

Roadmap 2022 Milestone

A new baseline for
immersive graphics

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KRONOS
GROUP

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Vulkan[®]

Roadmap 2022 Milestone

Vulkan Roadmap aims to reduce fragmentation

For mid- to high-end smartphone, tablet, laptop, console, and desktop devices

Aimed at immersive graphics experiences:
Gaming, interactive media, visualization, content authoring, etc.

Roadmap 2022 Milestone is the first step

Key Features:

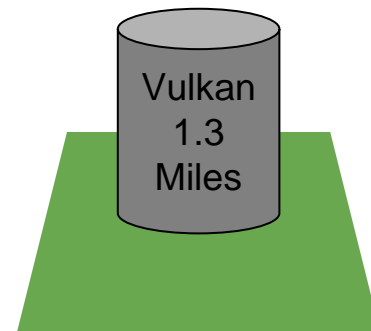
[Descriptor Indexing](#)

Consistent subgroup support

Multi-process scheduling

Scalar Block Layout

Many other features raising the bar!



The Roadmap 2022 Milestone sets a new baseline for immersive graphics

Descriptor Indexing

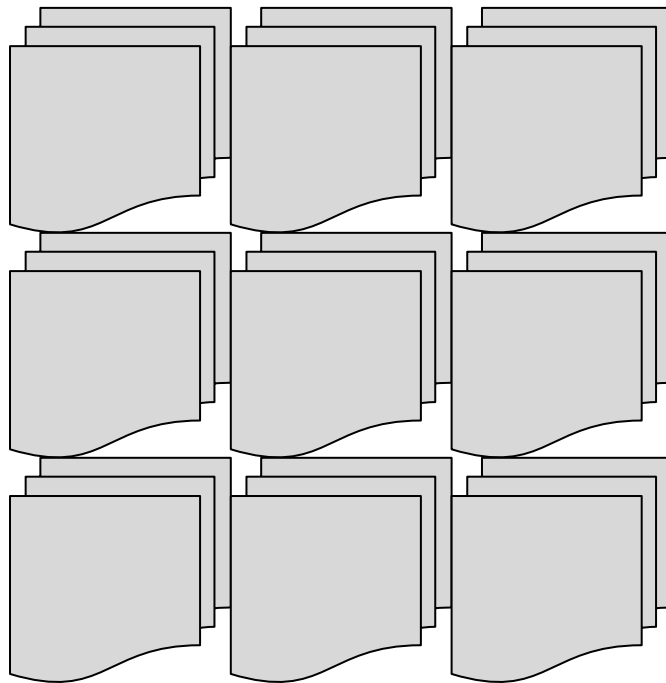
Without Descriptor Indexing

Low max descriptors per set

Statically uniform indexing only - cannot generate dynamic indices in shader

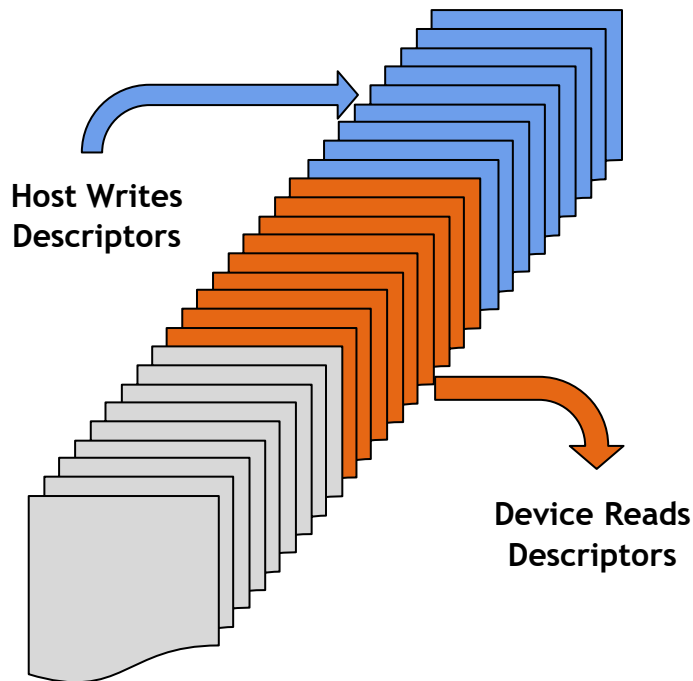
Descriptors must be uploaded to sets before being recorded

New descriptors need new descriptor set allocations



Descriptors can require per-draw set allocations and significant host management

Descriptor Indexing



With Descriptor Indexing

High max descriptors per set - at least 500K for most resources

Dynamic and non uniform resource indexing enables device driven rendering

Stream descriptors in and out of the same sets while the set is in use

No need to create new sets - allocate a handful of large sets at creation time

Descriptor Indexing enables simpler resource management both in the API and from shaders

Subgroups

Hardware Runs Threads in Parallel

Groups of threads (subgroups) execute locally to a processing unit

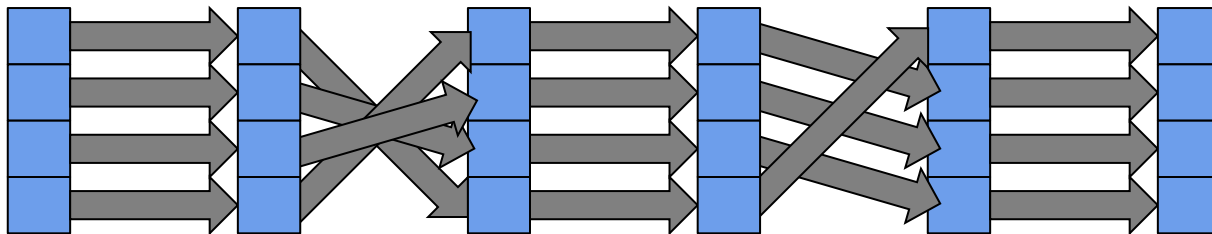
Subgroup operations expose ability to coordinate these threads and communicate between them

Roadmap 2022 Baseline

Subgroups must be at least 4 invocations

Operations must be supported in fragment and compute shaders

Most operations must be available

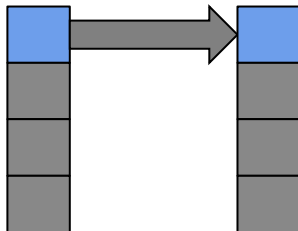


Subgroup operations enable efficient local communication between threads

Required Subgroup Operations

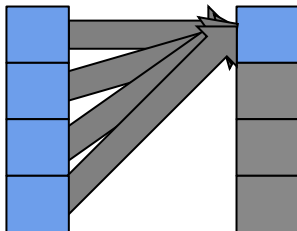
Basic

Size query,
Invocation election



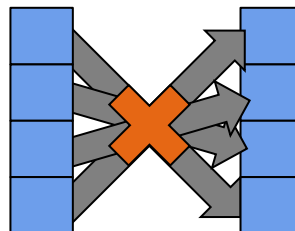
Vote

Any, All
Reduce divergence



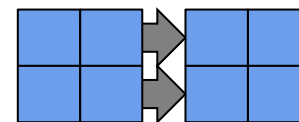
Arithmetic

Whole Subgroup
Results and Scans



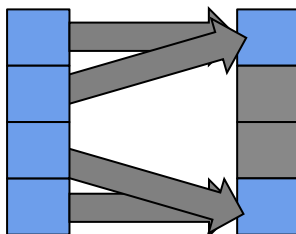
Quad

Matches derivatives in
fragment shaders



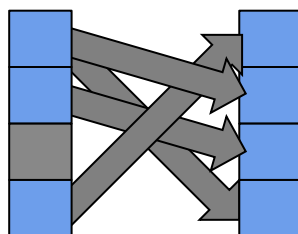
Ballot

Finer control over
divergence



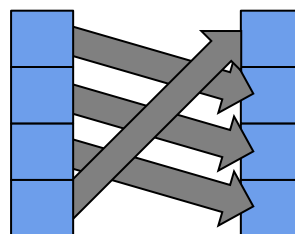
Shuffle

Read from any
other invocation



Shuffle Relative

Read from adjacent
invocations



Global Priority

Multiple Processes Accessing the GPU

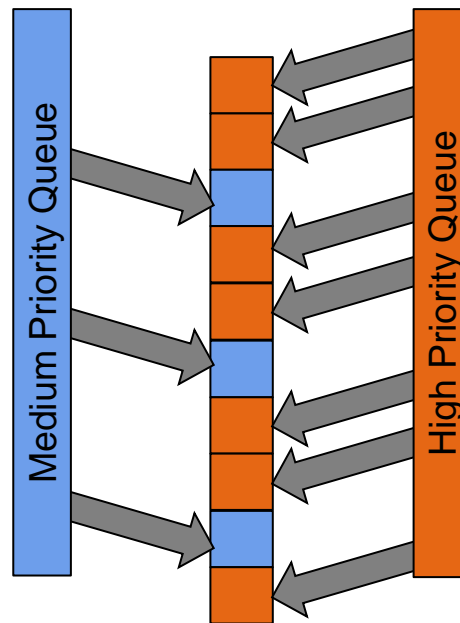
Vulkan 1.0 included a basic priority mechanism that enabled setting per-queue priorities within a process

Some use cases (notably composition) need to be able to identify elevated privilege across processes, to ensure screen updates hit your eye on time

This is particularly important for XR use cases, where latency tolerance is incredibly tight

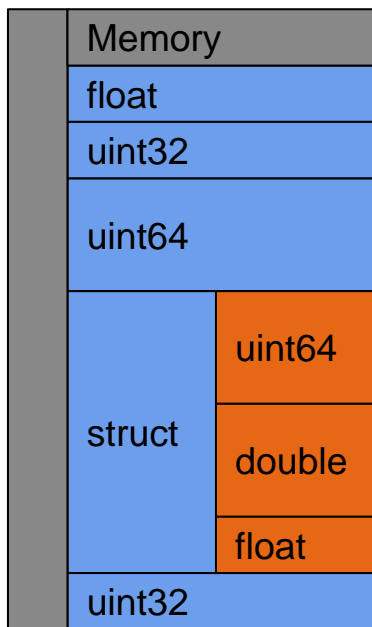
VK_KHR_global_queue_priority provides the ability for an application to request different priorities for different queue families

Submissions on high priority queues will be preferentially scheduled when ready



Global queue priorities provide cross-process prioritisation

Scalar Block Layout



Simpler Host-Device Variable Access

Scalar block layout allows alignment of variables to the size of their scalar elements for buffer memory

So a vector of four floats can be aligned to 4-byte boundaries (the size of a floating point value)

This allows the layout of data in host-side structures to map 1:1 in the majority of cases without needing to add host-side padding

Scalar block layout data layout capabilities to parity with host programming languages

Other Required Features

- 8k images
- Fragment shader stores and atomics
- $Y'C_B C_R$ image sampling
- Anisotropic filtering
- Precise occlusion queries
- Inf/NaN preservation for 32-/16-bit float
- Depth clamp
- Depth bias clamp
- Sample rate shading
- Mirror once then clamp UV wrapping
- Per-attachment blending
- Cubemap arrays
- 32-bit draw indexing
- Draw instance offset

Raising the Baseline for Immersive Graphics

Enhanced functionality for immersive graphics

Roadmap 2022 sets a new baseline for applications targeting an immersive graphics experience

See the Vulkan 1.3 specification for the full list of [additional features, limits, and extensions](#)

Explicitly targets mid- and high-end devices across smartphone, tablet, laptop, console, and desktop

Enables newer features to be required, improving the developer experience, allowing final products to be the best they can be

