Synchronization

Remember the Overall Block Diagram?

Instance

Physical

Device

Logical

Device

Queue

Command Buffer

Semaphores

- Indicates that a batch of commands has been processed from a queue. Basically announces "I am finished!"
- You create one and give it to a Vulkan function which sets it. Later on, you tell another Vulkan function to wait for this semaphore to be signaled.
- You don't end up setting, resetting, or checking the semaphore yourself.
- Semaphores must be initialized ("created") before they can be used.

Creating a Semaphore

```c
VkSemaphoreCreateInfo vsci;
vsci.sType = VK_STRUCTURE_TYPE_SEMAPHORE_CREATE_INFO;
vsci.pNext = nullptr;
vsci.flags = 0;
VkSemaphore semaphore;
result = vkCreateSemaphore( LogicalDevice, IN &vsci, PALLOCATOR, OUT &semaphore );
```

This doesn't actually do anything with the semaphore - it just sets it up

Semaphores Example during the Render Loop

```c
uint32_t nextImageIndex;
vkAcquireNextImageKHR( LogicalDevice, IN SwapChain, IN UINT64_MAX, IN imageReadySemaphore, IN VK_NULL_HANDLE, OUT &nextImageIndex );

VkPipelineStageFlags waitAtBottomOfPipe = VK_PIPELINE_STAGE_BOTTOM_OF_PIPE_BIT;
VkSubmitInfo vsi;
vsi.sType = VK_STRUCTURE_TYPE_SUBMIT_INFO;
vsi.pNext = nullptr;
vsi.waitSemaphoreCount = 1;
vsi.pWaitSemaphores = &imageReadySemaphore;
vsi.pWaitDstStageMask = &waitAtBottomOfPipe;
vsi.commandBufferCount = 1;
vsi.pCommandBuffers = &CommandBuffers[nextImageIndex];
vsi.signalSemaphoreCount = 0;
vsi.pSignalSemaphores = (VkSemaphore) nullptr;
result = vkQueueSubmit( presentQueue, 1, IN &vsi, IN renderFence );
```

You do this to wait for an image to be ready to be rendered into
Fences

- Used to synchronize CPU-GPU tasks.
- Used when the host needs to wait for the device to complete something big.
- Announces that queue-submitted work is finished.
- You can un-signal, signal, test or block-while-waiting.

Events

- Events provide even finer-grained synchronization.
- Events are a primitive that can be signaled by the host or the device.
- Can even signal at one place in the pipeline and wait for it at another place in the pipeline.
- Signaling in the pipeline means "signal me as the last piece of this draw command passes that point in the pipeline".
- You can signal, un-signal, or test from a vk function or from a vkCmd function.
- Can wait from a vkCmd function.

Controlling Events from the Host

Controlling Events from the Device

Note: the host cannot block waiting for an event, but it can test for it

Note: the device cannot test for an event, but it can block