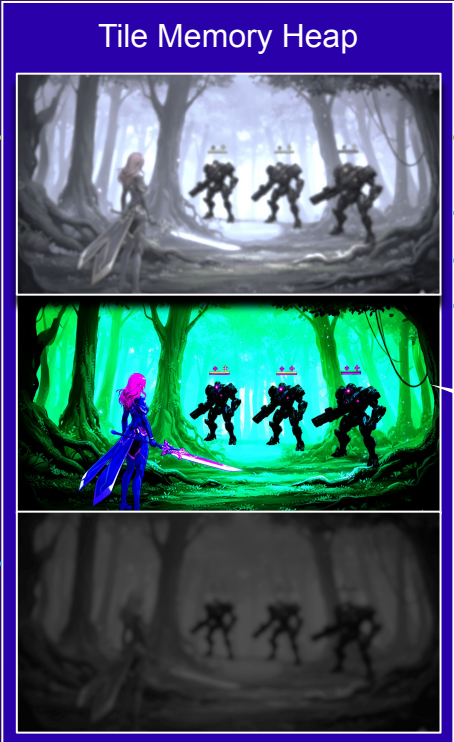


VK_QCOM_tile_memory_heap

- New API command to reserve tile memory:
 - `vkCmdBindTileMemoryQCOM(..)`
- Tile Memory contents outside the currently bound range become undefined
- If Range of the tile memory heap is not Set then, Driver may use any unreserved
- Tile Memory persists in a single queue submission batch.



Tile Memory Heap Tips/Best Practices



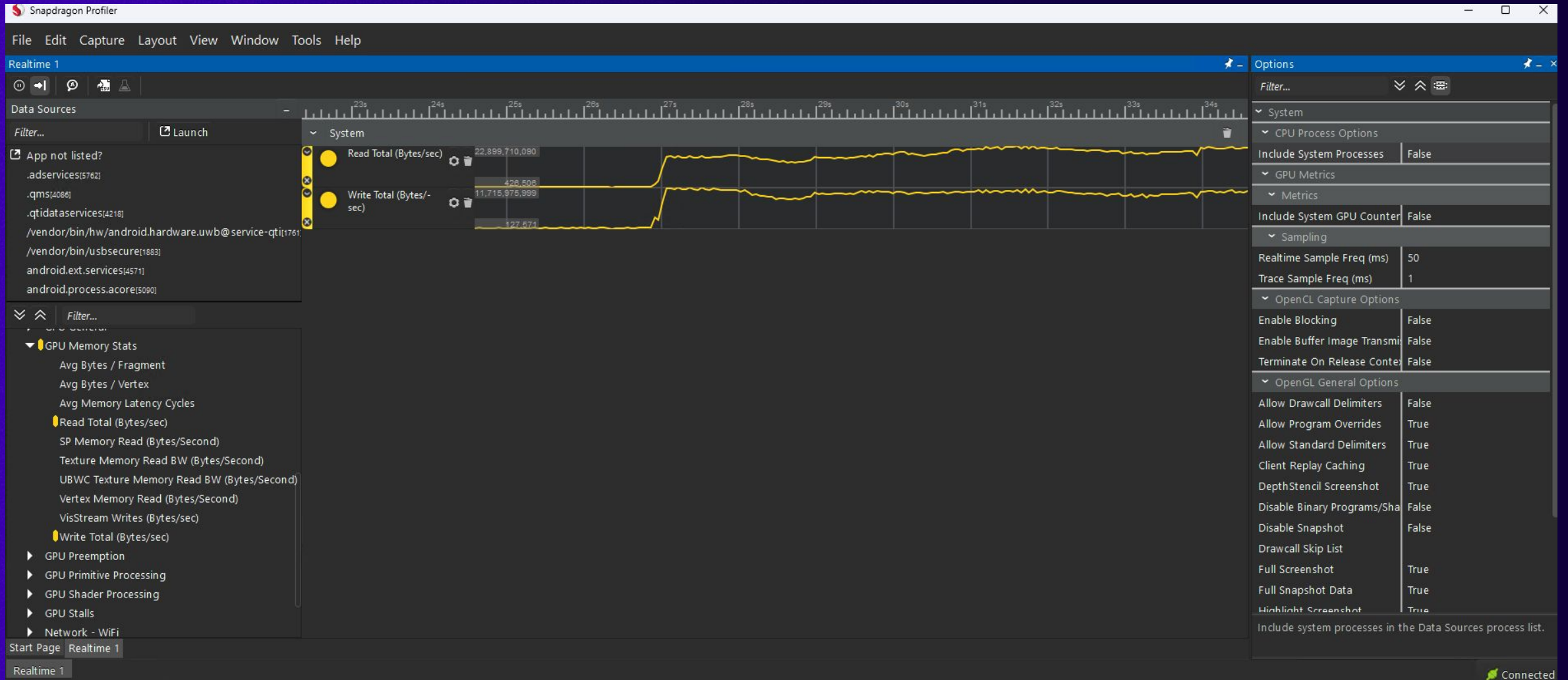
Use Tile Memory with Resources Accessed multiple times across the frame Don't need to preserve past the frame Example: Albedo, Normals, and/or Depth

- Write - Color Attachment
- Read - Sampler Image
- Depth/Stencil

Swapchain

Tile Memory Heap Tips/Best Practices

Use Snapdragon profiler to measure read/write memory bandwidth changes



ARENA
BREAKOUT

BLOOD STRIKE

DIABLO
IMMORTAL

第5人格
IDENTITY V

INFINITY
NIKKI

KNIVES OUT

NARAKA
BLADEPOINT MOBILE

NTE
NEVERNESS TO EVERNESS

HONKAI
STAR RAIL

ONCE
HUMAN

RACING MASTER

SWORD
OF
JUSTICE

WAR
THUNDER
MOBILE

WUTHERING
WAVES



Adreno High Performance Memory is improving power & performance for your favorite mobile games

VK_QCOM_tile_memory_heap

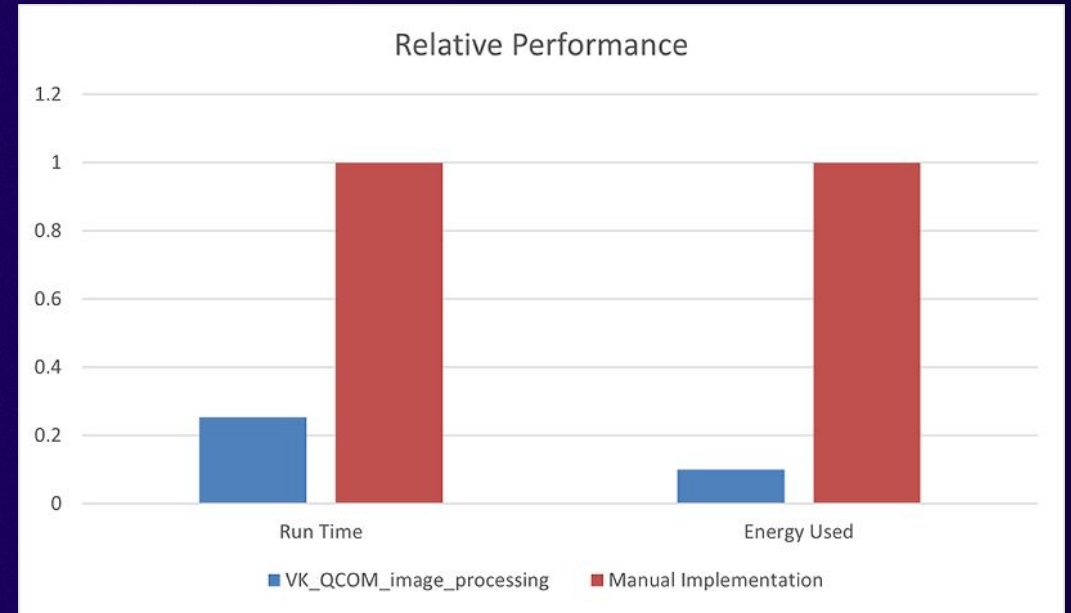
Developer Resources

- Extension available on Snapdragon® 8 Elite Gen 5, Snapdragon X2 Elite & Plus Platforms
- Spec:
https://docs.vulkan.org/refpages/latest/refpages/source/VK_QCOM_tile_memory_heap.html
- Validation Layer: 1.4.341.0 SDK
- Integration with existing apps is simple, Samples:
https://github.com/SnapdragonGameStudios/adreno-gpu-vulkan-code-sample-framework/tree/main/samples/tile_memory

VK_QCOM_Image_processing*

VK_QCOM_image_processing*

- Specialized image operations , Avoids several round trips between texture and shader units
- Supported operations, GLSL Functions
 - Weighted Sampling up to 64x64 kernel
 - textureWeightedQCOM
 - Box Filter up to 64x64 box size
 - textureBoxFilterQCOM
 - Block Matching (SSD/SAD) operations up to 64x64 search window
 - textureBlockMatchSADQCOM
 - textureBlockMatchSSDQCOM
 - TextureBlockMatch2QCOM
- Lower latency and significant power savings



8x8 weighted kernel to perform 3 iterations of a 4x downscaling algorithm for thumbnail generation

VK_QCOM_image_processing*

Developer Resources

Spec:

- https://github.com/KhronosGroup/Vulkan-Docs/blob/main/proposals/VK_QCOM_image_processing.adoc
- https://github.khronos.org/SPIRV-Registry/extensions/QCOM/SPV_QCOM_image_processing.html

Blog:

- <https://www.qualcomm.com/developer/blog/2024/02/high-order-filtering-and-block-matching-new-image-processing-extension-vulkan-optimizes>

Samples:

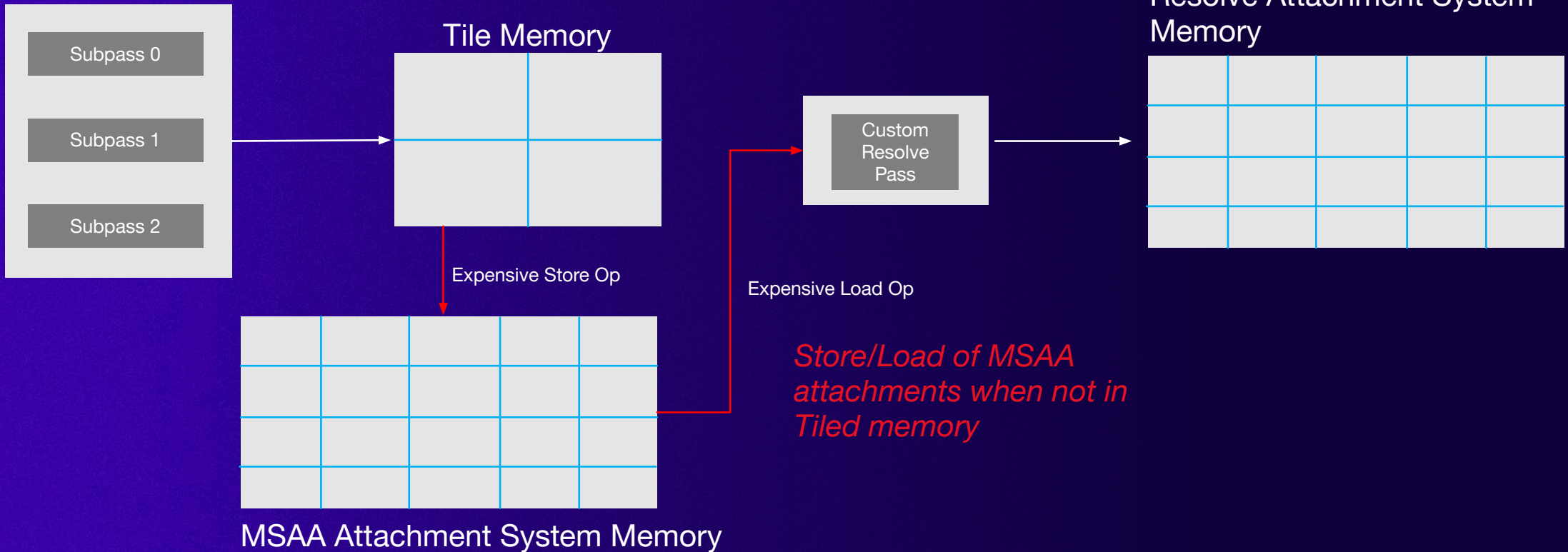
https://github.com/SnapdragonGameStudios/adreno-gpu-vulkan-code-sample-framework/tree/main/samples/image_processing

VK_QCOM_render_pass_shader_resolve & VK_EXT_custom_resolve

Problem

- MSAA attachments need extra store/load if custom filtering is needed.
 - **Tile memory** → **system memory** store of MSAA surface
 - **System memory** → **GPU load** for the custom shader pass
 - Final store of resolved 1× image

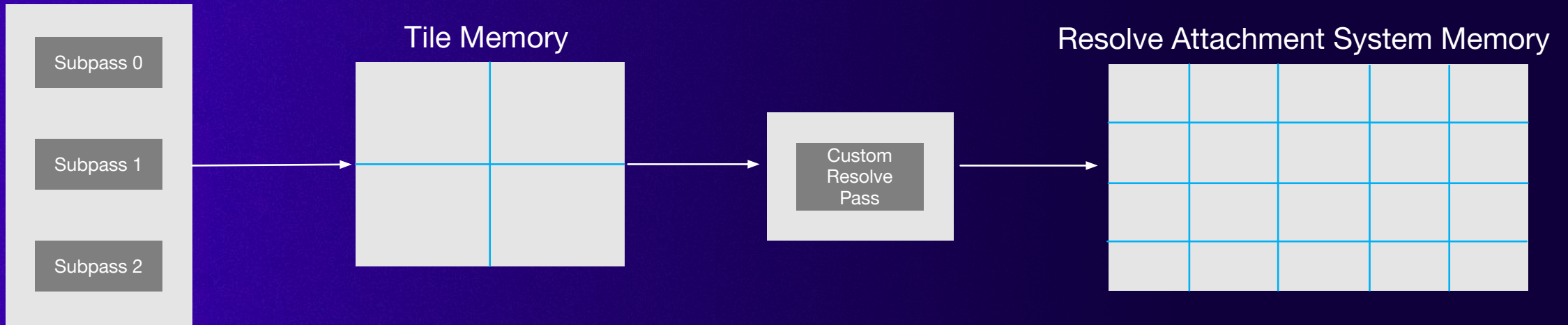
Dynamic/Render Passes



VK_QCOM_render_pass_shader_resolve

- Allows to add a (last) subpass
- Reads the MSAA image as an input attachment
- Performs arbitrary resolve filtering in the fragment shader
 - Example: tone-mapping or color-space conversion
- Avoid MSAA store/load round-trips to system memory
- Memory-bandwidth & power savings.
- No need to allocate system memory for MSAA, Memory savings.

Dynamic/Render Passes



Efficient Use of Tiling memory for MSAA Custom resolves

Thank you

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