Physical Devices

Vulkan: Overall Block Diagram

Application

Instance

Physical Device

Logical Device

Queue

Queue

Queue

Queue

Queue

Queue

Command Buffer

Command Buffer

Command Buffer
uint32_t count;
result = vkEnumeratePhysicalDevices( Instance, OUT &count, OUT (VkPhysicalDevice *)[nullptr];

VkPhysicalDevice * physicalDevices = new VkPhysicalDevice[count];
result = vkEnumeratePhysicalDevices( Instance, OUT &count, OUT physicalDevices);

This way of querying information is a recurring OpenCL and Vulkan pattern (get used to it):

result = vkEnumeratePhysicalDevices( Instance, &count, nullptr );
result = vkEnumeratePhysicalDevices( Instance, &count, physicalDevices );
VkResult result = VK_SUCCESS;
result = vkEnumeratePhysicalDevices( Instance, OUT &PhysicalDeviceCount, (VkPhysicalDevice *)nullptr );
if( result != VK_SUCCESS || PhysicalDeviceCount <= 0 )
{
    fprintf( FpDebug, "Could not count the physical devices\n" );
    return VK_SHOULD_EXIT;
}
physicalDevices = new VkPhysicalDevice[ PhysicalDeviceCount ];
result = vkEnumeratePhysicalDevices( Instance, OUT &PhysicalDeviceCount, OUT physicalDevices );
if( result != VK_SUCCESS )
{
    fprintf( FpDebug, "Could not enumerate the %d physical devices\n", PhysicalDeviceCount );
    return VK_SHOULD_EXIT;
}

int discreteSelect = -1;
int integratedSelect = -1;
for( unsigned int i = 0; i < PhysicalDeviceCount; i++ )
{
    VkPhysicalDeviceProperties vpdp;
    vkGetPhysicalDeviceProperties( IN physicalDevices[i], OUT &vpdp );
    if( result != VK_SUCCESS )
    {
        fprintf( FpDebug, "Could not get the physical device properties of device %d\n", i );
        return VK_SHOULD_EXIT;
    }
    fprintf( FpDebug, "\n\nDevice %2d:\n", i );
    fprintf( FpDebug, "\tAPI version: %d\n", vpdp.apiVersion );
    fprintf( FpDebug, "\tDriver version: %d\n", vpdp.apiVersion );
    fprintf( FpDebug, "\tVendor ID: 0x%04x\n", vpdp.vendorID );
    fprintf( FpDebug, "\tDevice ID: 0x%04x\n", vpdp.deviceID );
    fprintf( FpDebug, "\tPhysical Device Type: \%d =\", vpdp.deviceType );
    if( vpdp.deviceType == VK_PHYSICAL_DEVICE_TYPE_DISCRETE_GPU ) fprintf( FpDebug, " (Discrete GPU)\n" );
    if( vpdp.deviceType == VK_PHYSICAL_DEVICE_TYPE_INTEGRATED_GPU ) fprintf( FpDebug, " (Integrated GPU)\n" );
    if( vpdp.deviceType == VK_PHYSICAL_DEVICE_TYPE_VIRTUAL_GPU ) fprintf( FpDebug, " (Virtual GPU)\n" );
    if( vpdp.deviceType == VK_PHYSICAL_DEVICE_TYPE_CPU ) fprintf( FpDebug, " (CPU)\n" );
    fprintf( FpDebug, "\tDevice Name: %s\n", vpdp.deviceName );
    fprintf( FpDebug, "\t(Pipeline Cache Size: %d\n", vpdp.pipelineCacheUUID[0] );
    if
// need some logical here to decide which physical device to select:

if (vpdp.deviceType == VK_PHYSICAL_DEVICE_TYPE_DISCRETE_GPU)
    discreteSelect = i;

if (vpdp.deviceType == VK_PHYSICAL_DEVICE_TYPE_INTEGRATED_GPU)
    integratedSelect = i;
}

int which = -1;
if (discreteSelect >= 0)
{
    which = discreteSelect;
    PhysicalDevice = physicalDevices[which];
} else if (integratedSelect >= 0)
{
    which = integratedSelect;
    PhysicalDevice = physicalDevices[which];
} else
{
    fprintf(FpDebug, "Could not select a Physical Device\n");
    return VK_SHOULD_EXIT;
}

VkPhysicalDeviceProperties PhysicalDeviceFeatures;
vkGetPhysicalDeviceFeatures(IN PhysicalDevice, OUT &PhysicalDeviceFeatures);

fprintf(FpDebug, "nPhysical Device Features:\n");
fprintf(FpDebug, "geometryShader = %2d\n", PhysicalDeviceFeatures.geometryShader);
fprintf(FpDebug, "tessellationShader = %2d\n", PhysicalDeviceFeatures.tessellationShader);
fprintf(FpDebug, "multiDrawIndirect = %2d\n", PhysicalDeviceFeatures.multiDrawIndirect);
fprintf(FpDebug, "wideLines = %2d\n", PhysicalDeviceFeatures.wideLines);
fprintf(FpDebug, "largePoints = %2d\n", PhysicalDeviceFeatures.largePoints);
fprintf(FpDebug, "multiViewport = %2d\n", PhysicalDeviceFeatures.multiViewport);
fprintf(FpDebug, "occlusionQueryPrecise = %2d\n", PhysicalDeviceFeatures.occlusionQueryPrecise);
fprintf(FpDebug, "pipelineStatisticsQuery = %2d\n", PhysicalDeviceFeatures.pipelineStatisticsQuery);
fprintf(FpDebug, "shaderFloat64 = %2d\n", PhysicalDeviceFeatures.shaderFloat64);
fprintf(FpDebug, "shaderInt64 = %2d\n", PhysicalDeviceFeatures.shaderInt64);
fprintf(FpDebug, "shaderInt16 = %2d\n", PhysicalDeviceFeatures.shaderInt16);
Here's What the NVIDIA RTX 2080 Ti Produced

vkEnumeratePhysicalDevices:
Device 0:
  API version: 4198499
  Driver version: 4198499
  Vendor ID: 0x10de
  Device ID: 0x1e04
  Physical Device Type: 2 = (Discrete GPU)
  Device Name: RTX 2080 Ti
  Pipeline Cache Size: 206
Device #0 selected ('RTX 2080 Ti')
Physical Device Features:
gometryShader = 1
tessellationShader = 1
multiDrawIndirect = 1
wideLines = 1
largePoints = 1
multiViewport = 1
occlusionQueryPrecise = 1
pipelineStatisticsQuery = 1
shaderFloat64 = 1
shaderInt64 = 1
shaderInt16 = 1

Here's What the Intel HD Graphics 520 Produced

vkEnumeratePhysicalDevices:
Device 0:
  API version: 4194360
  Driver version: 4194360
  Vendor ID: 0x8086
  Device ID: 0x1916
  Physical Device Type: 1 = (Integrated GPU)
  Device Name: Intel(R) HD Graphics 520
  Pipeline Cache Size: 213
Device #0 selected ('Intel(R) HD Graphics 520')
Physical Device Features:
gometryShader = 1
tessellationShader = 1
multiDrawIndirect = 1
wideLines = 1
largePoints = 1
multiViewport = 1
occlusionQueryPrecise = 1
pipelineStatisticsQuery = 1
shaderFloat64 = 1
shaderInt64 = 1
shaderInt16 = 1
Asking About the Physical Device's Different Memories

```c
VkPhysicalDeviceMemoryProperties vpdmp;
vkGetPhysicalDeviceMemoryProperties( PhysicalDevice, OUT &vpdmp );

fprintf( FpDebug, "\n%d Memory Types:\n", vpdmp.memoryTypeCount );
for( unsigned int i = 0; i < vpdmp.memoryTypeCount; i++ ) {
    VkMemoryType vmt = vpdmp.memoryTypes[i];
    fprintf( FpDebug, "Memory %2d: ", i );
    if( ( vmt.propertyFlags & VK_MEMORY_PROPERTY_DEVICE_LOCAL_BIT       ) != 0 )    fprintf( FpDebug, " DeviceLocal" );
    if( ( vmt.propertyFlags & VK_MEMORY_PROPERTY_HOST_VISIBLE_BIT       ) != 0 )    fprintf( FpDebug, " HostVisible" );
    if( ( vmt.propertyFlags & VK_MEMORY_PROPERTY_HOST_COHERENT_BIT      ) != 0 )    fprintf( FpDebug, " HostCoherent" );
    if( ( vmt.propertyFlags & VK_MEMORY_PROPERTY_HOST_CACHED_BIT        ) != 0 )    fprintf( FpDebug, " HostCached" );
    if( ( vmt.propertyFlags & VK_MEMORY_PROPERTY_LAZILY_ALLOCATED_BIT   ) != 0 )    fprintf( FpDebug, " LazilyAllocated" );
    fprintf(FpDebug, "\n");
}

fprintf( FpDebug, "\n%d Memory Heaps:\n", vpdmp.memoryHeapCount );
for( unsigned int i = 0; i < vpdmp.memoryHeapCount; i++ ) {
    VkMemoryHeap vmh = vpdmp.memoryHeaps[i];
    fprintf( FpDebug, "Heap %d: ", i);
    if( ( vmh.flags & VK_MEMORY_HEAP_DEVICE_LOCAL_BIT  ) != 0 )     fprintf( FpDebug, "DeviceLocal" );     // only one in use
    fprintf(FpDebug, "\n");
}
```

Here's What I Got

11 Memory Types:
- Memory 0:
- Memory 1:
- Memory 2:
- Memory 3:
- Memory 4:
- Memory 5:
- Memory 6:
- Memory 7: DeviceLocal
- Memory 8: DeviceLocal
- Memory 9: HostVisible HostCoherent
- Memory 10: HostVisible HostCoherent HostCached

2 Memory Heaps:
- Heap 0: size = 0xb7c00000 DeviceLocal
- Heap 1: size = 0xfac00000
Asking About the Physical Device's Queue Families

```c
uint32_t count = -1;
vkGetPhysicalDeviceQueueFamilyProperties( IN PhysicalDevice, &count, OUT (VkQueueFamilyProperties *)nullptr );
fprintf( FpDebug, "Found %d Queue Families:\n", count );
VkQueueFamilyProperties *vqfp = new VkQueueFamilyProperties[ count ];
vkGetPhysicalDeviceQueueFamilyProperties( IN PhysicalDevice, &count, OUT vqfp );
for( unsigned int i = 0; i < count; i++ )
{
    fprintf( FpDebug, "%d: queueCount = %2d  ;   ", i, vqfp[i].queueCount );
    if( ( vqfp[i].queueFlags & VK_QUEUE_GRAPHICS_BIT ) != 0 )       fprintf( FpDebug, " Graphics" );
    if( ( vqfp[i].queueFlags & VK_QUEUE_COMPUTE_BIT  ) != 0 )       fprintf( FpDebug, " Compute ");
    if( ( vqfp[i].queueFlags & VK_QUEUE_TRANSFER_BIT ) != 0 )       fprintf( FpDebug, " Transfer" );
    fprintf(FpDebug, "\n");
}
```

Here's What I Got

```
Found 3 Queue Families:
0: queueCount = 16 ; Graphics Compute Transfer
1: queueCount =  2 ; Transfer
2: queueCount =  8 ; Compute
```