Getting Information Back from the Graphics System

Oregon State University
Mike Bailey
mjb@cs.oregonstate.edu

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License.

Getting Information Back

• There are 3 types of Queries: Occlusion, Pipeline Statistics, and Timestamp
• Vulkan requires you to first setup “Query Pools”, one for each specific type
• This indicates that Vulkan thinks that Queries are time-consuming (relatively) to setup, and thus better to set them up in program-setup than in program-runtime
### Setting up Query Pools

```c
VkQueryPoolCreateInfo vqpci;
vqpci.sType = VK_STRUCTURE_TYPE_QUERY_POOL_CREATE_INFO;
vqpci.pNext = nullptr;
vqpci.flags = 0;
vqpci.queryType = VK_QUERY_TYPE_OCCLUSION;
// VK_QUERY_TYPE_PIPELINE_STATISTICS
// VK_QUERY_TYPE_TIMESTAMP
vqpci.queryCount = 1;

VkQueryPool occlusionQueryPool;
result = vkCreateQueryPool( LogicalDevice, IN &vqpci, PALLOCATOR, OUT &occlusionQueryPool );

VkQueryPool statisticsQueryPool;
result = vkCreateQueryPool( LogicalDevice, IN &vqpci, PALLOCATOR, OUT &statisticsQueryPool );

VkQueryPool timestampQueryPool;
result = vkCreateQueryPool( LogicalDevice, IN &vqpci, PALLOCATOR, OUT &timestampQueryPool );
```

### Resetting, Filling, and Examining a Query Pool

```c
vkCmdResetQueryPool( CommandBuffer, occlusionQueryPool, 0, 1 );

vkCmdBeginQuery( CommandBuffer, occlusionQueryPool, 0, VK_QUERY_CONTROL_PRECISE_BIT );
...

vkCmdEndQuery( CommandBuffer, occlusionQueryPool, 0 );

#define DATASIZE 128
uint32_t data[DATASIZE];

result = vkGetQueryPoolResults( LogicalDevice, occlusionQueryPool, 0, 1, DATASIZE*sizeof(uint32_t), data, stride, flags );
// or'ed combinations of:
// VK_QUERY_RESULT_64_BIT
// VK_QUERY_RESULT_WAIT_BIT
// VK_QUERY_RESULT_WITH_AVAILABILITY_BIT
// VK_QUERY_RESULT_PARTIAL_BIT
// stride is # of bytes in between each result
```
Occlusion Query

Occlusion Queries count the number of fragments drawn between the *vkCmdBeginQuery* and the *vkCmdEndQuery* that pass both the Depth and Stencil tests.

This is commonly used to see what level-of-detail should be used when drawing a complicated object.

Some hints:
- Don’t draw the whole scene – just draw the object you are interested in.
- Don’t draw the whole object – just draw a simple bounding volume at least as big as the object.
- Don’t draw the whole bounding volume – cull away the back faces (two reasons: time and correctness).
- Don’t draw the colors – just draw the depths (especially if the fragment shader is time-consuming).

```c
uint32_t fragmentCount;
result = vkGetQueryPoolResults( LogicalDevice, occlusionQueryPool, 0, 1,
    sizeof(uint32_t), &fragmentCount, 0, VK_QUERY_RESULT_WAIT_BIT);
```

Pipeline Statistics Query

Pipeline Statistics Queries count how many of various things get done between the *vkCmdBeginQuery* and the *vkCmdEndQuery*.

```c
uint32_t counts[NUM_STATS];
result = vkGetQueryPoolResults( LogicalDevice, statisticsQueryPool, 0, 1,
    NUM_STATS*sizeof(uint32_t), counts, 0, VK_QUERY_RESULT_WAIT_BIT);
```

// vqpci.pipelineStatistics = or’ed bits of:
// VK_QUERY_PIPELINE_STATISTIC_INPUT_ASSEMBLY_VERTICES_BIT
// VK_QUERY_PIPELINE_STATISTIC_INPUT ASSEMBLY_PRIMITIVES_BIT
// VK_QUERY_PIPELINE_STATISTIC_VERTEX_SHADER_INVOCATIONS_BIT
// VK_QUERY_PIPELINE_STATISTIC_GEOMETRY_SHADER_INVOCATIONS_BIT
// VK_QUERY_PIPELINE_STATISTIC_GEOMETRY_SHADER_PRIMITIVES_BIT
// VK_QUERY_PIPELINE_STATISTIC_CLIPPING_INVOCATIONS_BIT
// VK_QUERY_PIPELINE_STATISTIC_CLIPPING_PRIMITIVES_BIT
// VK_QUERY_PIPELINE_STATISTIC_FRAGMENT_SHADER_INVOCATIONS_BIT
// VK_QUERY_PIPELINE_STATISTIC_TESSELLATION CONTROL_SHADER PATCHES_BIT
// VK_QUERY_PIPELINE_STATISTIC_TESSELLATION EVALUATION_SHADER_INVOCATIONS_BIT
// VK_QUERY_PIPELINE_STATISTIC_COMPUTE_SHADER_INVOCATIONS_BIT
## Timestamp Query

Timestamp Queries count how many nanoseconds of time elapsed between the `vkCmdBeginQuery` and the `vkCmdEndQuery`.

```c
uint64_t nanosecondsCount;
result = vkGetQueryPoolResults( LogicalDevice, timestampQueryPool, 0, 1, sizeof(uint64_t), &nanosecondsCount, 0,
                                VK_QUERY_RESULT_64_BIT | VK_QUERY_RESULT_WAIT_BIT);
```

### Timestamp Query

The `vkCmdWriteTimeStamp()` function produces the time between when this function is called and when the first thing reaches the specified pipeline stage.

Even though the stages are "bits", you are supposed to only specify one of them, not "or" multiple ones together.

```c
vkCmdWriteTimeStamp( CommandBuffer, pipelineStages, timestampQueryPool, 0 );
```

- `VK_PIPELINE_STAGE_TOP_OF_PIPE_BIT`
- `VK_PIPELINE_STAGE_DRAW间接_BIT`
- `VK_PIPELINE_STAGE_VERTEX_INPUT_BIT`
- `VK_PIPELINE_STAGE_VERTEX_SHADER_BIT`
- `VK_PIPELINE_STAGE_TESSELLATION_CONTROL_SHADER_BIT`
- `VK_PIPELINE_STAGE_TESSELLATION_EVALUATION_SHADER_BIT`
- `VK_PIPELINE_STAGE_GEOMETRY_SHADER_BIT`
- `VK_PIPELINE_STAGE_FRAGMENT_SHADER_BIT`
- `VK_PIPELINE_STAGE_EARLY_FRAGMENT_TESTS_BIT`
- `VK_PIPELINE_STAGE_LATE_FRAGMENT_TESTS_BIT`
- `VK_PIPELINE_STAGE_COMPUTE_SHADER_BIT`
- `VK_PIPELINE_STAGE_TRANSFER_BIT`
- `VK_PIPELINE_STAGE_BOTTOM_OF_PIPE_BIT`
- `VK_PIPELINE_STAGE_HOST_BIT`