0 A.D. game: Vulkan API

Vladislav Belov

A.D.
Empires Ascendant

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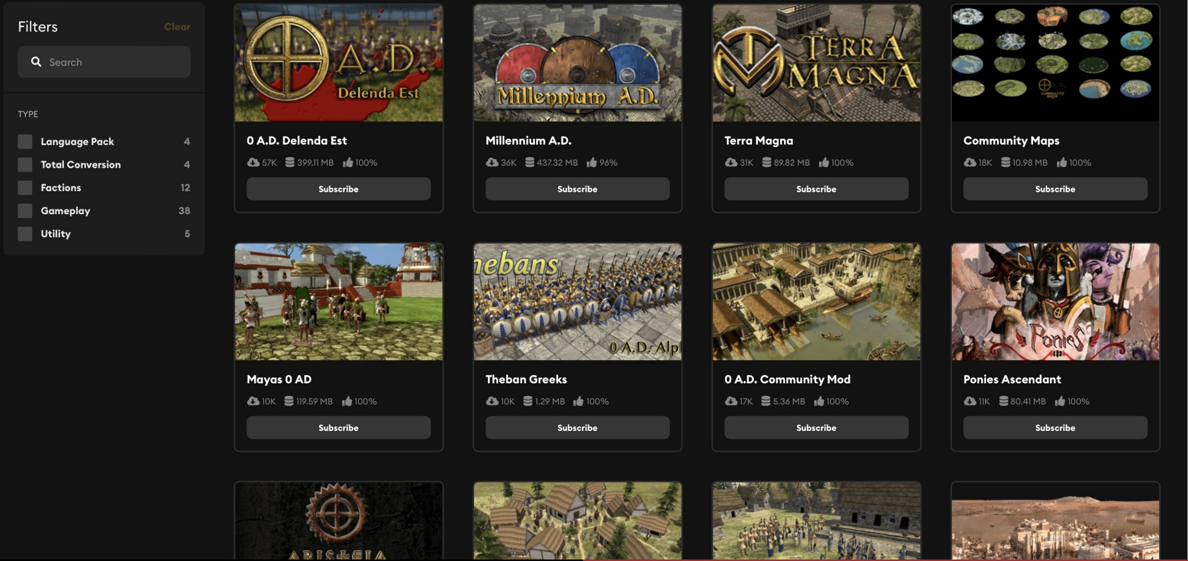

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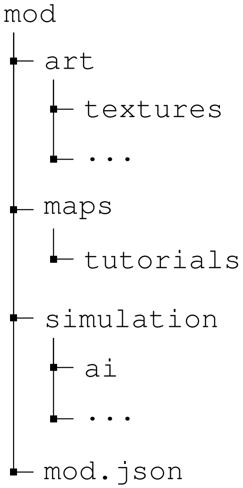
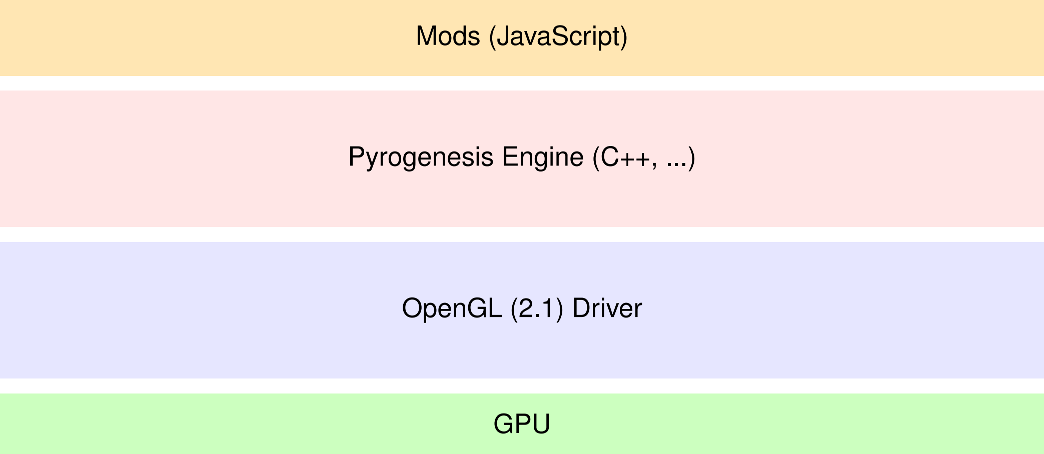


```
mod
  art
    textures
    ...
  maps
    tutorials
  simulation
    ai
    ...
  mod.json
```

Graphics

Structure Before



Mods (JavaScript)

Pyrogenesis Engine (C++, ...)

OpenGL (2.1) Driver

GPU

Code Before

```
glDepthMask(0);

CPatchRData::RenderBlends(visiblePatches, context, shadow);

CDecalRData::RenderDecals(visibleDecals, context, shadow);

g_Renderer.BindTexture(1, 0);
g_Renderer.BindTexture(2, 0);
g_Renderer.BindTexture(3, 0);

glDepthMask(1);
glBlendFunc(GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA);
glDisable(GL_BLEND);
```

OpenGL Problems

- CPU performance and unpredictable cost of some function calls
- No proper queries for supported features/GPUs
- Lack of additional/debug validations
- Single-threaded

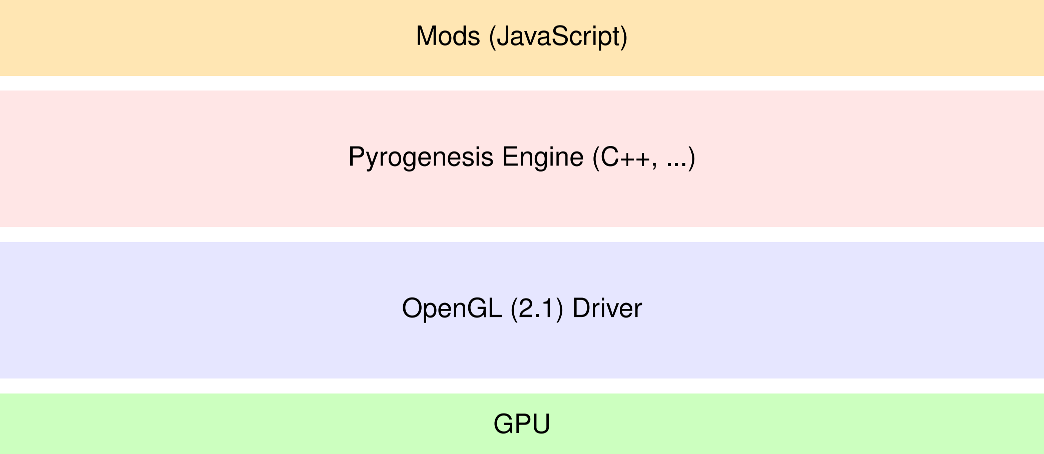
OpenGL Versions reported by drivers

- 3.3
- 3.3.0
- 3.3.0 - Build 8.0.0.1000
- 3.3.9000 Compatibility Profile Context
- 3.3 (Compatibility Profile) Mesa 23.1.2
- 3.3 Mesa 21.3.5
- 3.3 ATI-4.8.101
- 3.3 NVIDIA-10.17.5 355.10.05.45f01

OpenGL GPUs reported by drivers

- Radeon RX 550
- Radeon (TM) RX 550
- Radeon(TM) RX 550
- Radeon RX550/550 Series
- AMD Radeon RX 550 / 550 Series
- AMD Radeon RX 550 Series
- AMD Radeon RX550 series

Structure Before



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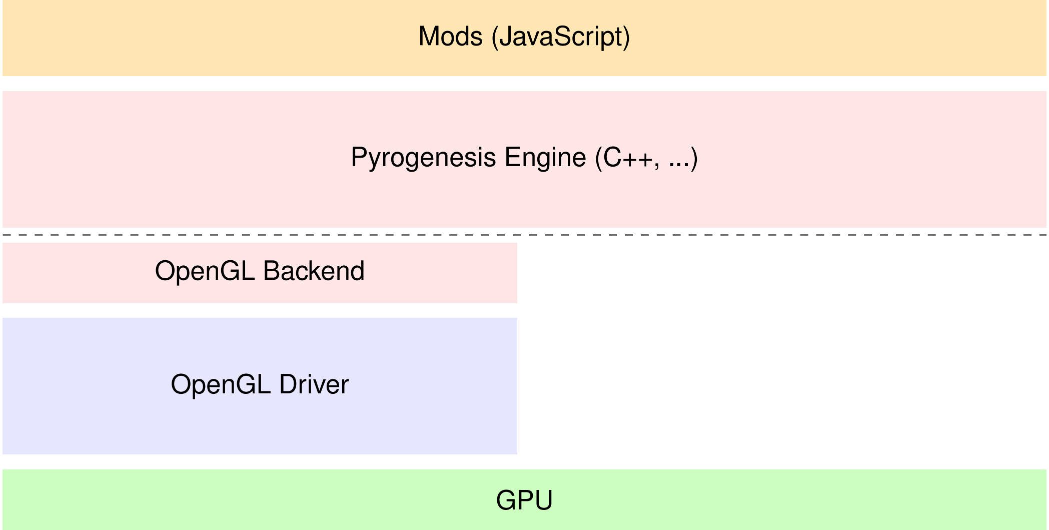
Structure



Mods (JavaScript)

Pyrogenesis Engine (C++, ...)

OpenGL Backend

OpenGL Driver

GPU

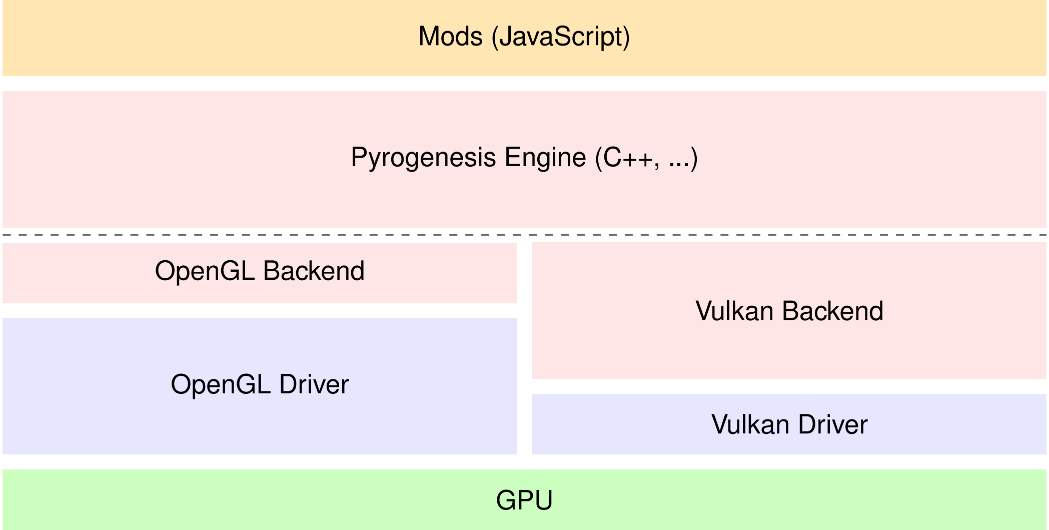
Interfaces

```
class IDevice
{
  // ...
  virtual std::unique_ptr<ITexture> CreateTexture(
    const char* name, const ITexture::Type type, const uint32_t usage,
    const Format format, const uint32_t width, const uint32_t height,
    const Sampler::Desc& defaultSamplerDesc, const uint32_t MIPLevelCount,
    const uint32_t sampleCount) = 0;
  // ...
};

class IDeviceCommandContext
{
  // ...
  virtual void SetTexture(const int32_t bindingSlot, ITexture* texture) = 0;
  // ...
};
```

Code

```
CPatchRData::RenderBlends(
  deviceCommandContext, m->blendVertexInputLayout,
  visiblePatches, context, shadow);

CDecalRData::RenderDecals(
  deviceCommandContext, m->decalsVertexInputLayout,
  visibleDecals, context, shadow);
```

Structure



Mods (JavaScript)

Pyrogenesis Engine (C++, ...)

OpenGL Backend

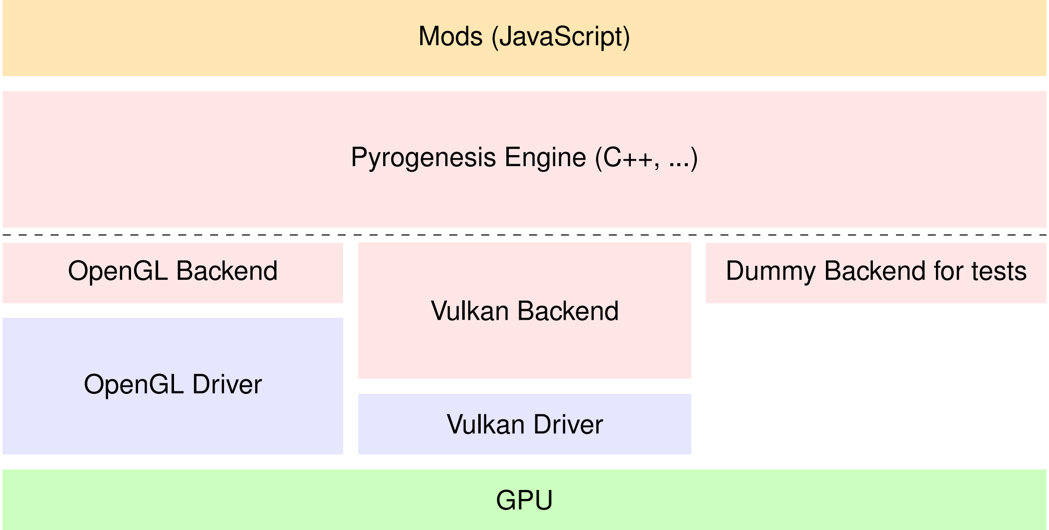
Vulkan Backend

OpenGL Driver

Vulkan Driver

GPU

Structure


Mods (JavaScript)
Pyrogenesis Engine (C++, ...)
OpenGL Backend
Vulkan Backend
Dummy Backend for tests
OpenGL Driver
Vulkan Driver
GPU

Code Comparison

- OpenGL backend ∼4k lines of code
- Vulkan backend ∼8k + VMA ∼17k lines of code

Results

- From 2021 to 2023 it took 1.5-2 months of full time work in total to add the abstraction
- About 2 weeks of full time work in total to add the Vulkan backend
- Validation layers
- Proper information about GPU and its Vendor
- Possible multi-threading support
- Performance

Was it worth it?

- Definitely!
- Performance (up to 3x times faster for some platforms)
- Stability and more predictable behavior (less amount of silent errors)
- Features (modern GPU functionality)

Does everyone need Vulkan at all?

- Ideally - yes!
- If your engine/application supports Vulkan - enable it
- If you can relatively easy switch to Vulkan (or a third party library which supports Vulkan) - do it
- If you use an own custom engine - spend time on it only if you need it

If you enjoy creating games, you will always be welcome!

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