

Genesis: Real-Time Raytracing in Virtual Production

technicolor



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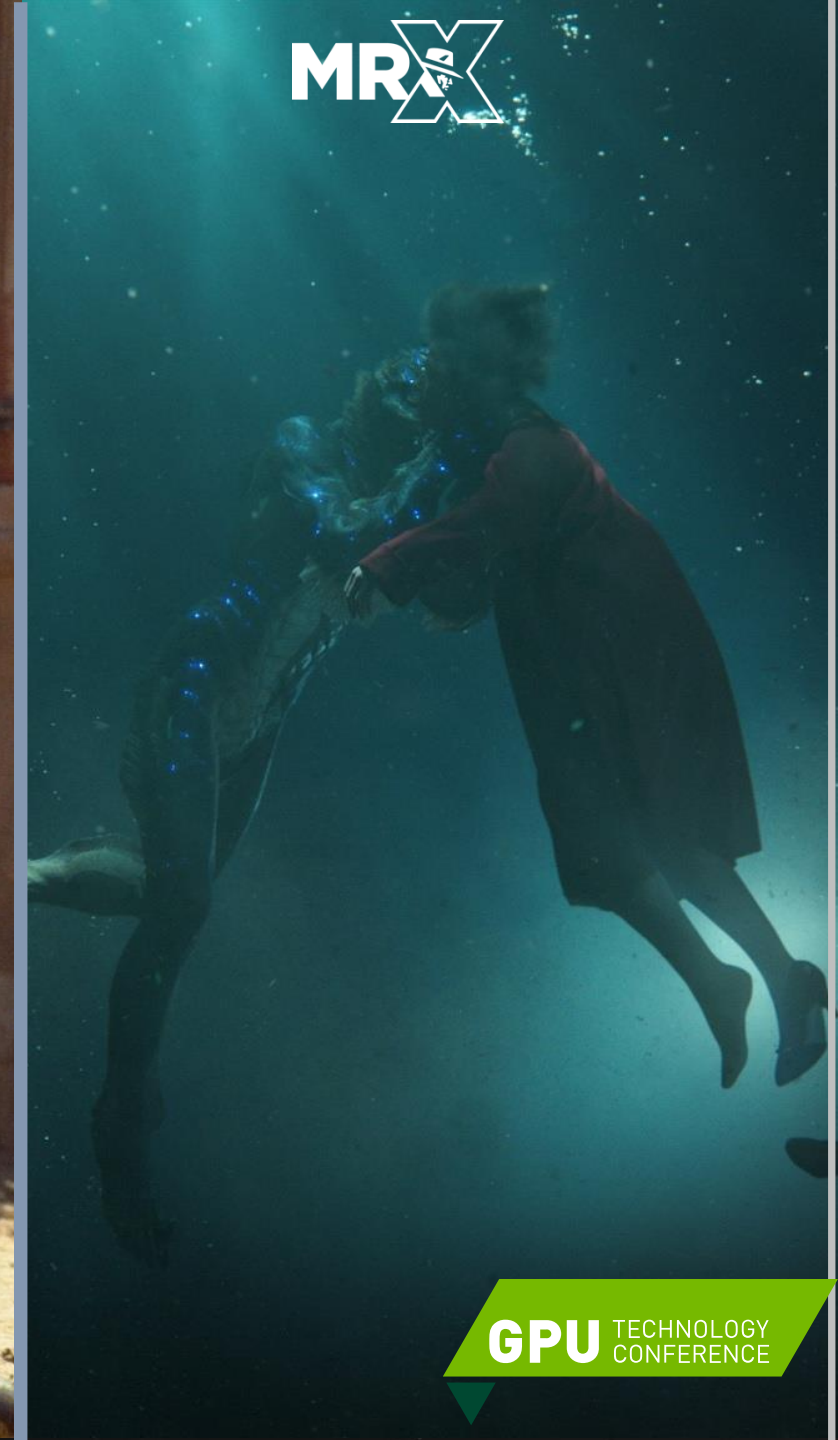


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MPC Film



GPU TECHNOLOGY
CONFERENCE

VISUAL EFFECTS GLOBAL FOOTPRINT



GENESIS



What is Virtual Production?

VR SCOUTING



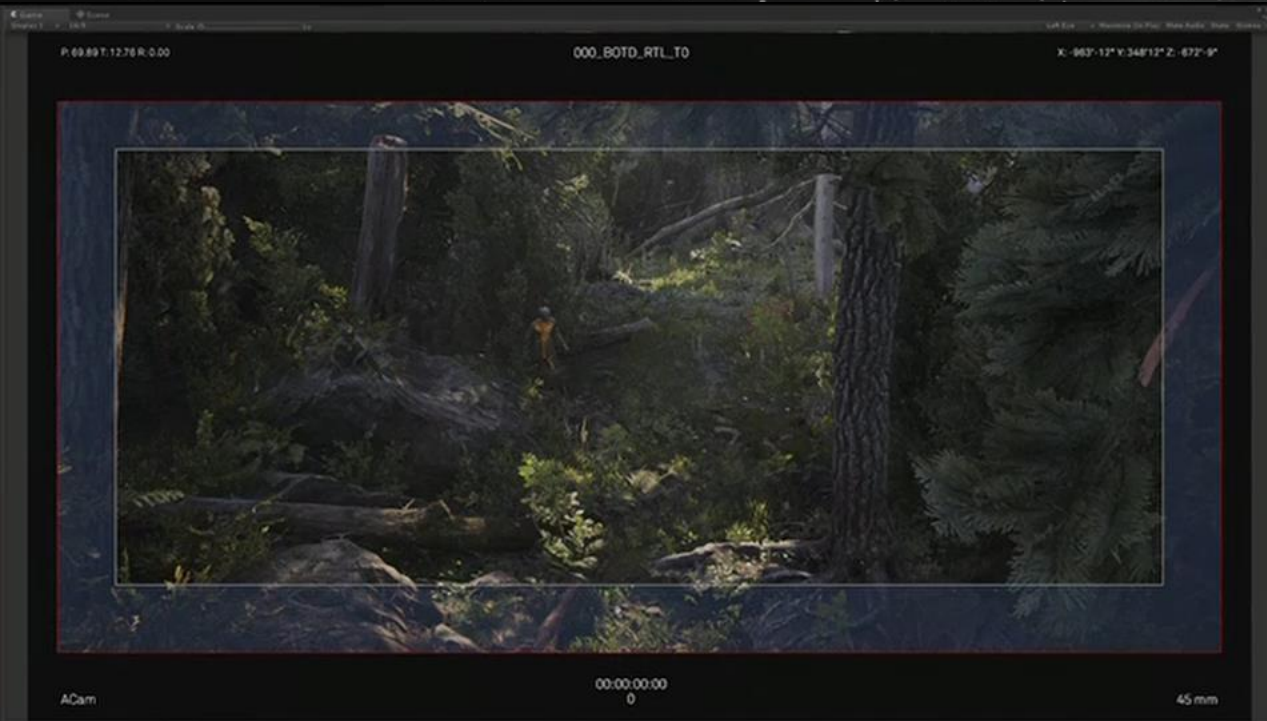
MOCAP



VIRTUAL CAMERA



LAYERING

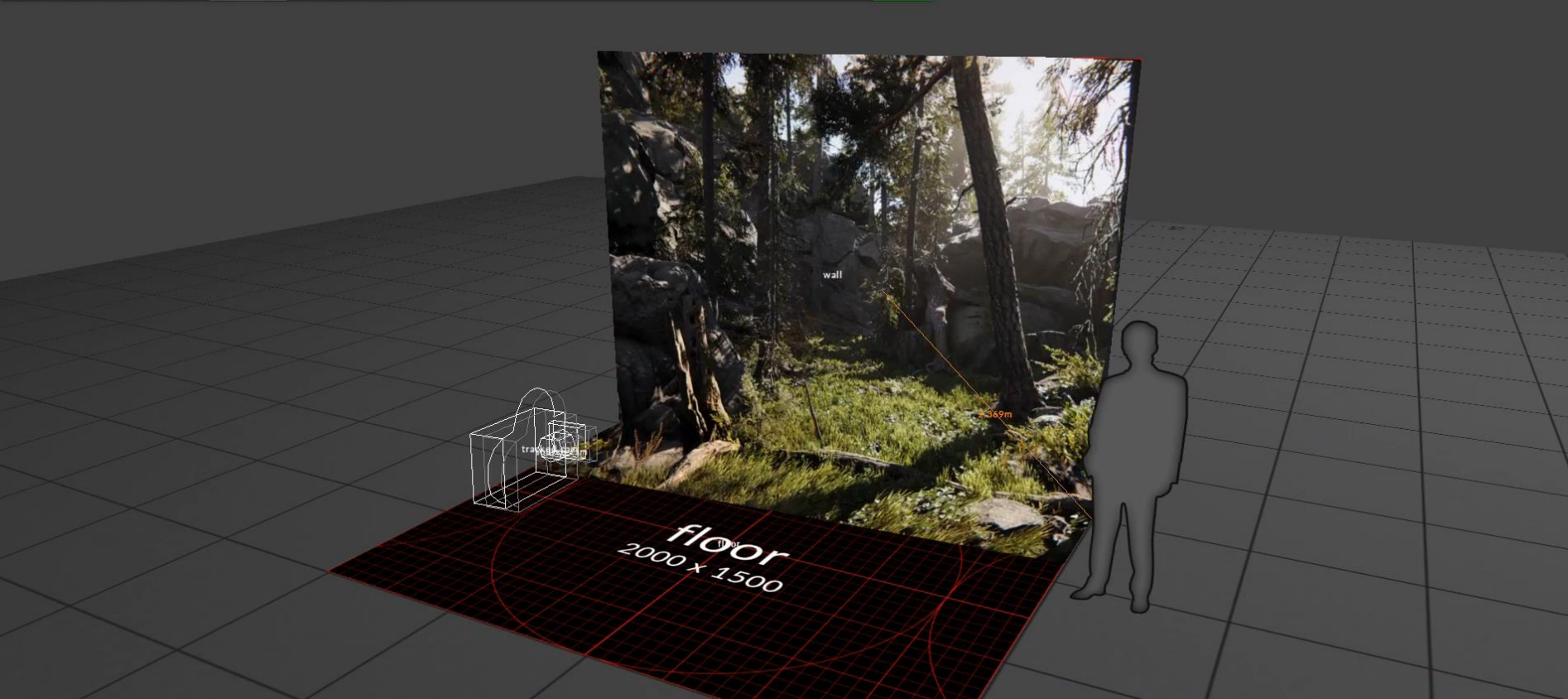


Phases of Virtual Production

- 1) Scout the environment, find shots, dress your set
- 2) Capture performance, add animations
- 3) Shoot virtual cameras
- 4) Iterate and layer

LED WALLS





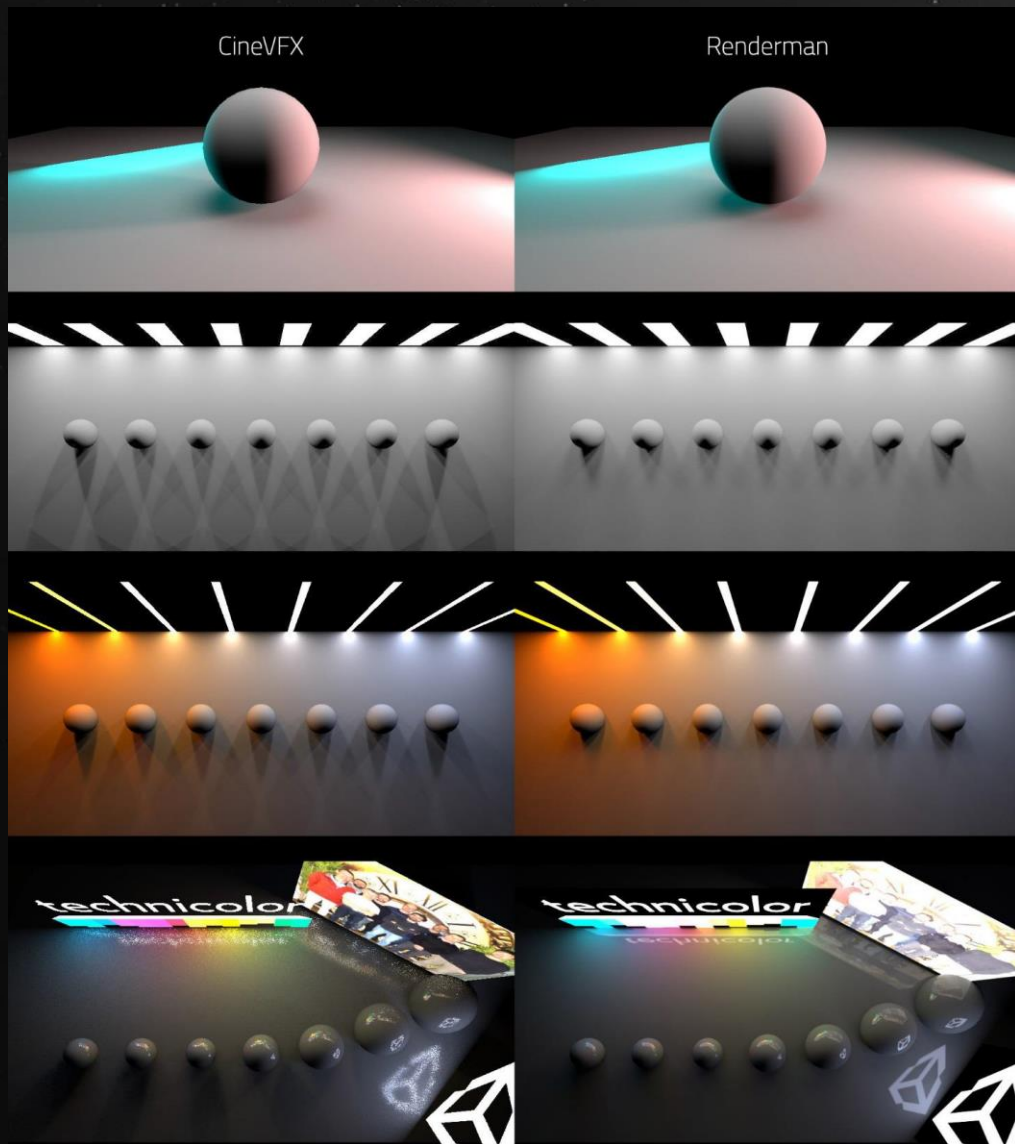
LED Walls



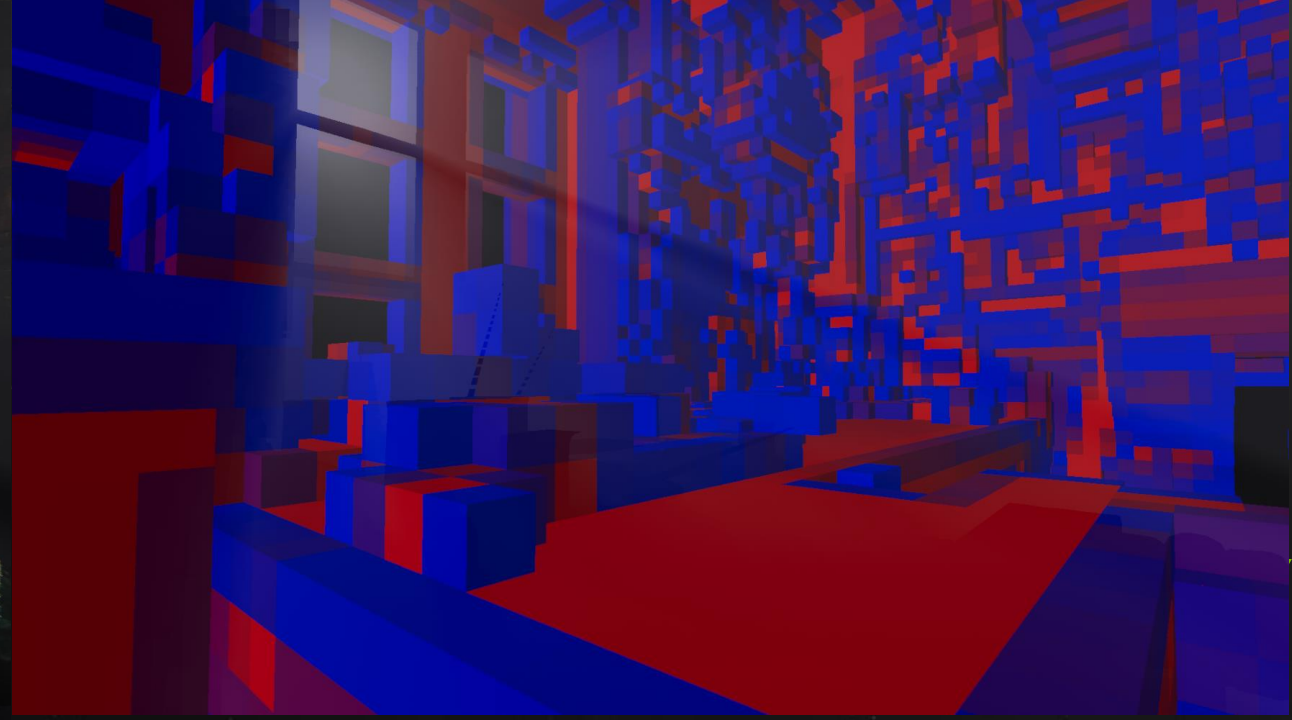
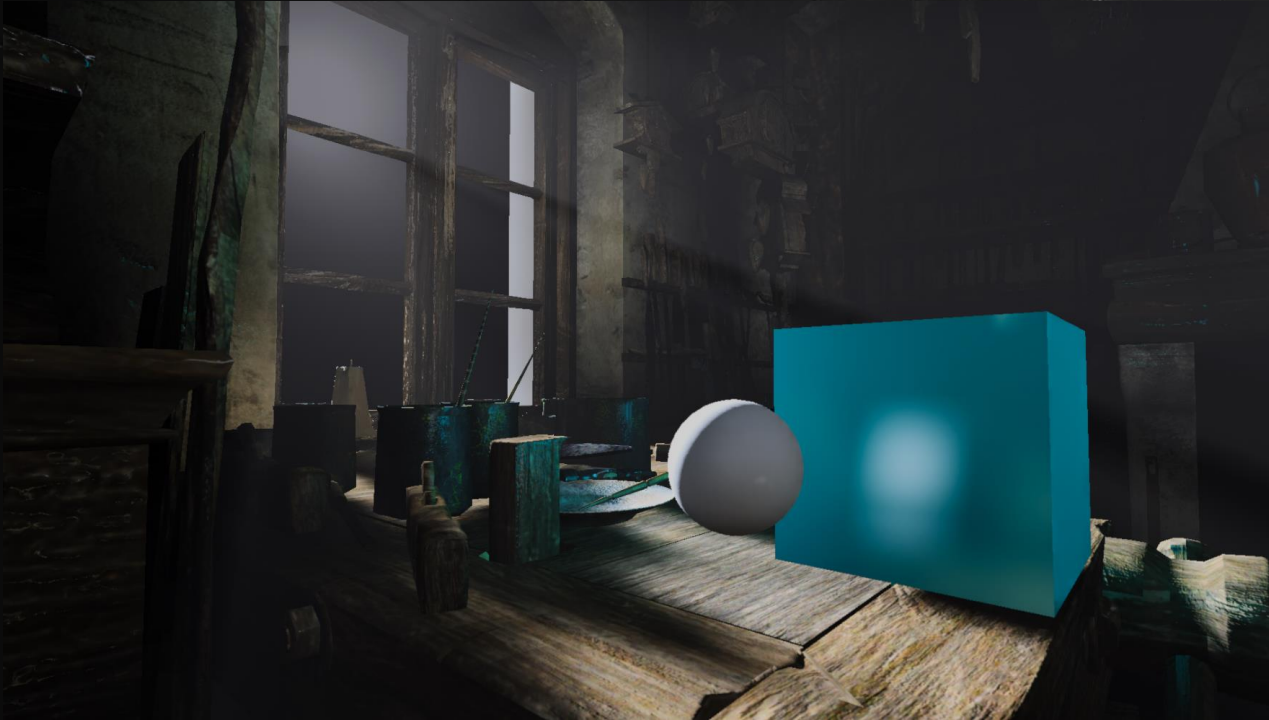
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Rendering Challenges

- 1) Advanced lighting for DP on set
- 2) Good approximation of final render
- 3) Final pixels in real time



AREA LIGHTS





VOLUMETRIC LIGHTING



DEPTH OF FIELD

Not enough

- Need more parity with lighting in post
- Need raytracing:
 - Live link with a path tracer
 - Raytracing in engine

Live-Link with Prism



S9197 – Prism & RTX

Victor Yudin, Lead Software Developer, Mill Film

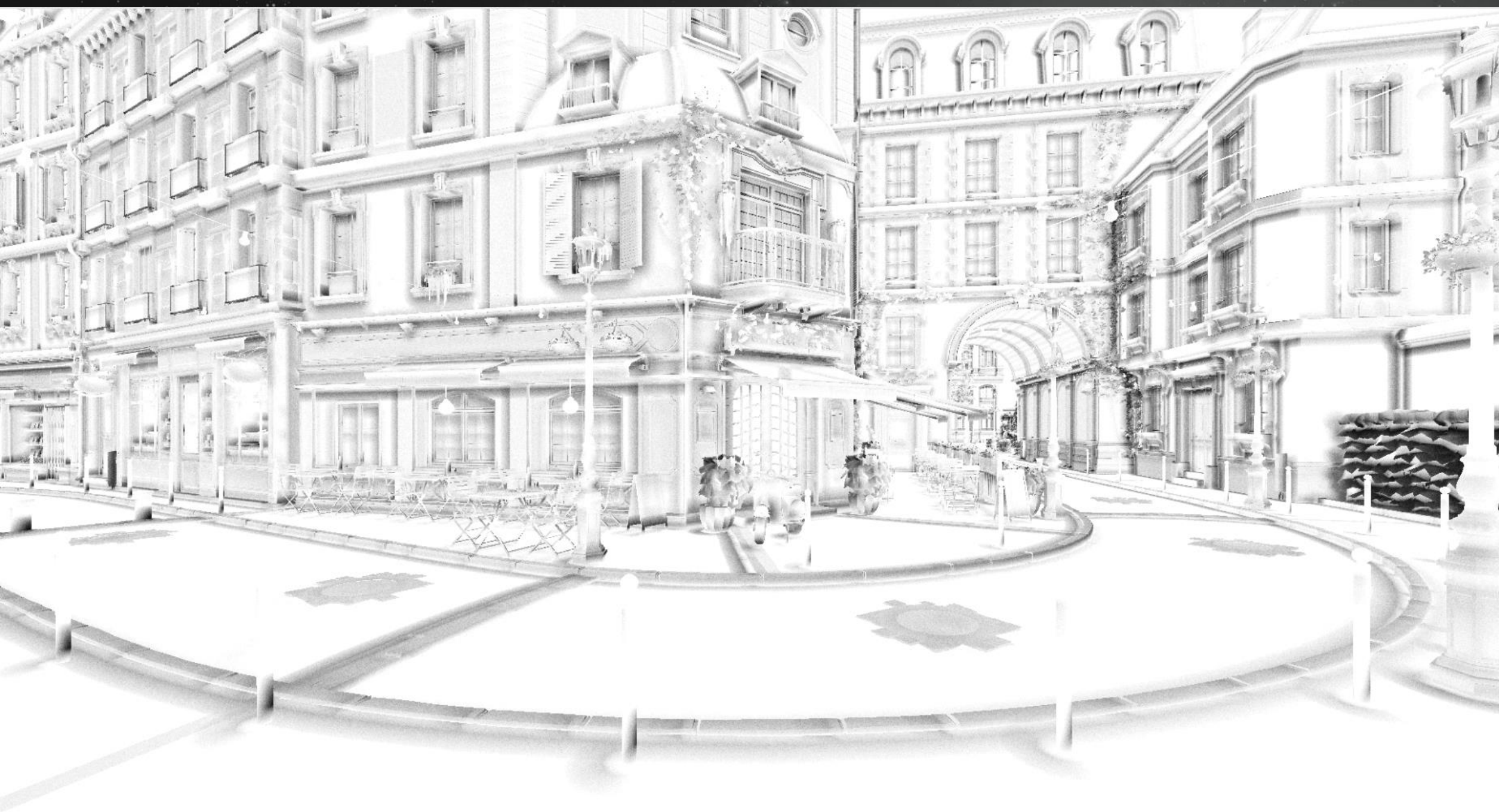
Wednesday, Mar 20, 9:00 AM - 09:50 AM
SJCC Room 230B (Concourse Level)

Live link with RenderMan XPU

- Same framework as Prism (Millefiori)
- Prism is a delegate for Hydra, can replace with RenderMan delegate
- USD enables loading the scene both in engine and in Millefiori
- USD Shade for transferring materials, but still needs lots of work (MaterialX, MDL)

Raytracing in Unity HDRP









Restaurant

Le Petit Coin





1280x720 (1280x720) Scale 0.69'



DXR INTEGRATION DETAILS

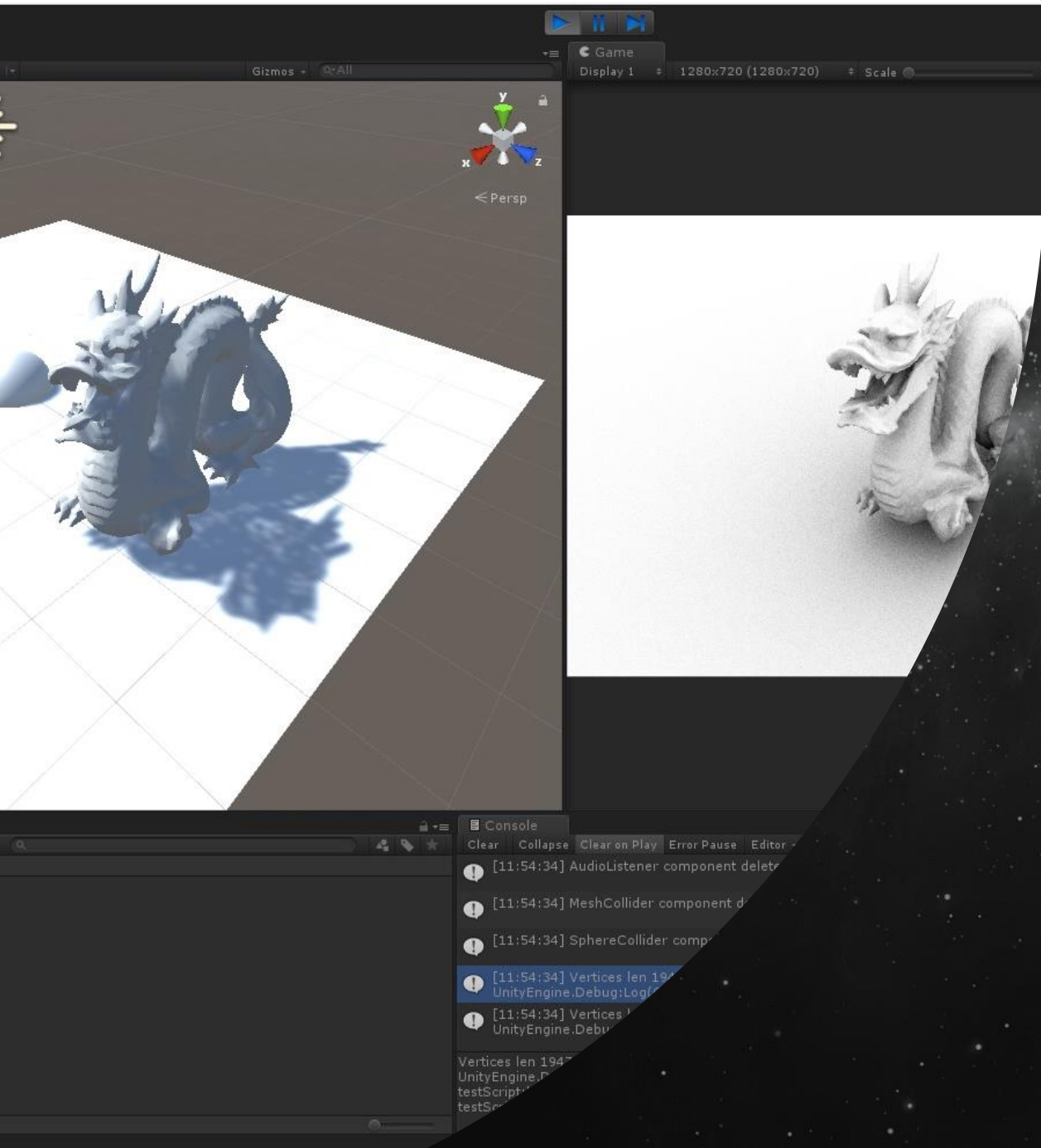
RAYTRACING IN GENESIS

The goal:

- **Leverage DXR to improve the quality of our renders**
- **Different FPS targets based on the use case**

The challenges:

- **New to DX12 and DXR**
- **Small team**
- **Unity low level integration**
- **New tech, with possible bugs to deal with**



AMBIENT OCCLUSION

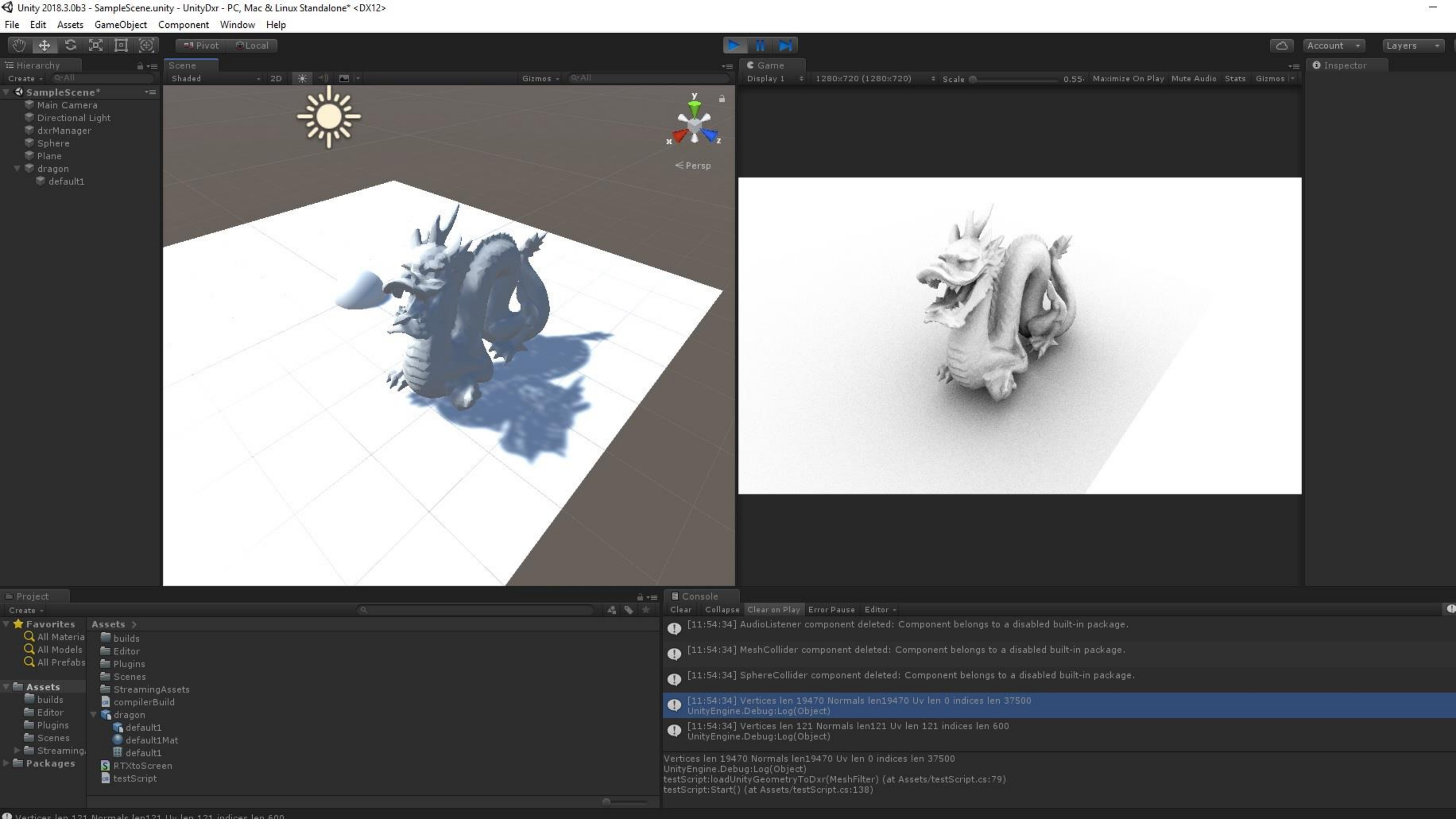
AMBIENT OCCLUSION

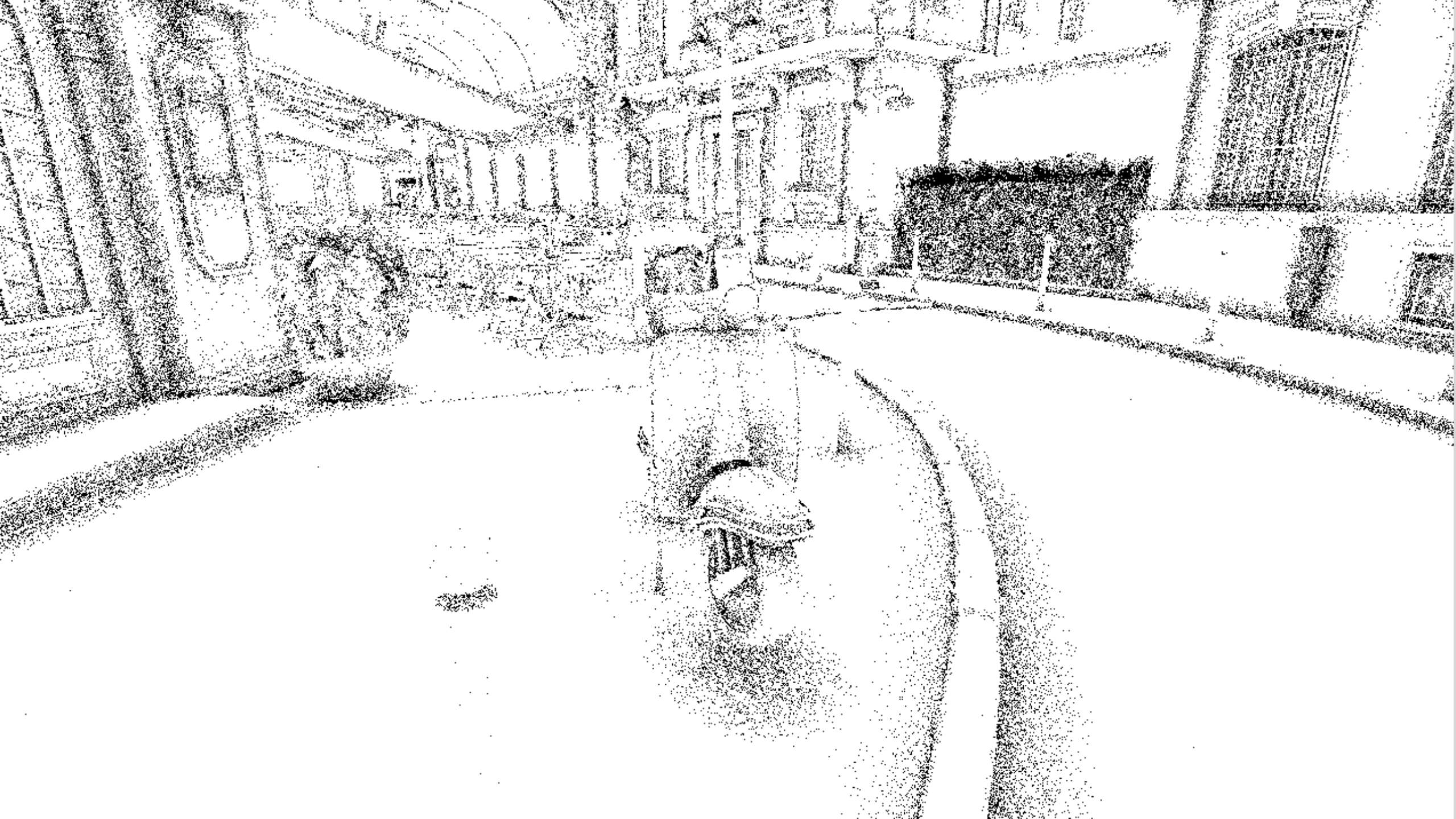
First effect implemented

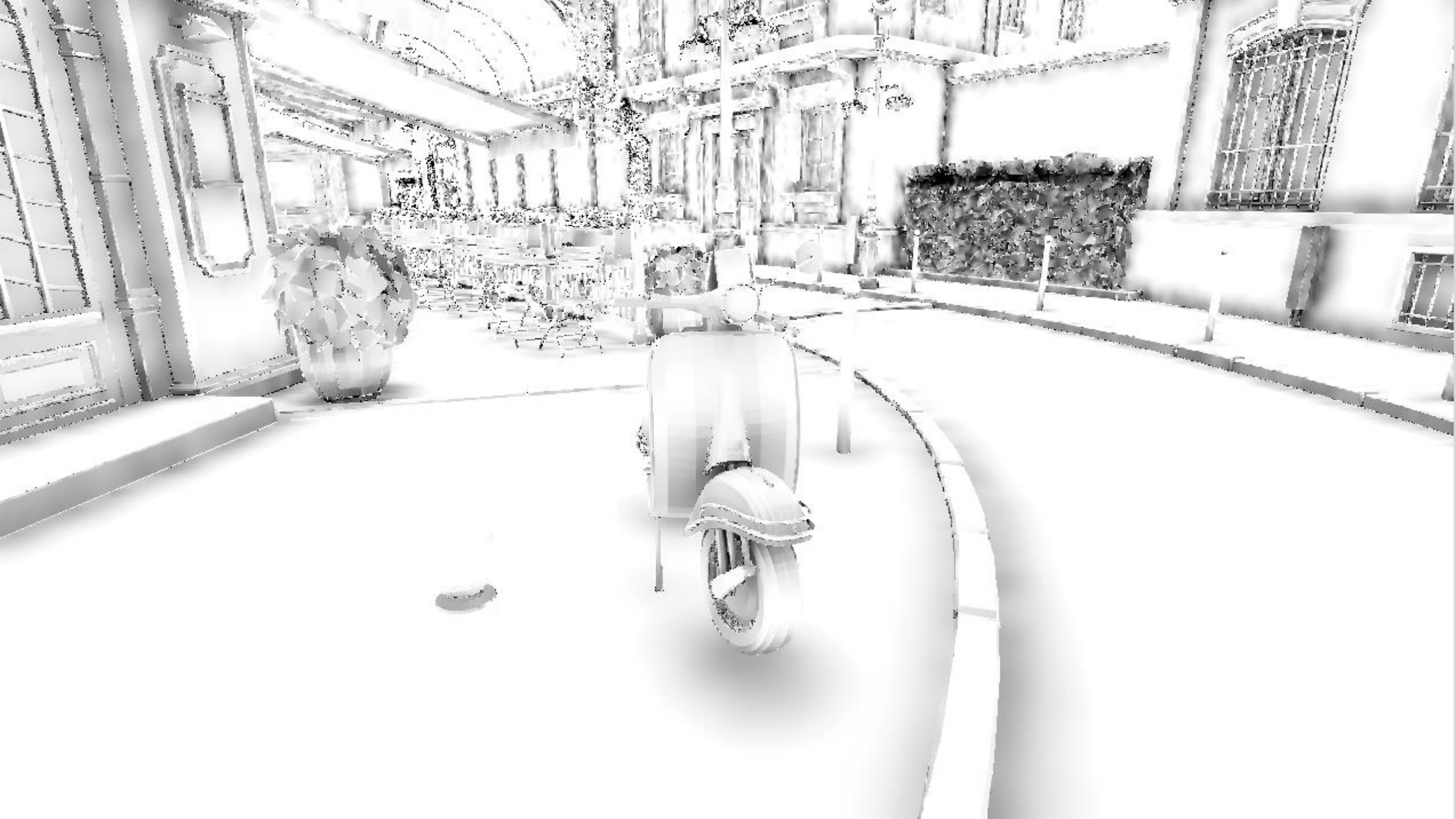
Plugin: boils down to a C interface dll

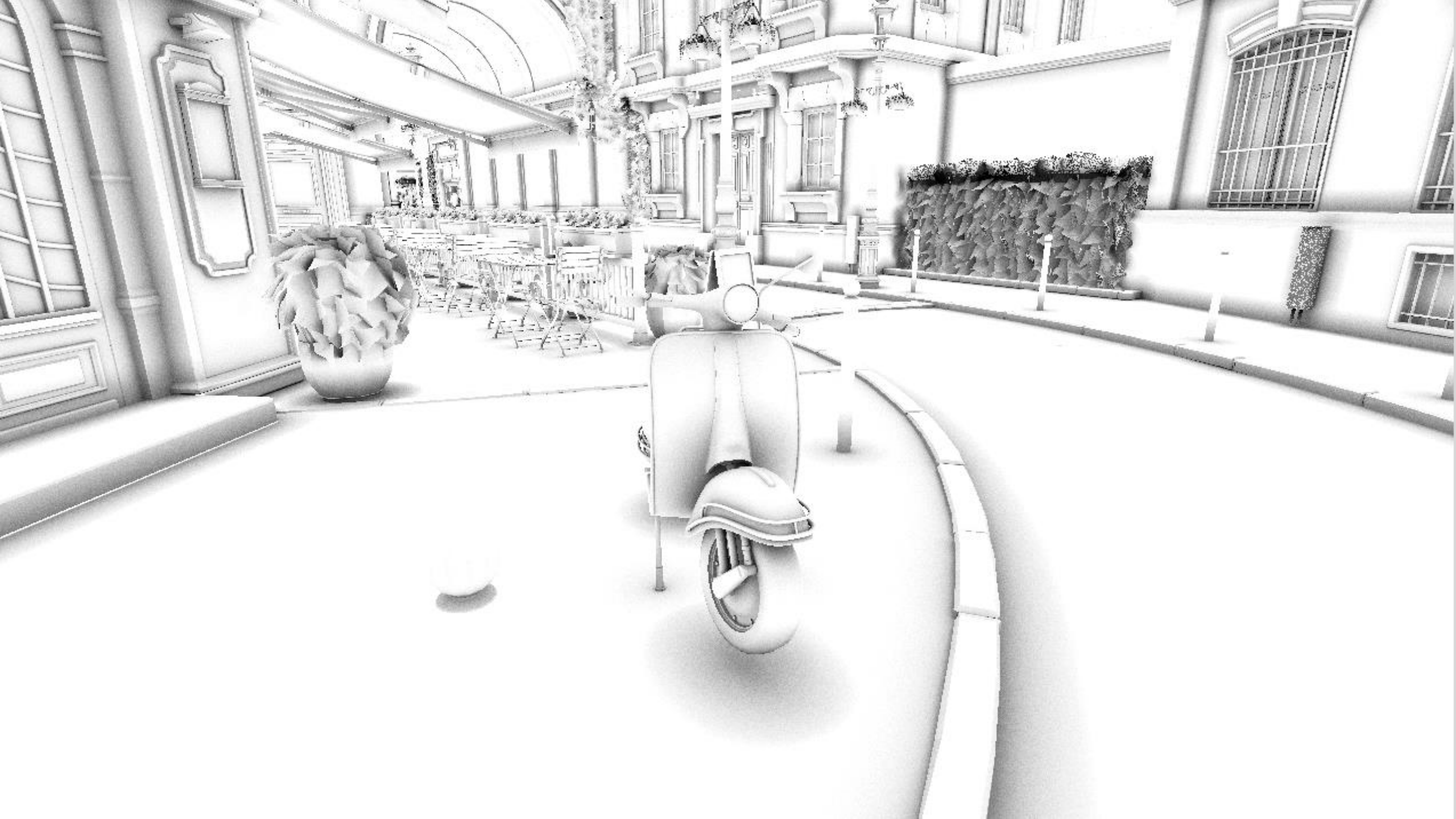
Faced the first issues with Unity integration:

- **Data marshalling**
- **Synchronization**
- **Delayed reaction of editor events**
- **Issue with resources lifetime**
- **Integration of gameworks denoisers**







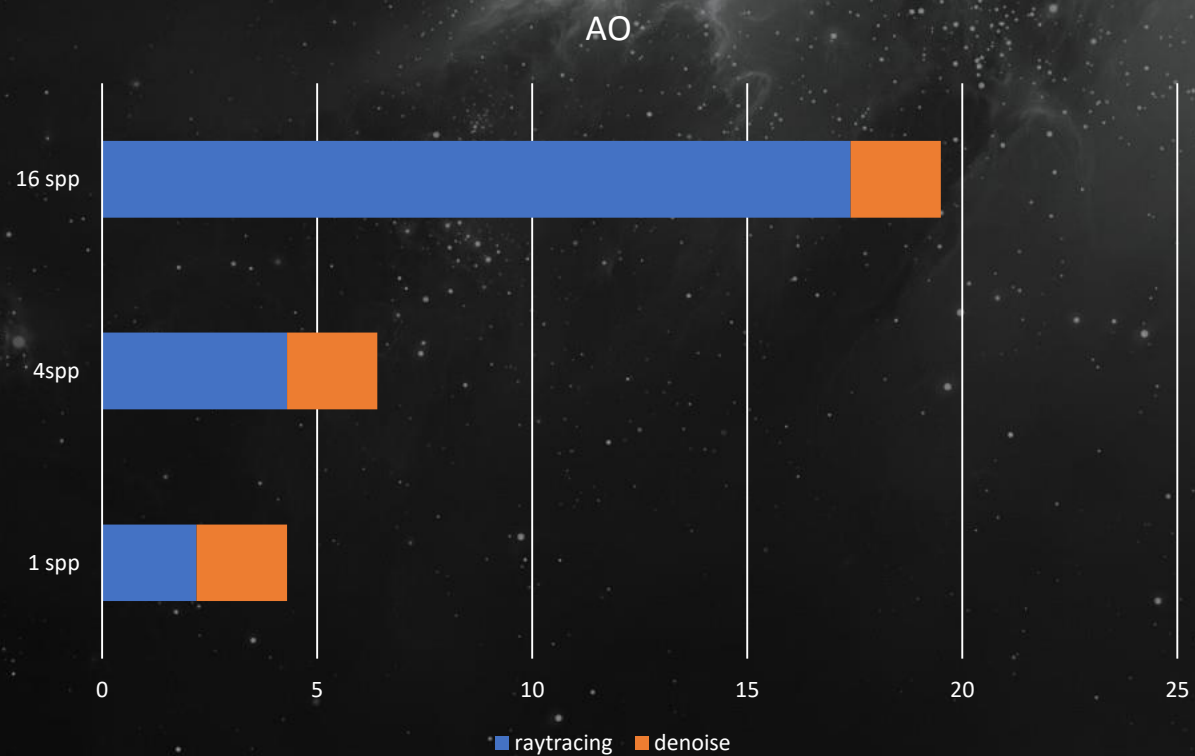


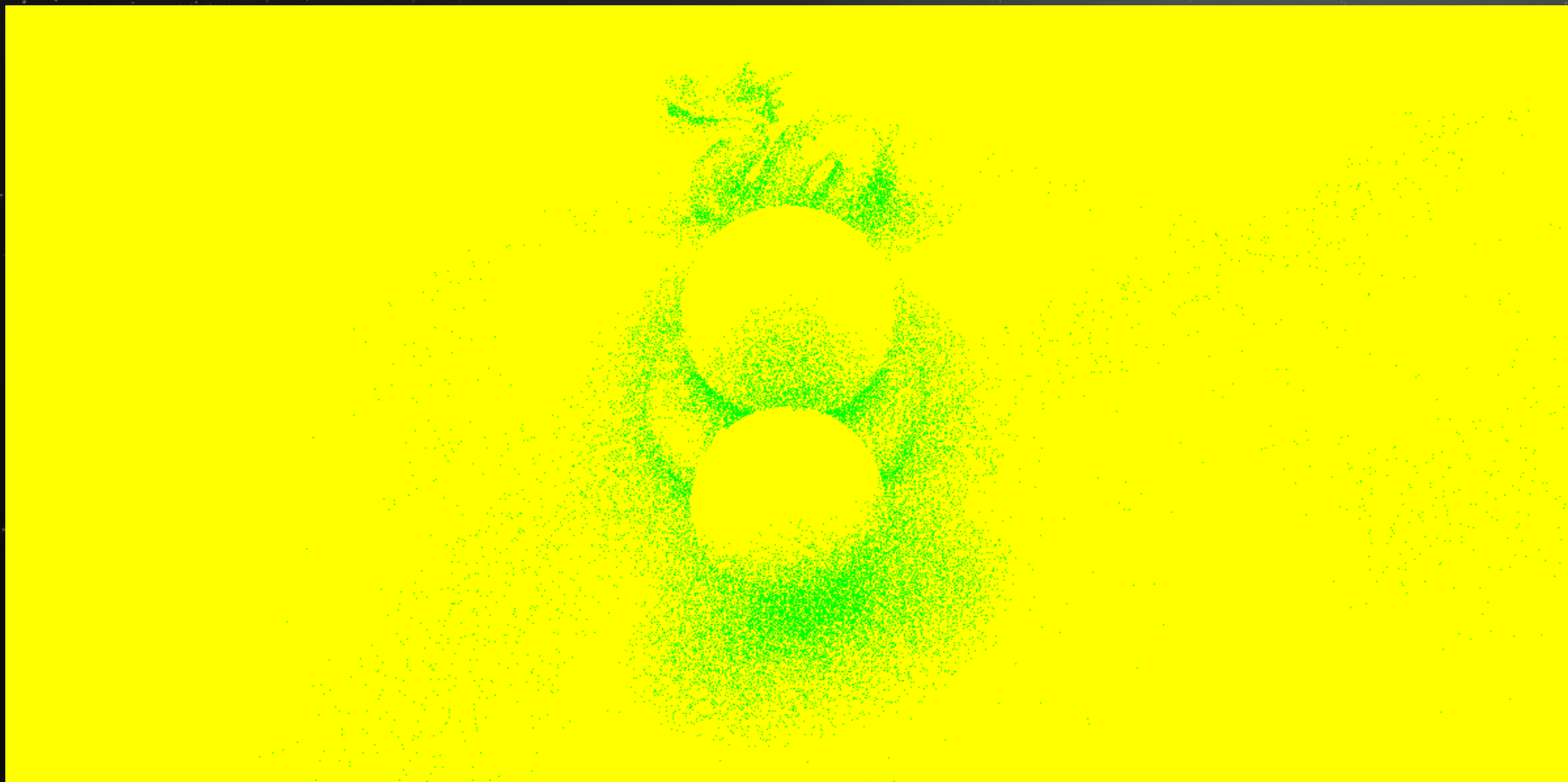




AO: TIMINGS

	1 spp	4spp	16 spp
raytracing	2.2	4.3	17.4
denoise	2.1	2.1	2.1





HDRP INTEGRATION

- **Unity use an AO renderer manager**
- **Harder to integrate without drilling down in the call stack**
- **Opted for simpler blit over Unity texture**
- **Render moves on as usual**
- **No tricks for increasing contrast**

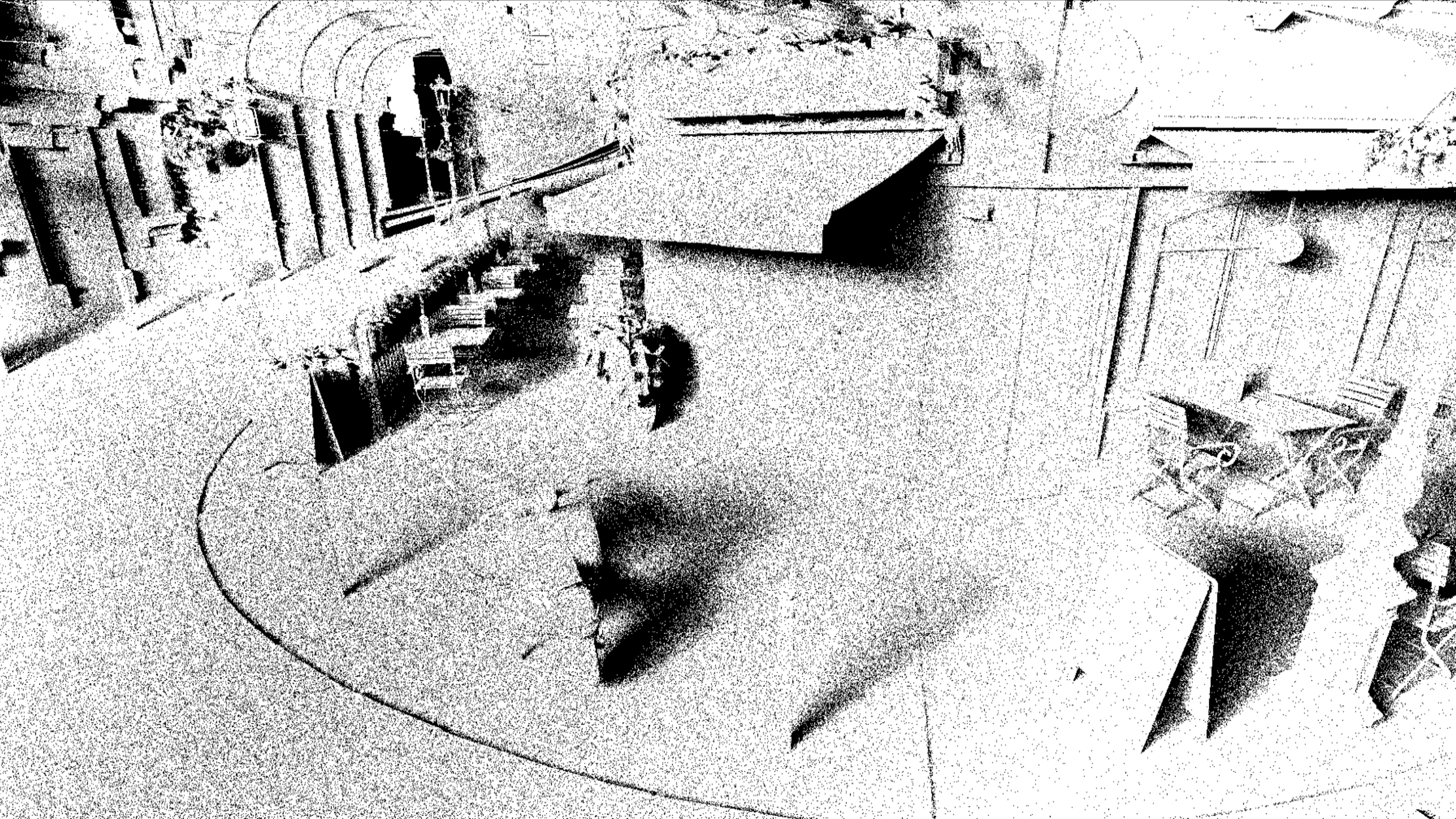


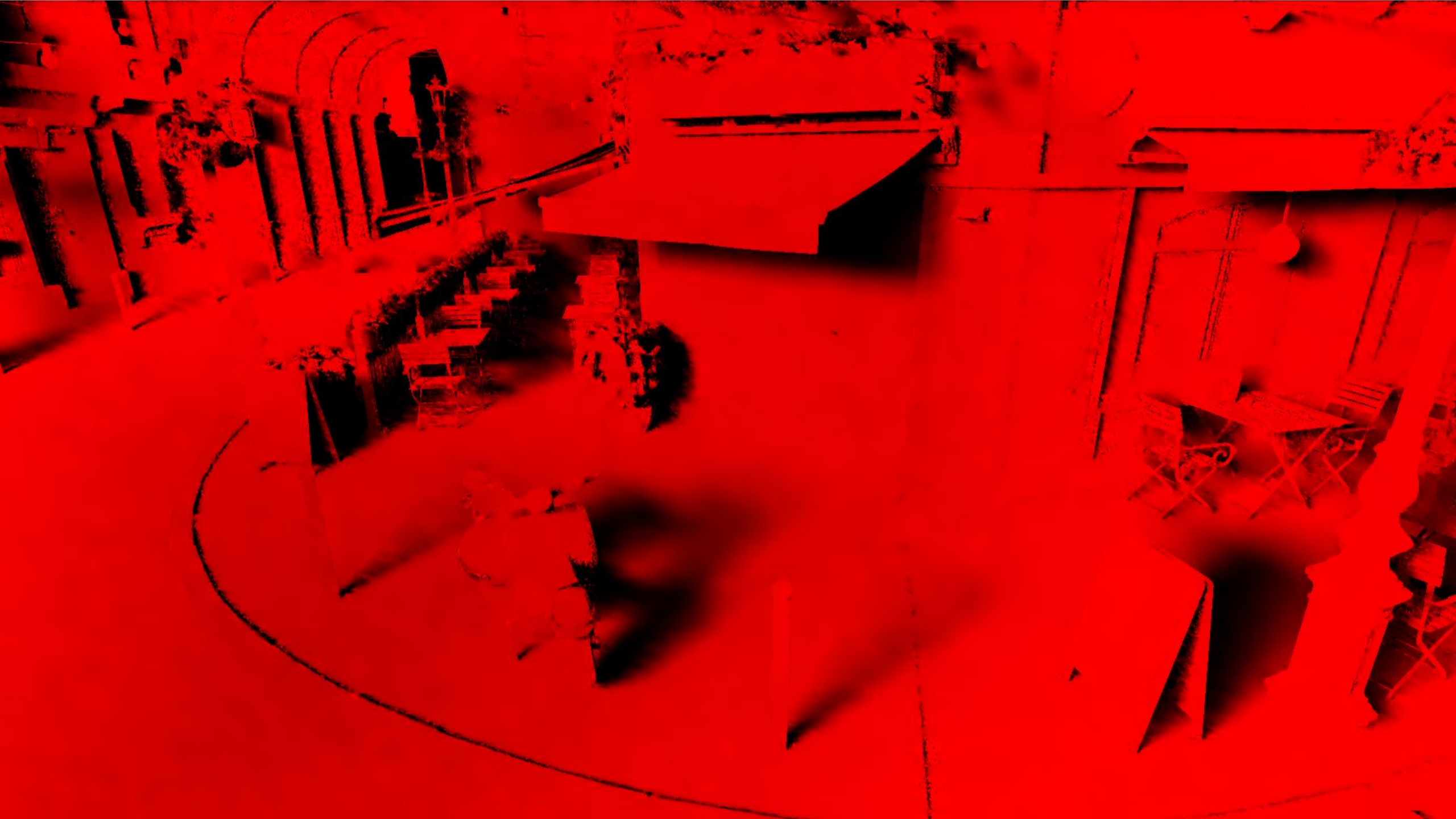
SOFT SHADOWS

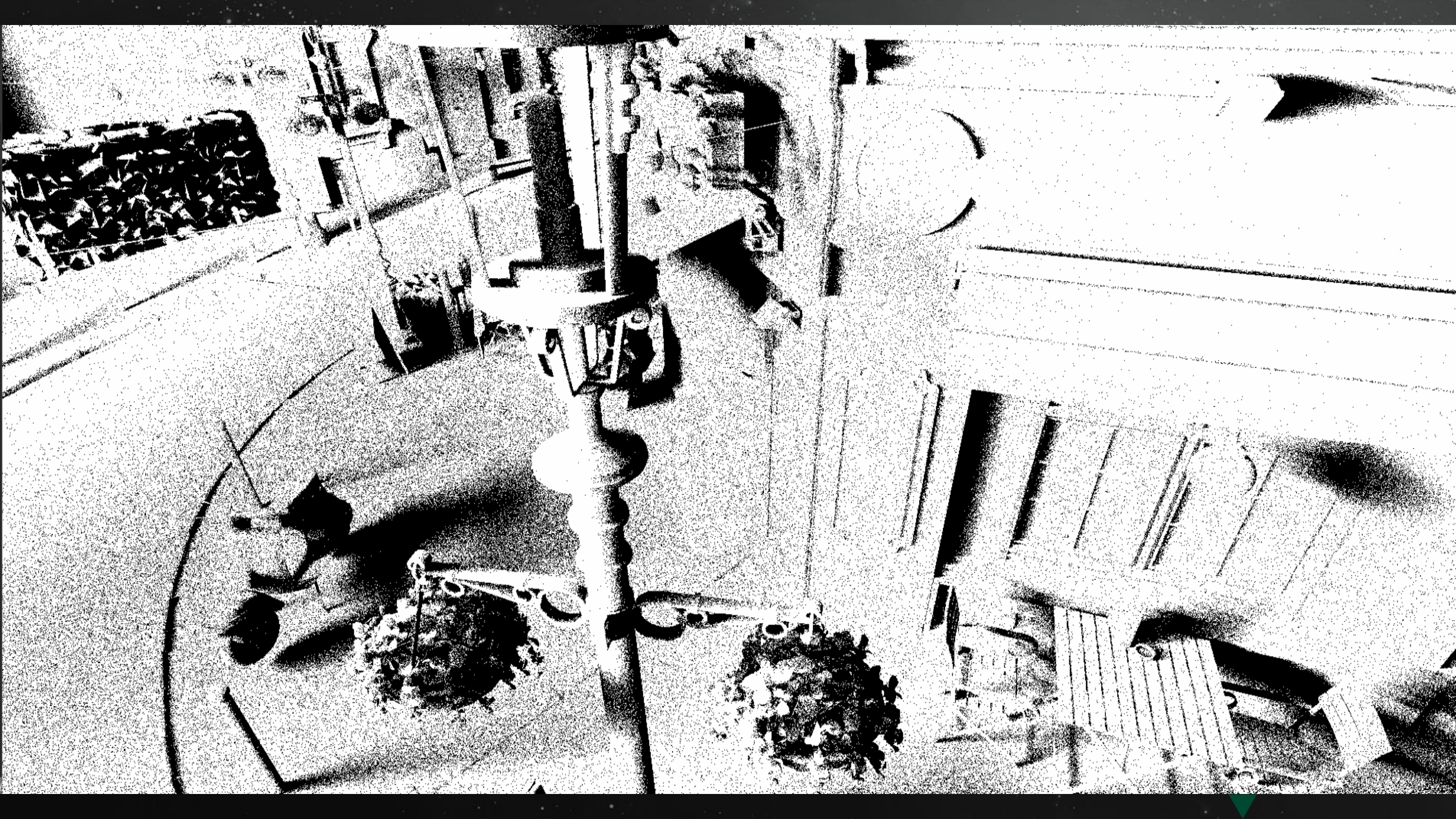


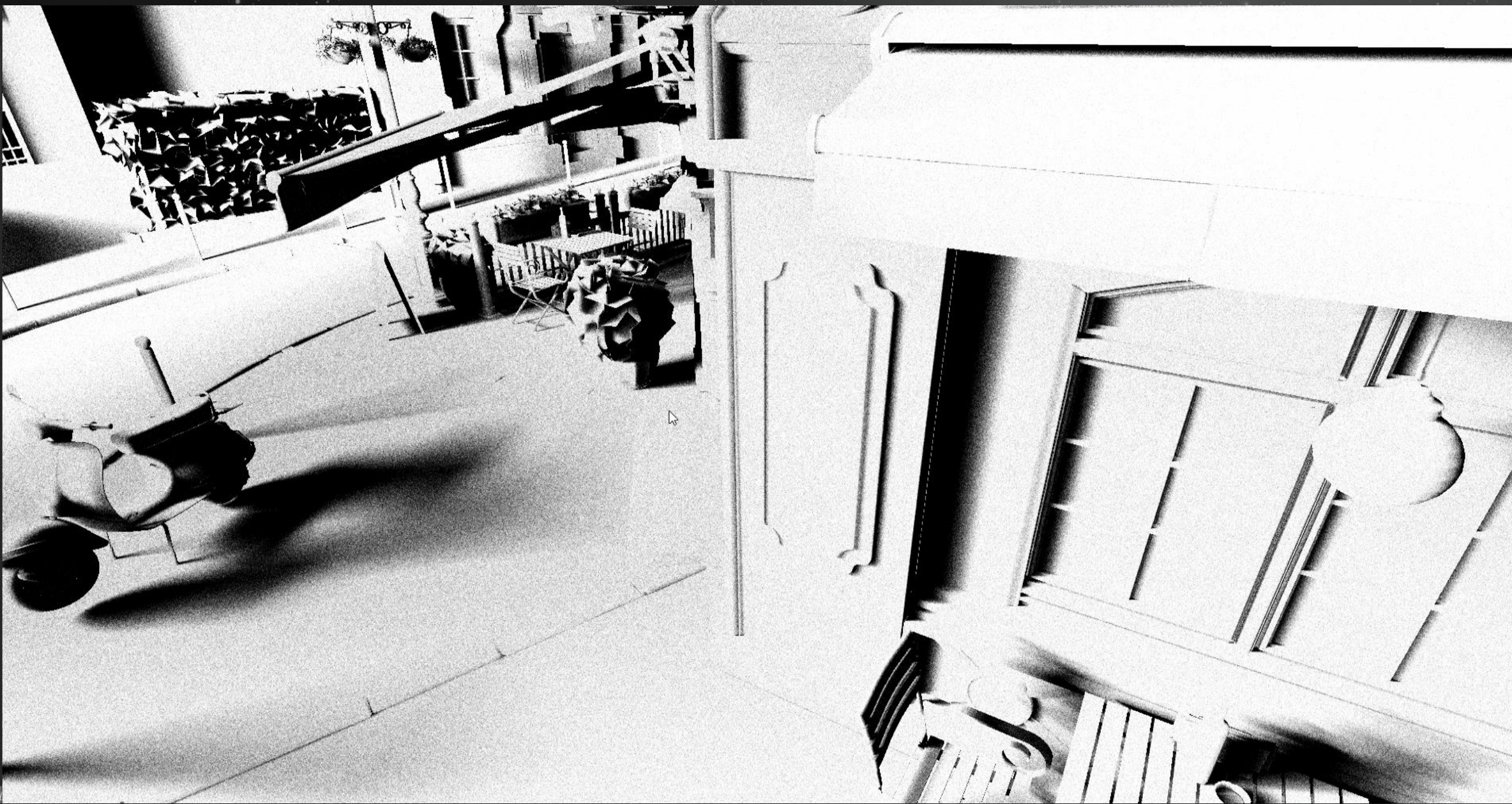
SOFT SHADOWS

- Heavy use of area lights
- Previously using in house solution with raymarched depth map.









HDRP INTEGRATION

- Did not find an easy way to get screen-space shadows
- Modified HDRP shader binding extra shadow map
- Multiply final lighting value by shadow
- Crude approximation
- Needed to extract texture from denoiser to C# texture to use it in Unity

Soft Shadows

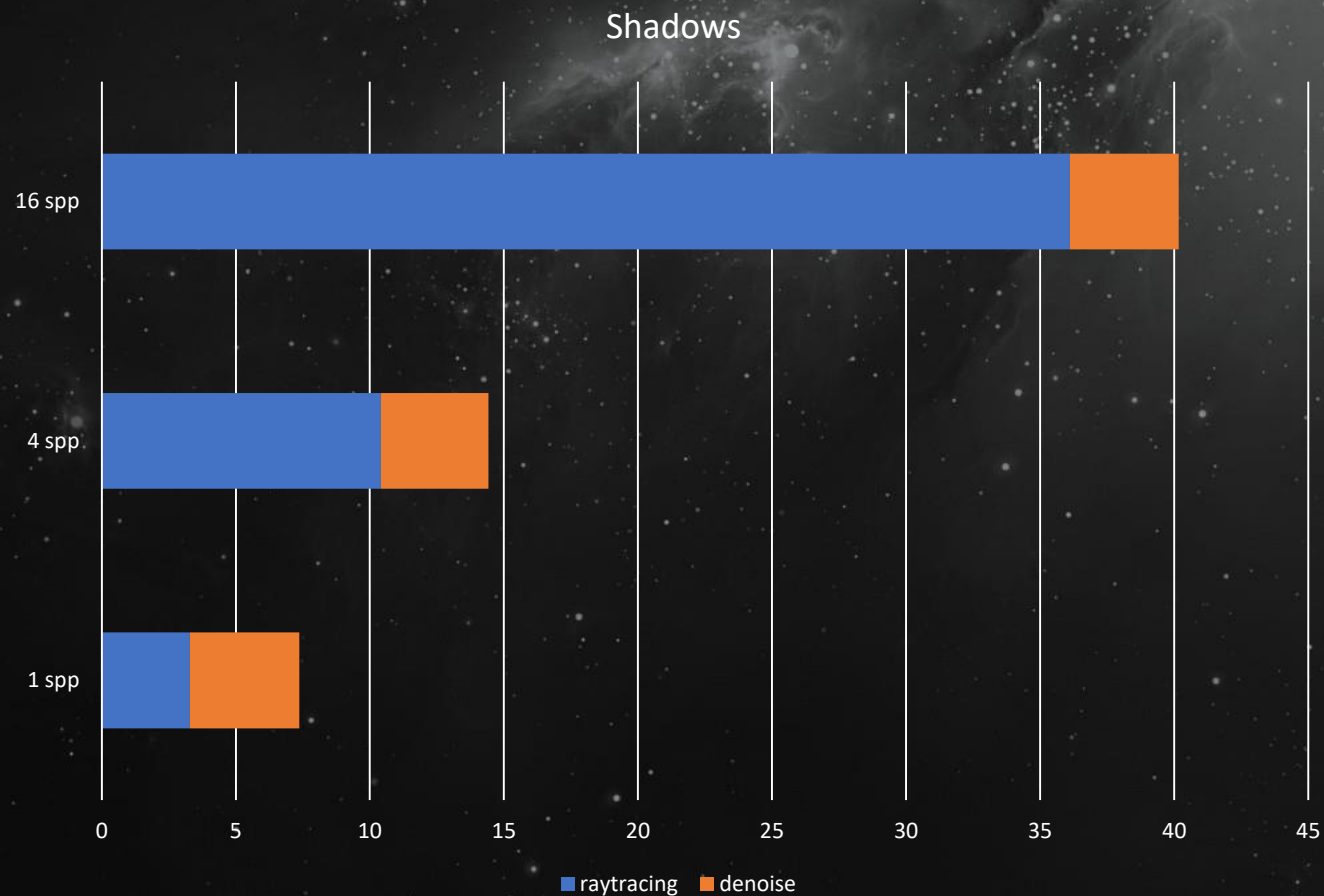
**Experimenting with several ways to combine
multiple area lights**





Timings

	1 spp	4 spp	16 spp
raytracing	3.29	10.41	36.11
denoise	4.08	4.01	4.06





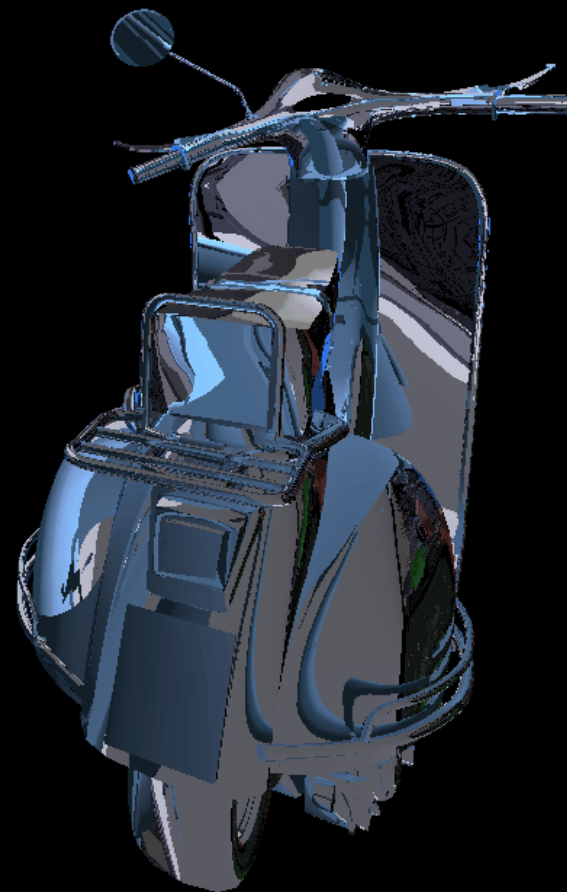
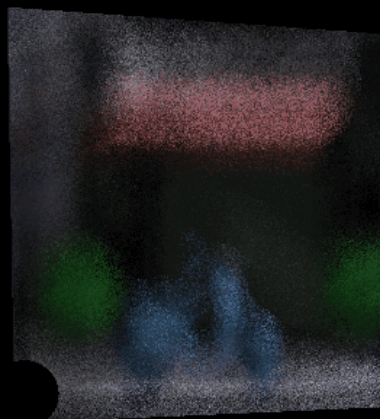
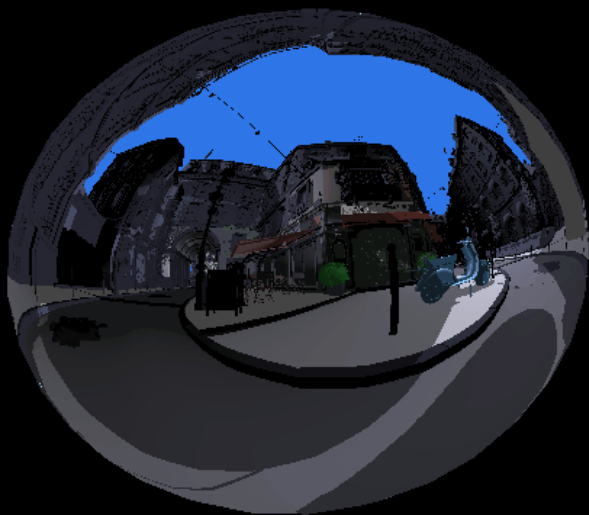


REFLECTIONS

Reflections

Most tricky effect to deal with:

- **No way to evaluate a Unity shader on hit**
- **Marshalling textures and textures lifetime**
- **Lighting**





Reflections

- One bounce only
- No texture marshalling
- Investigating bindless textures
- Only tracking directional light for simple Phong model
- Extra shadow ray

Timings

1 SPP	4 SPP	16 SPP
2.3	3.01	17.9





RECAP

- **DXR allowed us to step up quality of renders quite a bit**
- **Steep learning curve for DX12 and DXR**
- **Tricky Unity integration**
 - **Resource life time**
 - **Editor events**
 - **Render loop sync**

WHAT IS NEXT

- **Investigate new Unity DXR integration**
 - **Focus more on effects rather than plumbing**
- **Performance, performance, performance**

Special thanks to the twitter community for RTX and game dev help:

Matt Pettineo - @MyNameIsMJP

Alex Tardif - @longbool

Peter Morley - @Biblo_Shwag

Sebastian Altonen - @SebAltonen

Sebastien Lagarde - @SebLagarde

Kostas Anagnostou - @KostasAAA

Jesper Flicks - @catlikecoding

Special thanks to Nvidia and the outstanding Microsoft Pix Team

THANK YOU!



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