GENESIS:
REAL-TIME RAYTRACING IN VIRTUAL PRODUCTION

Darryl Gouder
Software Developer

MPC Film | MR X

technicolor

MPC Film |  | MRX

Technicolor has the industry’s most prominent portfolio of VFX brands, including MPC, MILL FILM and MR. X, Our VFX studios add VISUAL WONDER and CREATIVE EXPERTISE to film and episodic.

WE ARE A FAMILY OF CREATIVE VFX BRANDS

Each studio brings their own unique approach to the market while leveraging Technicolor’s R&D teams to harness the new technological demands of compelling


MPC Film

VISUAL EFFECTS GLOBAL FOOTPRINT

MPC

GENESIS

unity

VR SCOUTING

MOCAP

VIRTUAL CAMERA

LAYERING

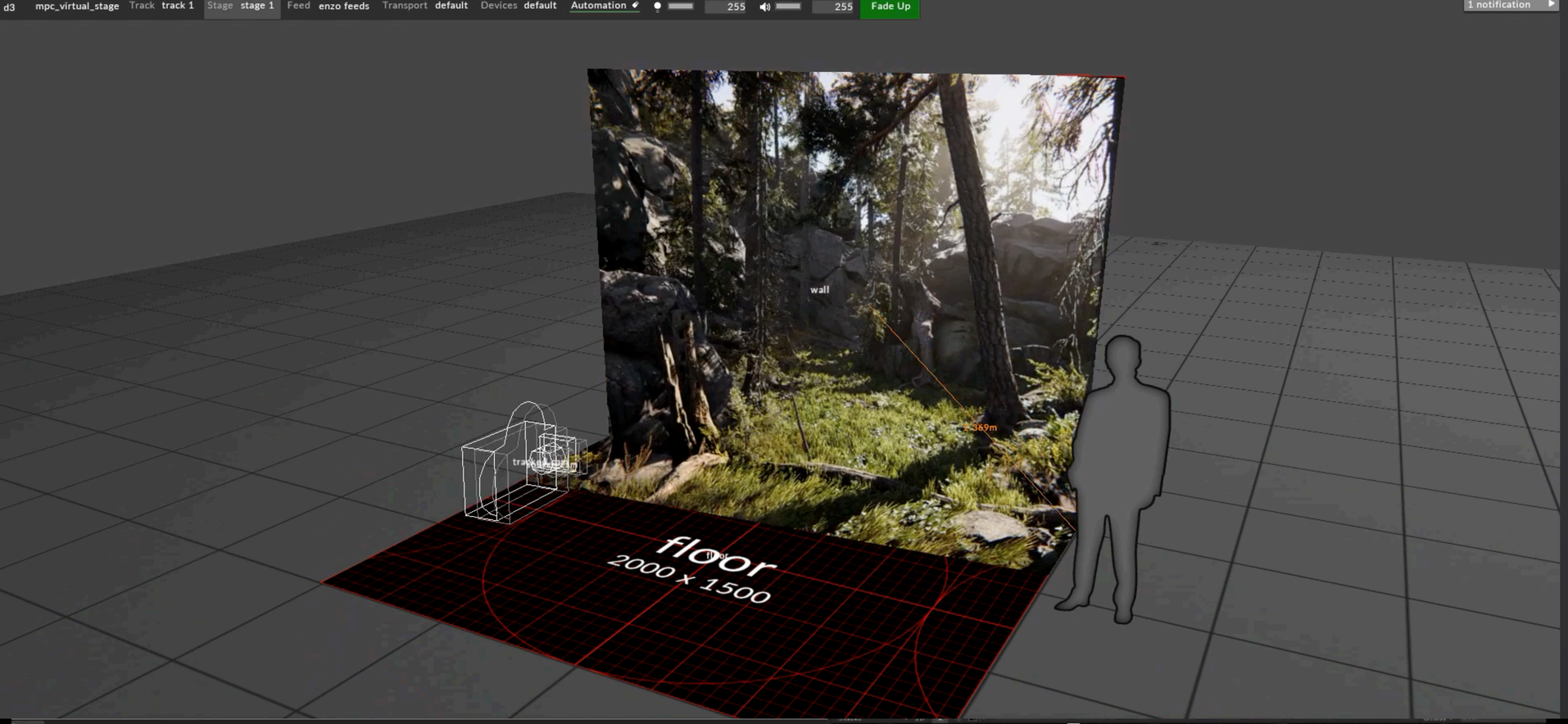
MPC

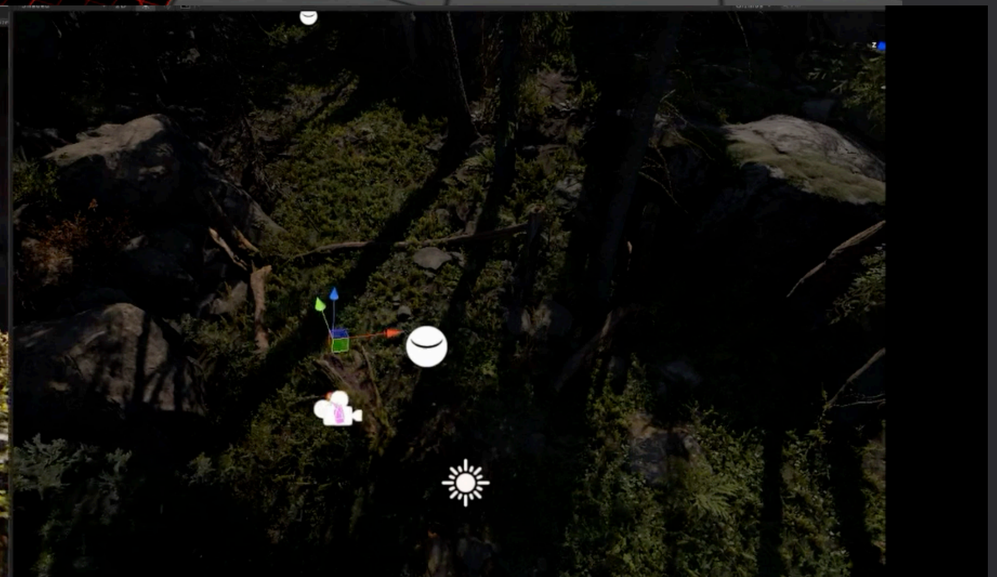
PHASES OF VIRTUAL PRODUCTION

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

MPC

LED WALLS



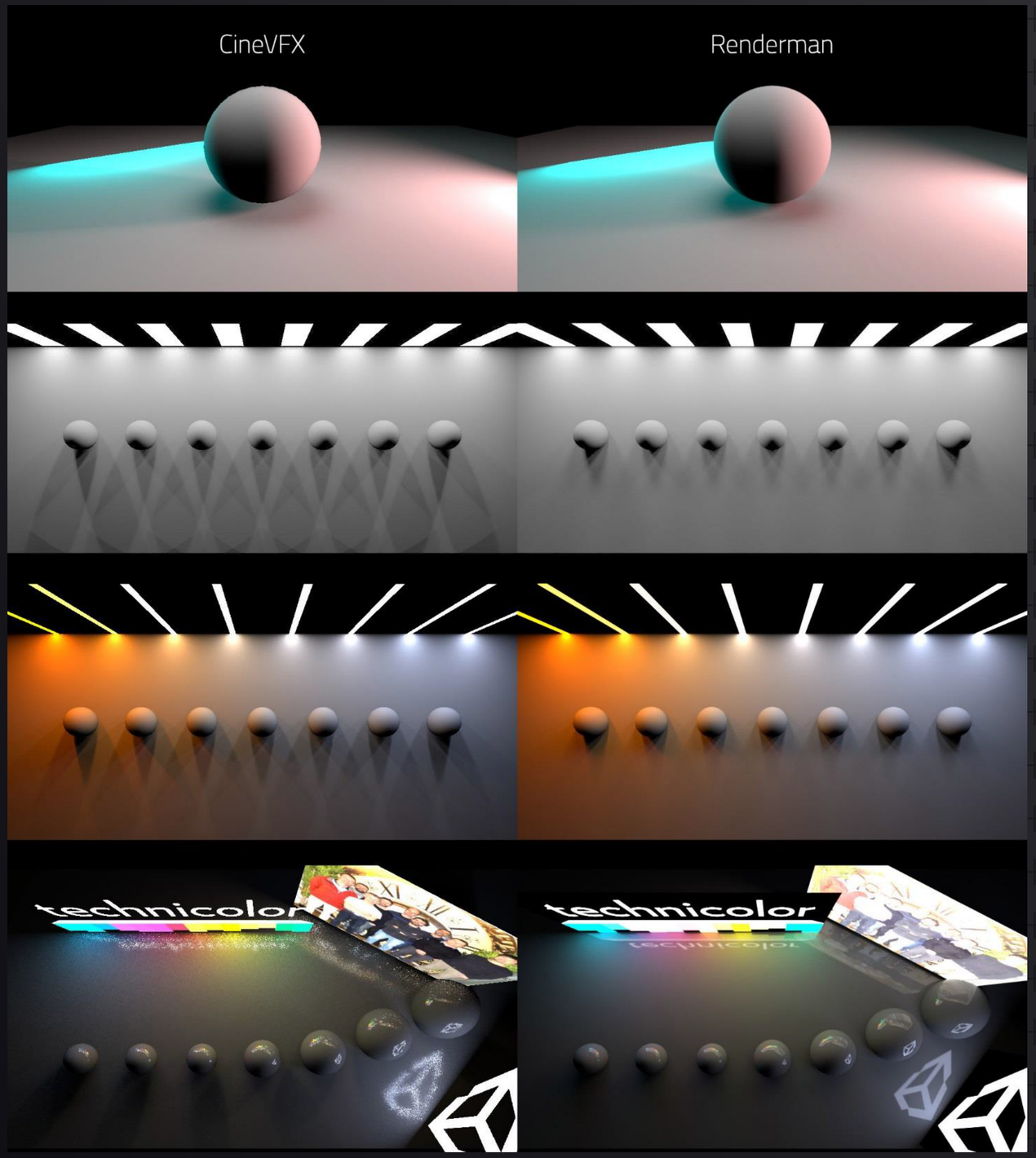


disguise

ncam®

RENDERING CHALLENGES

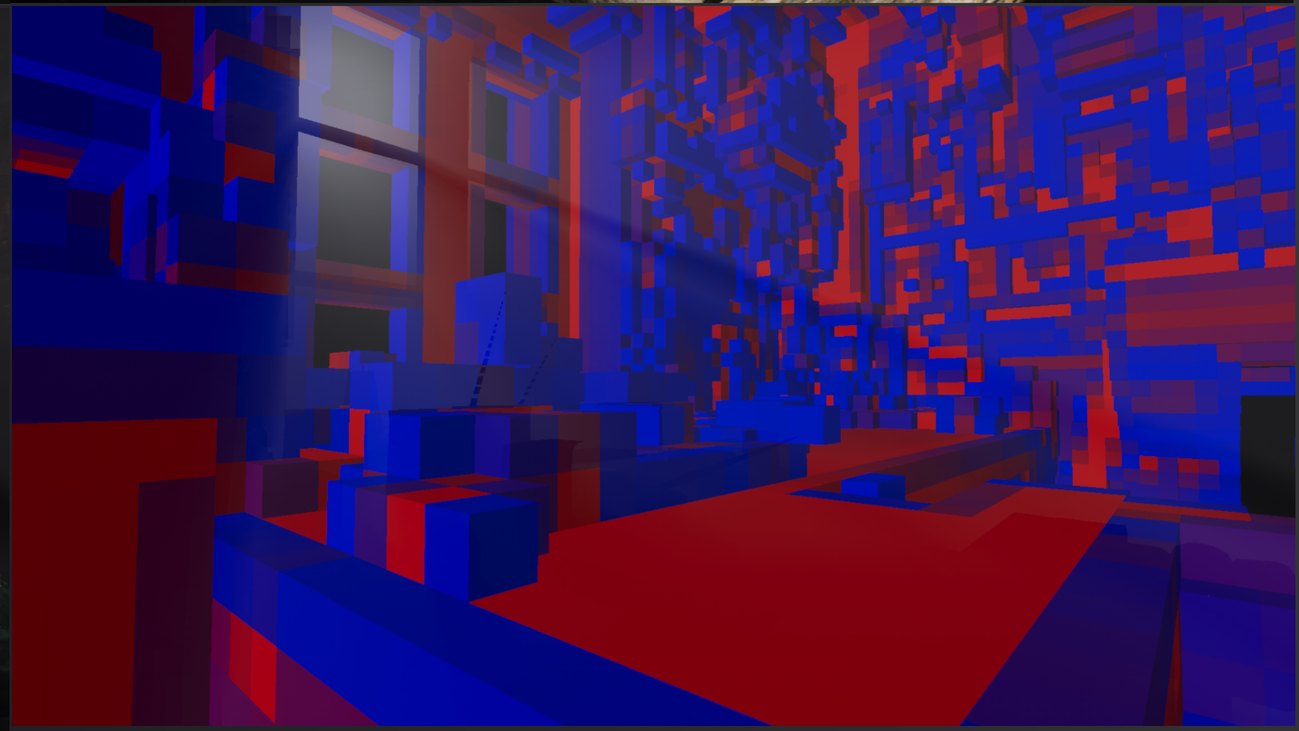
1) Advanced lighting for DP on set
2) Good approximation of final render
3) Final pixels in real time



MPC

AREA LIGHTS


VXGI



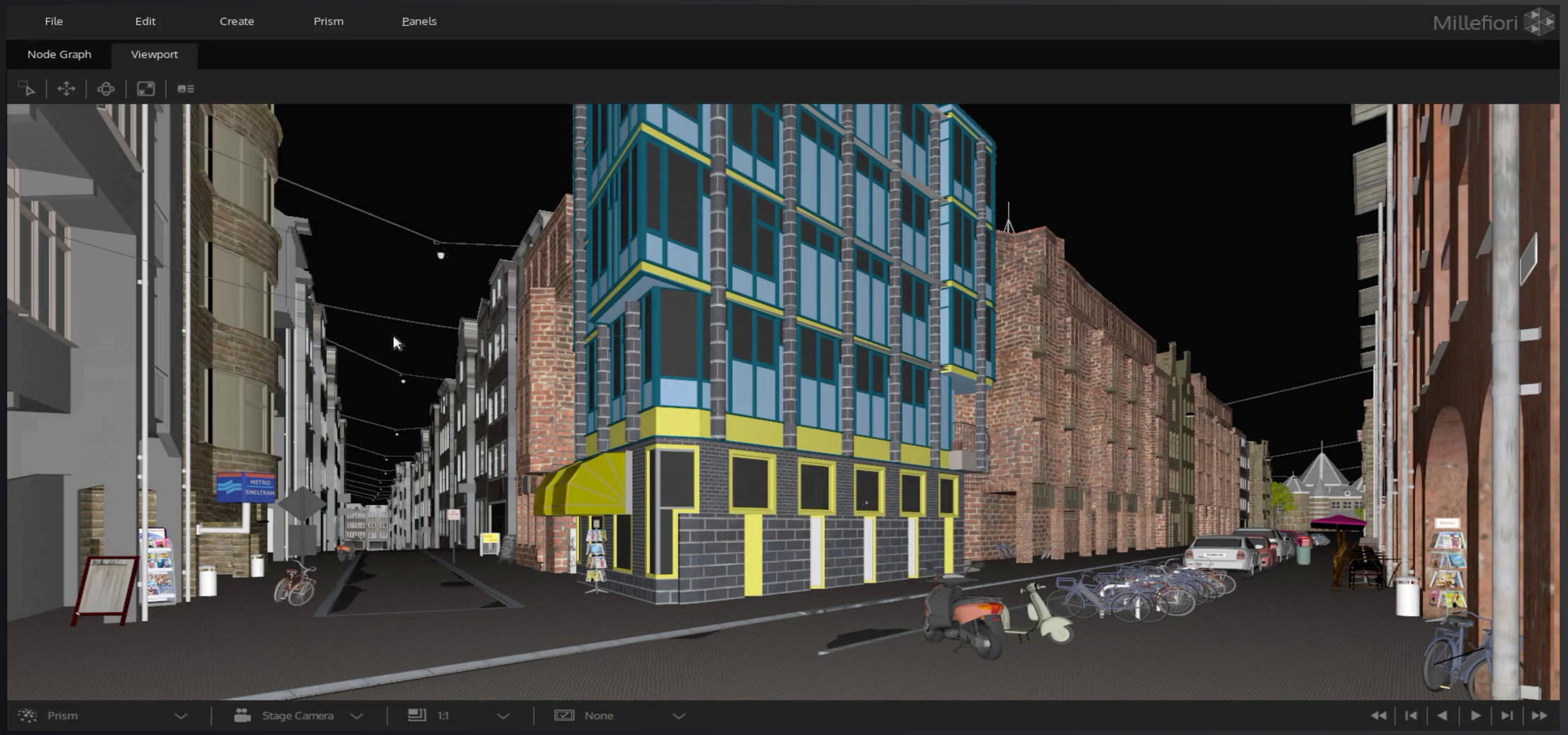

VOLUMETRIC LIGHTING


DEPTH OF FIELD

STILL NOT ENOUGH!

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

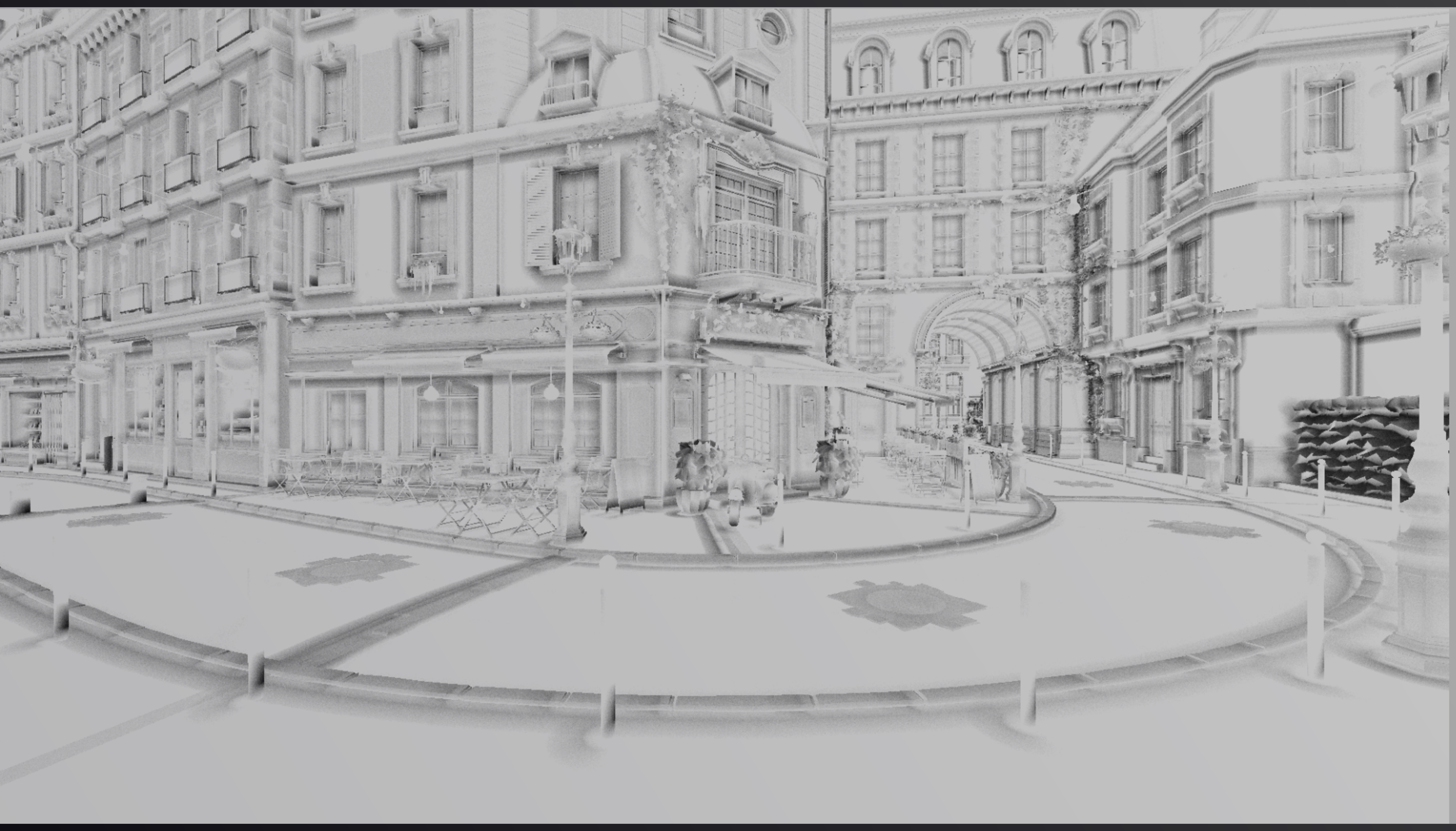
LIVE-LINK WITH PRISM



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 materals, but still needs lots of work (MaterialX, MDL)

RAYTRACING IN UNITY HDRP




Restaurant
Le Petit Coin


MENU

MPC

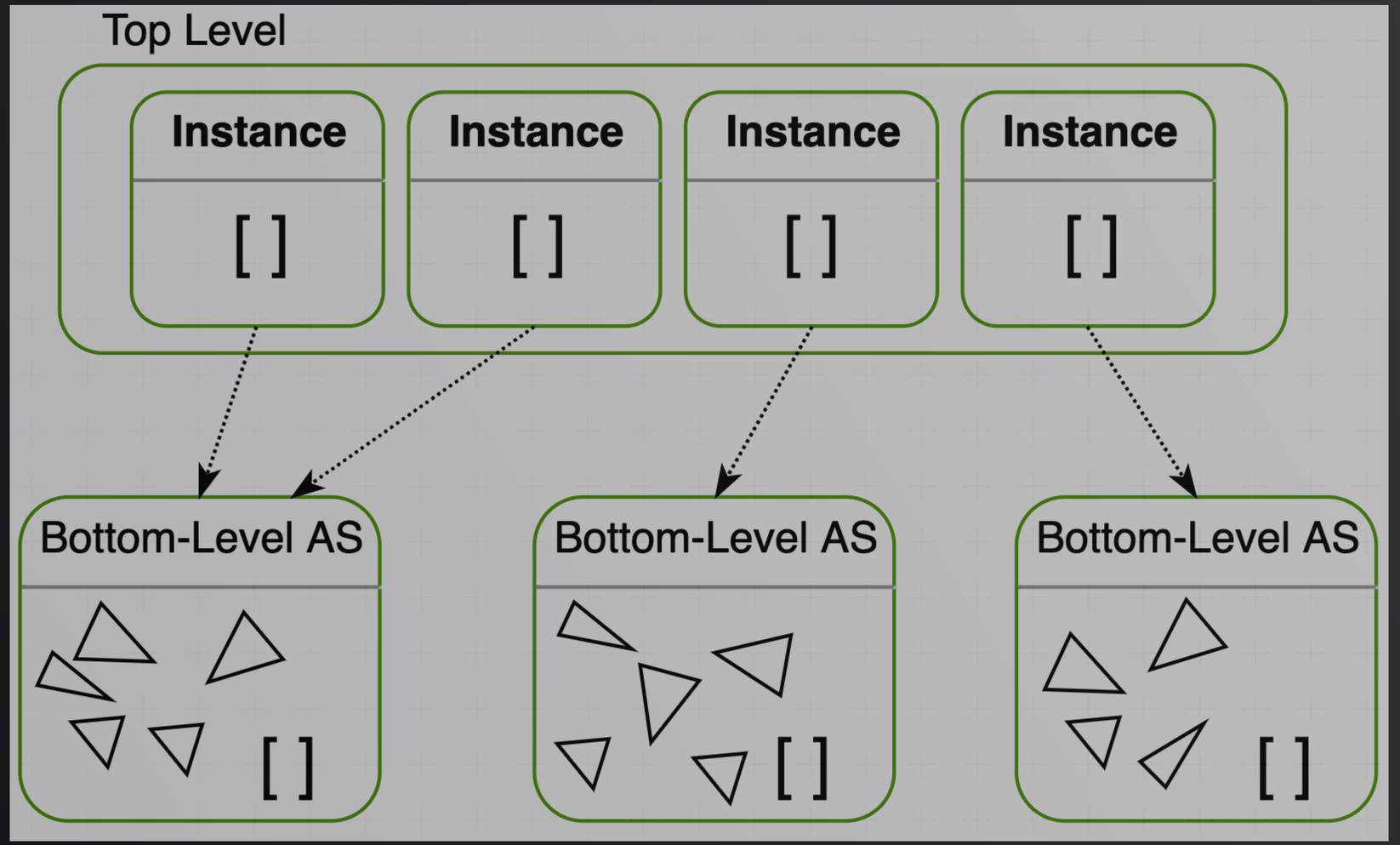
DXR INTEGRATION DETAILS

RAYTRACING IN GENESIS

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

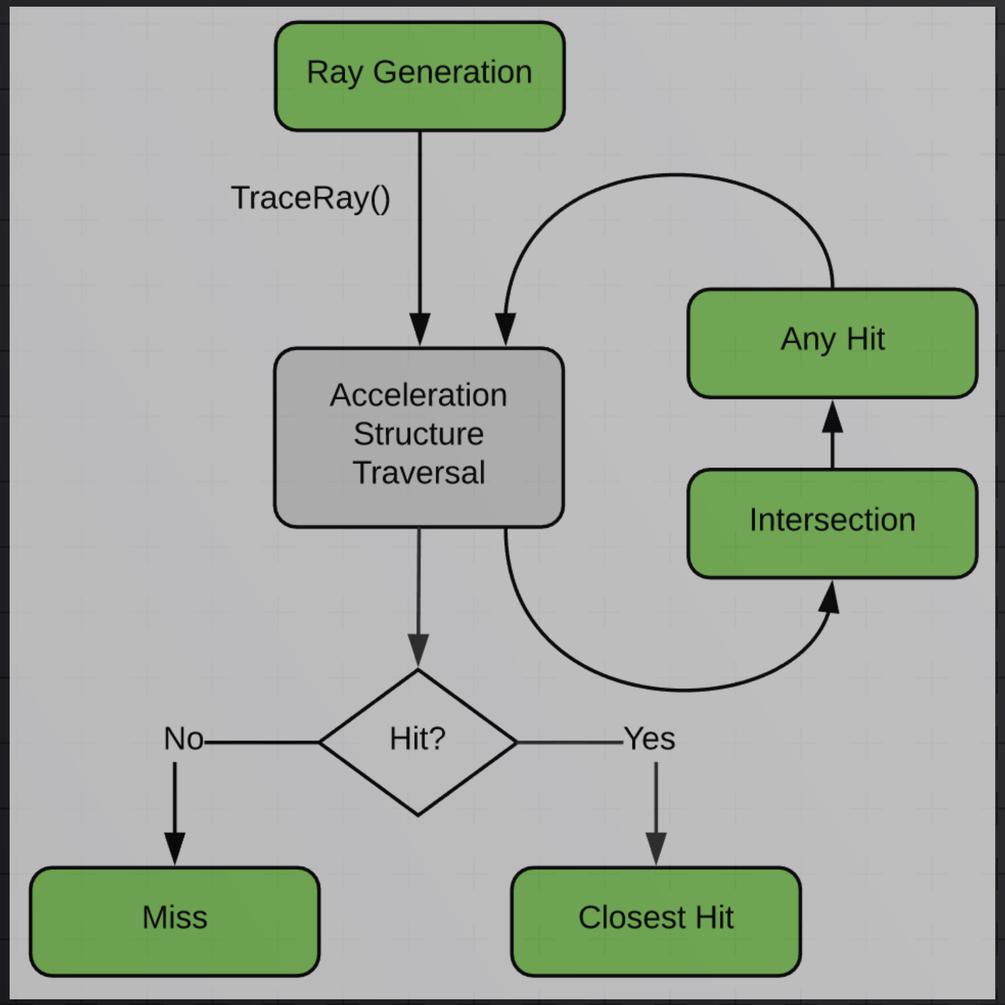
The challenges:
- New to DX12 and DXR
- Small team
- Unity low level integration
- New tech, with possible bugs to deal with

BUILDING THE BVH



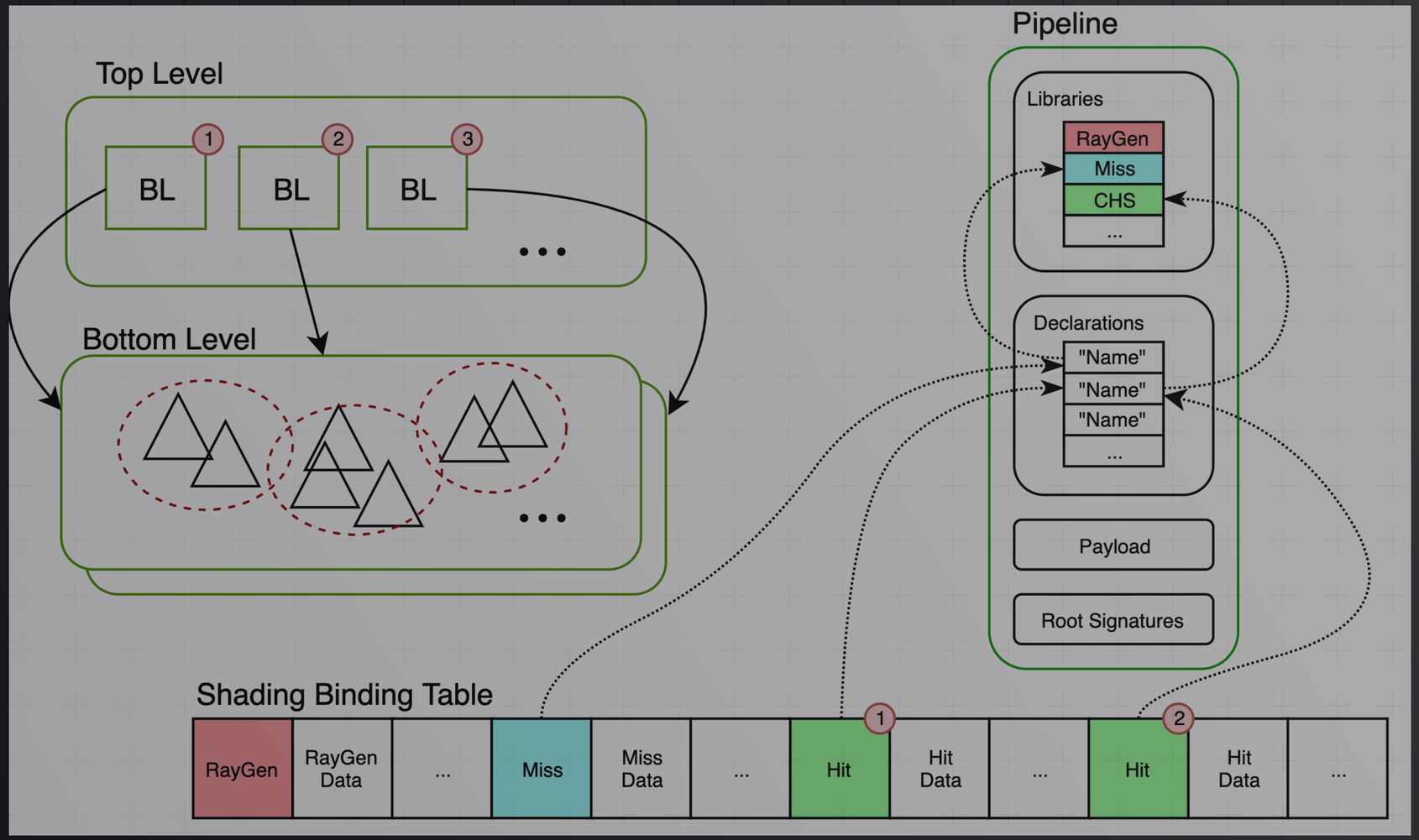
MPC

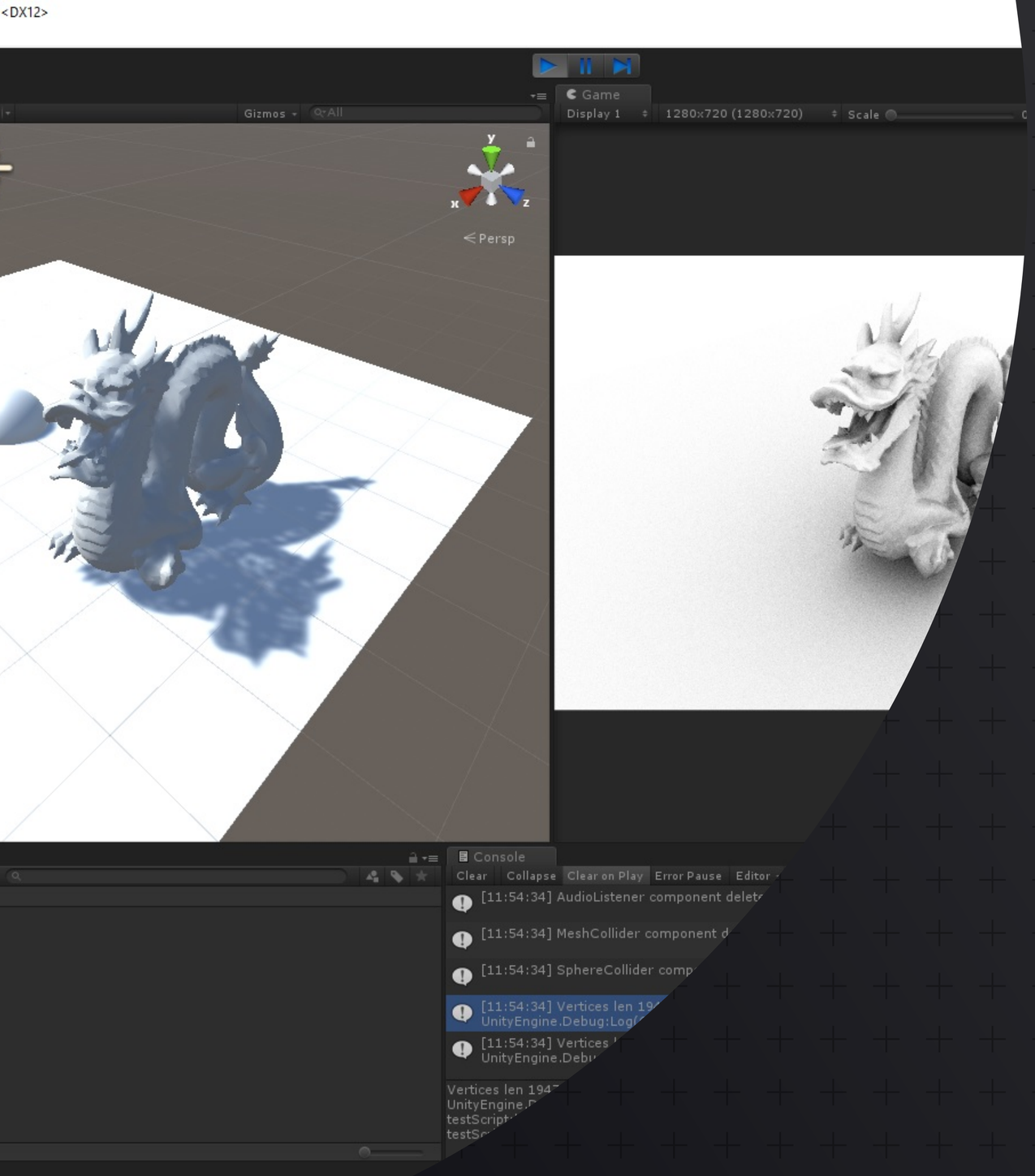
RAY TRACING



MPC

DXR RAYTRACING IN ONE PICTURE





MPC

AMBIENT OCCLUSION

AMBIENT OCCLUSION

First effect implemented
Plugin: boils down to a C interface dll
Faced the first issues with Unity integration:

- Data marshalling from Unity to DLL
- Synchronization - a lot of flushing
- Delayed reaction of editor events
- Issue with resources lifetime
- Integration of GameWorks denoisers

Unity 2018.3.0b3 - SampleScene.unity - UnityDxr - PC, Mac & Linux Standalone* <DX12>

File Edit Assets GameObject Component Window Help

Pivot Local

Account Layers

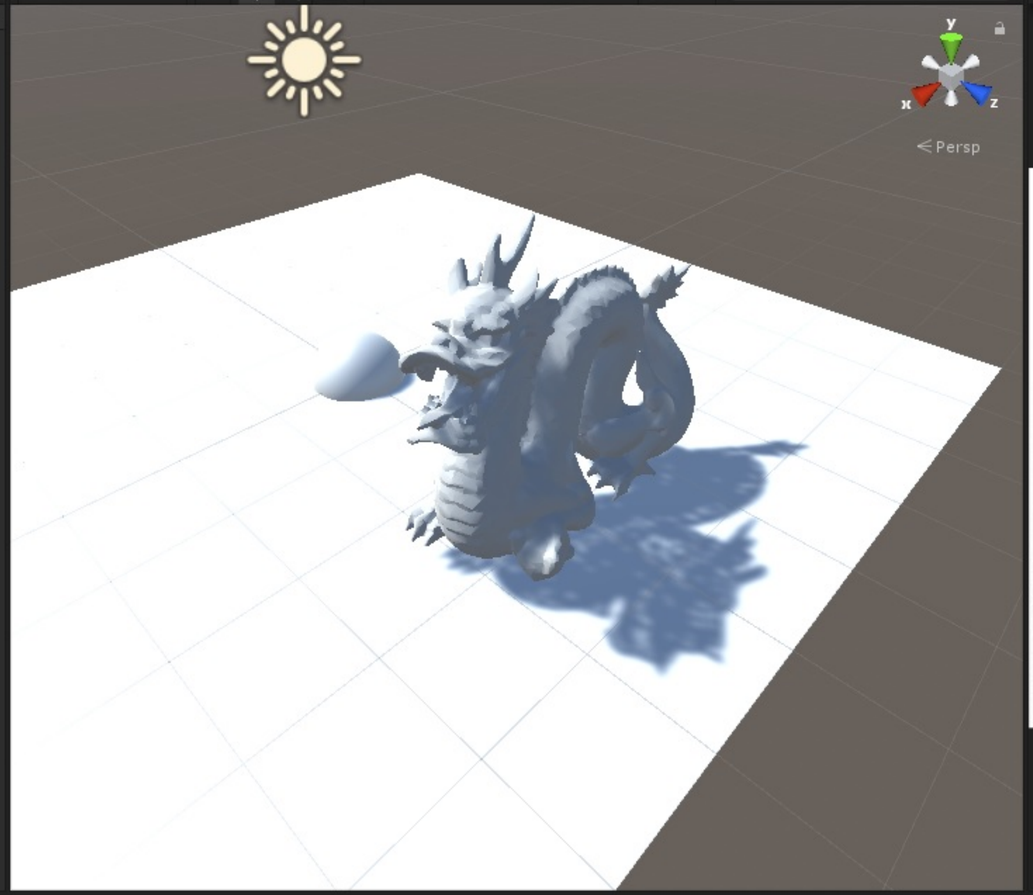
Hierarchy

Create All

SampleScene*
- Main Camera
- Directional Light
- dxrManager
- Sphere
- Plane
- dragon
  - default1

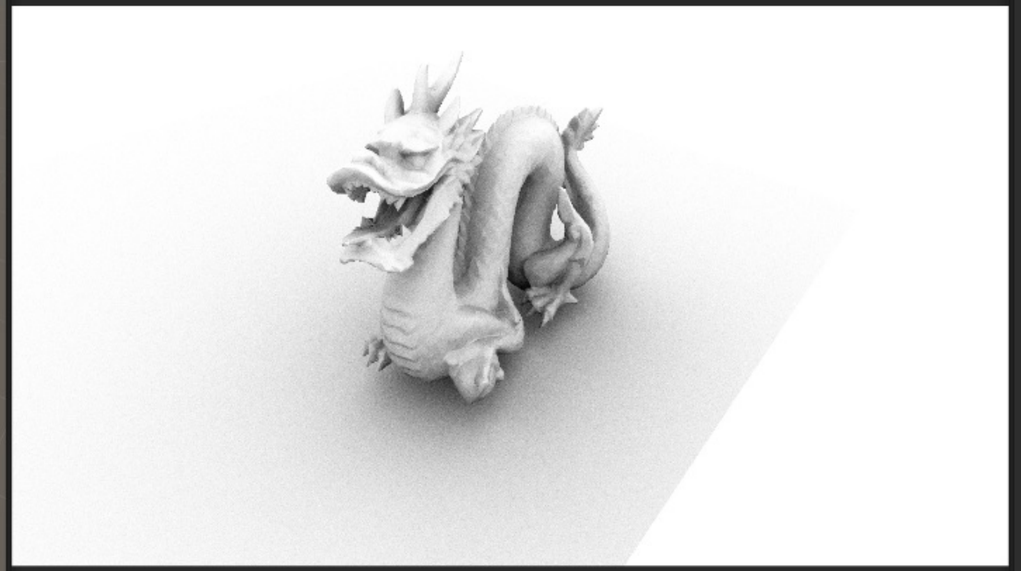
Scene

Shaded 2D Gizmos All



Game

Display 1 1280x720 (1280x720) Scale 0.55 Maximize On Play Mute Audio Stats Gizmos



Inspector

Project

Create

Favorites
- All Materia
- All Models
- All Prefabs

Assets
- builds
- Editor
- Plugins
- Scenes
- Streaming
- Packages

Assets >
- builds
- Editor
- Plugins
- Scenes
- StreamingAssets
- compilerBuild
- dragon
  - default1
  - default1Mat
  - default1
- RTXtoScreen
- testScript

Console

Clear Collapse Clear on Play Error Pause Editor

[11:54:34] AudioListener component deleted: Component belongs to a disabled built-in package.

[11:54:34] MeshCollider component deleted: Component belongs to a disabled built-in package.

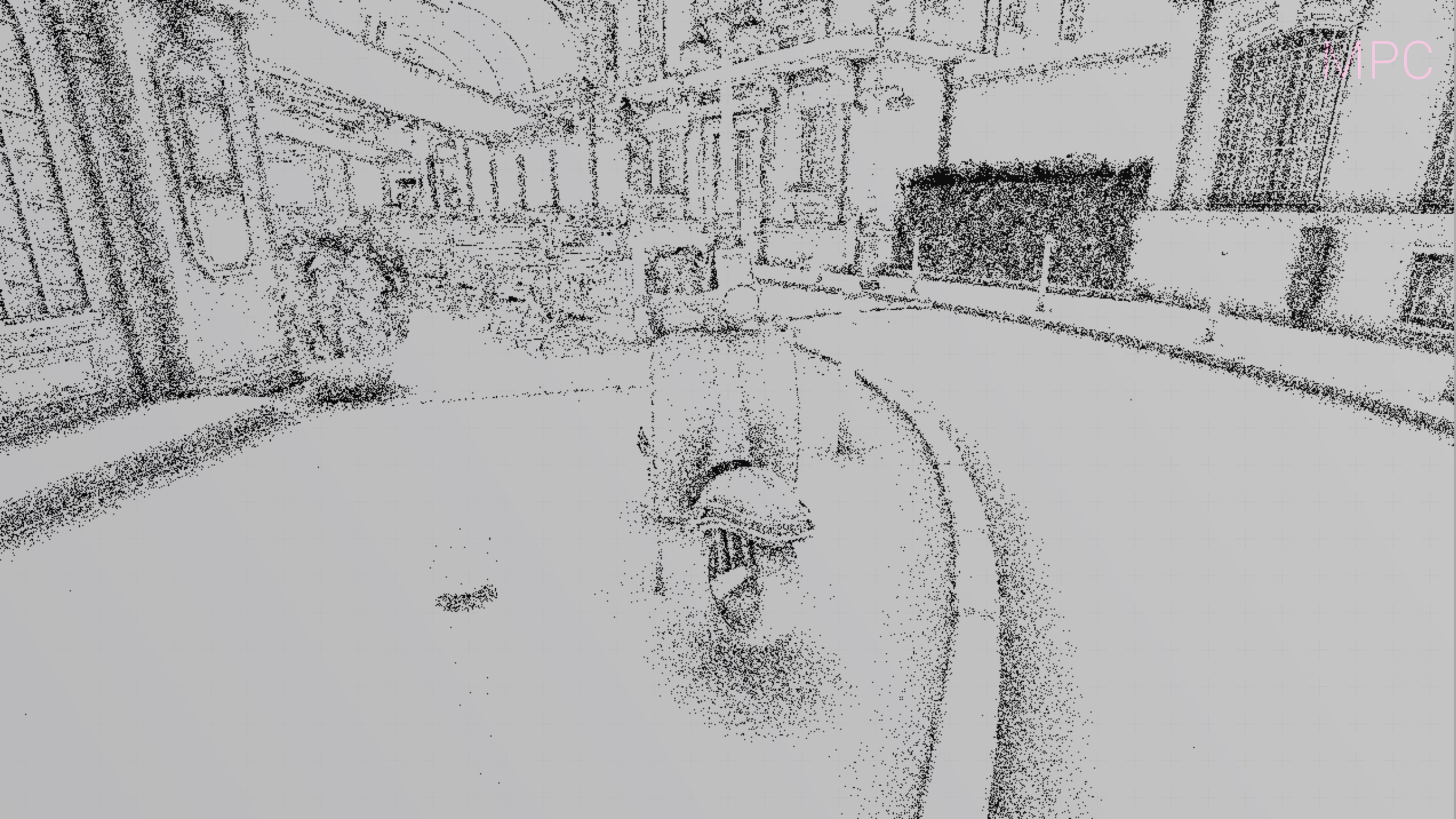
[11:54:34] SphereCollider component deleted: Component belongs to a disabled built-in package.

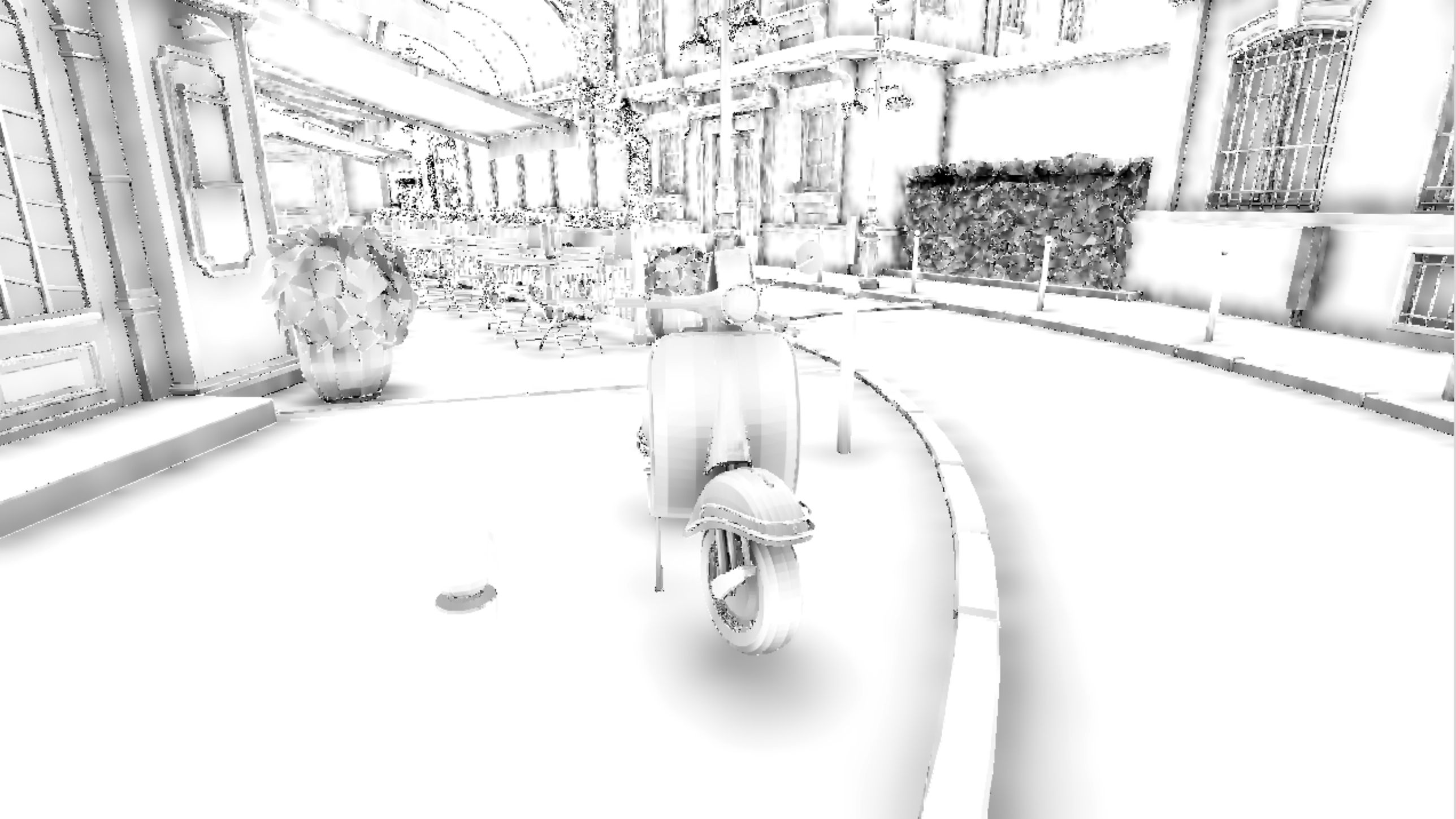
[11:54:34] Vertices len 19470 Normals len19470 Uv len 0 indices len 37500
UnityEngine.Debug:Log(Object)

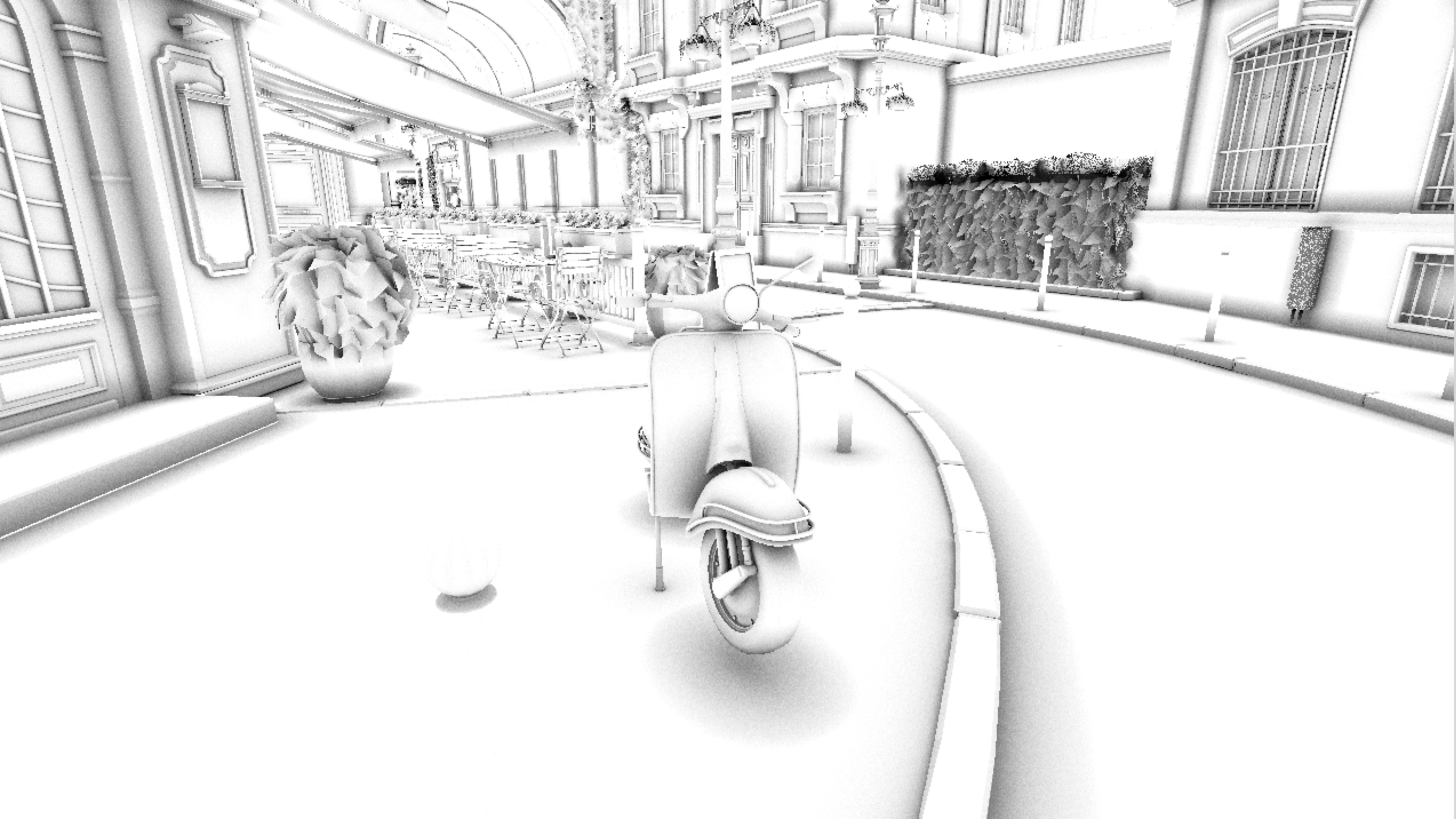
[11:54:34] Vertices len 121 Normals len121 Uv len 121 indices len 600
UnityEngine.Debug:Log(Object)

Vertices len 19470 Normals len19470 Uv len 0 indices len 37500
UnityEngine.Debug:Log(Object)
testScript:loadUnityGeometryToDxr(MeshFilter) (at Assets/testScript.cs:79)
testScript:Start() (at Assets/testScript.cs:138)

Vertices len 121 Normals len121 Uv len 121 indices len 600







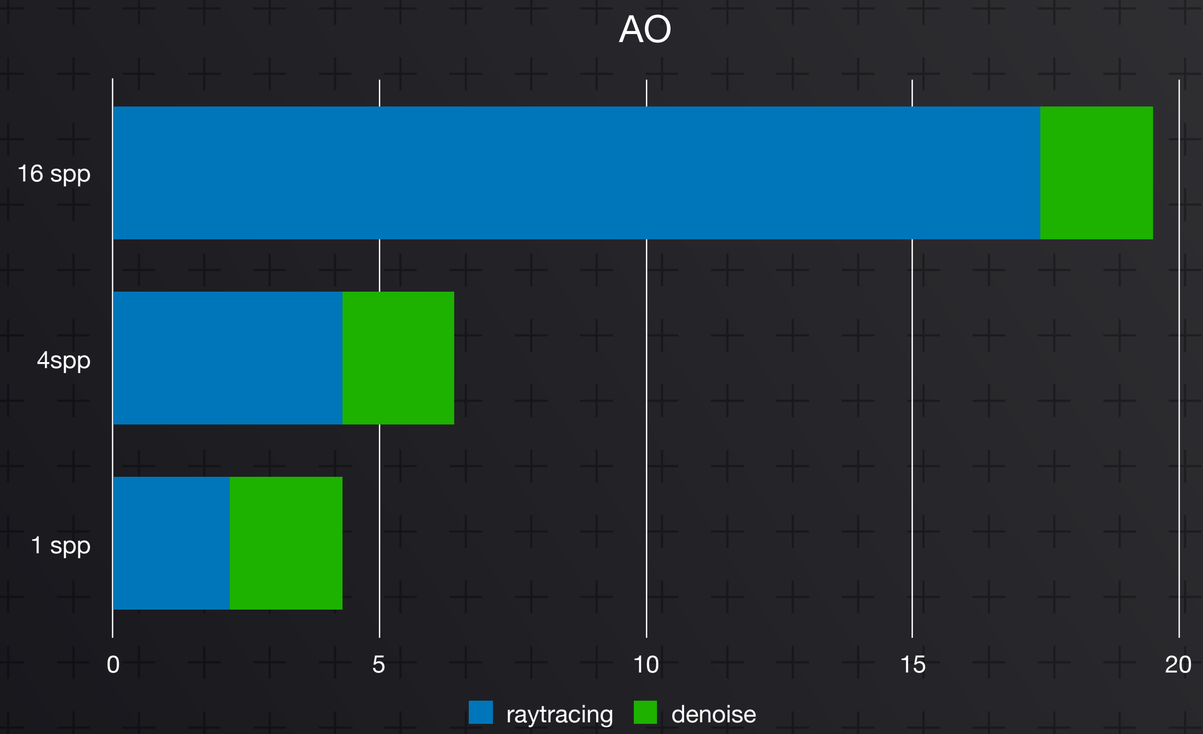

MENU


MENU

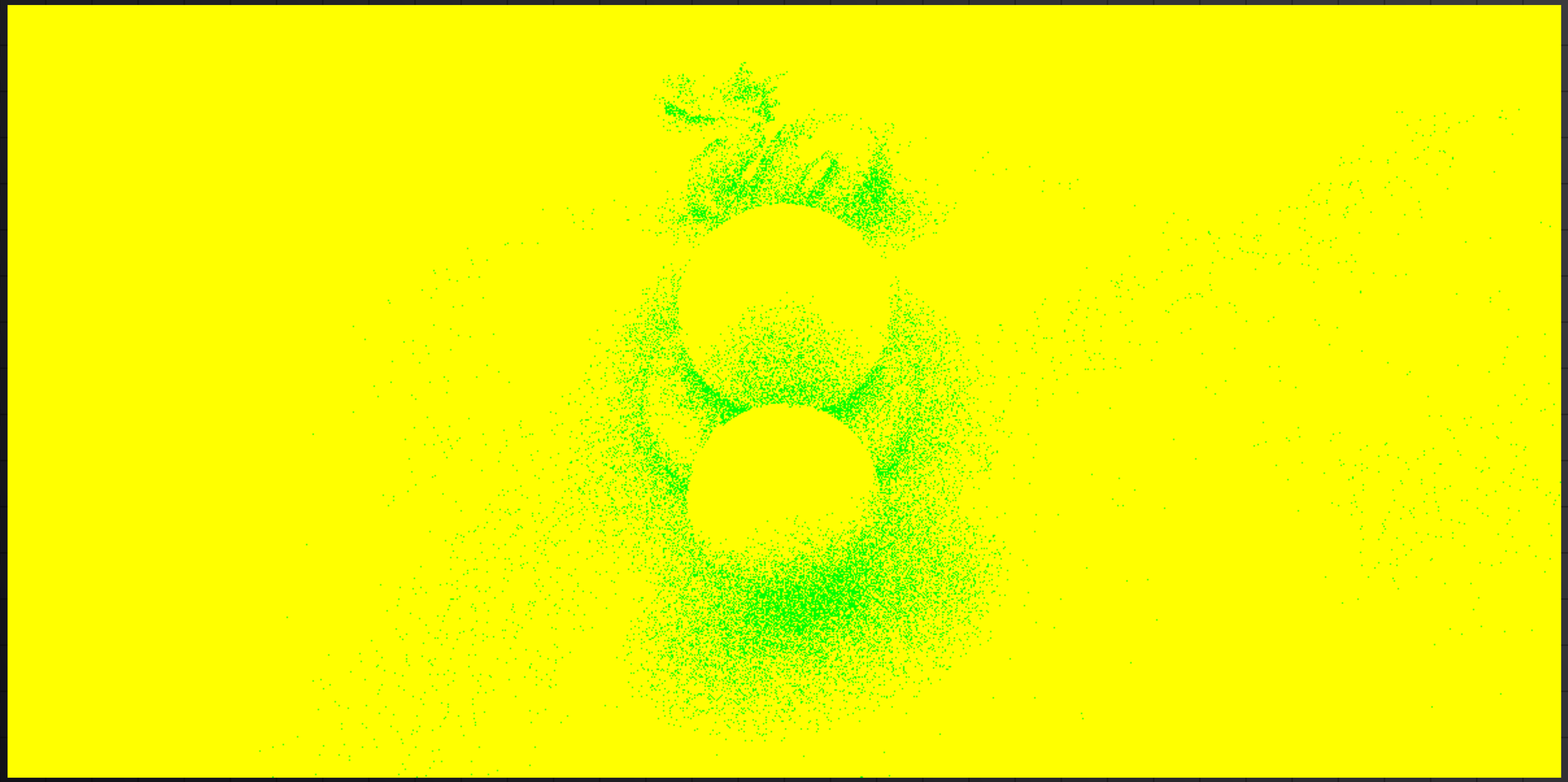
MPC

AO: TIMINGS

	1 spp	4spp	16 spp
Raytracing	2.2	4.3	17.4
Denoising	2.1	2.1	2.1



MPC



AMBIENT OCCLUSION

- Unity uses 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

MPC

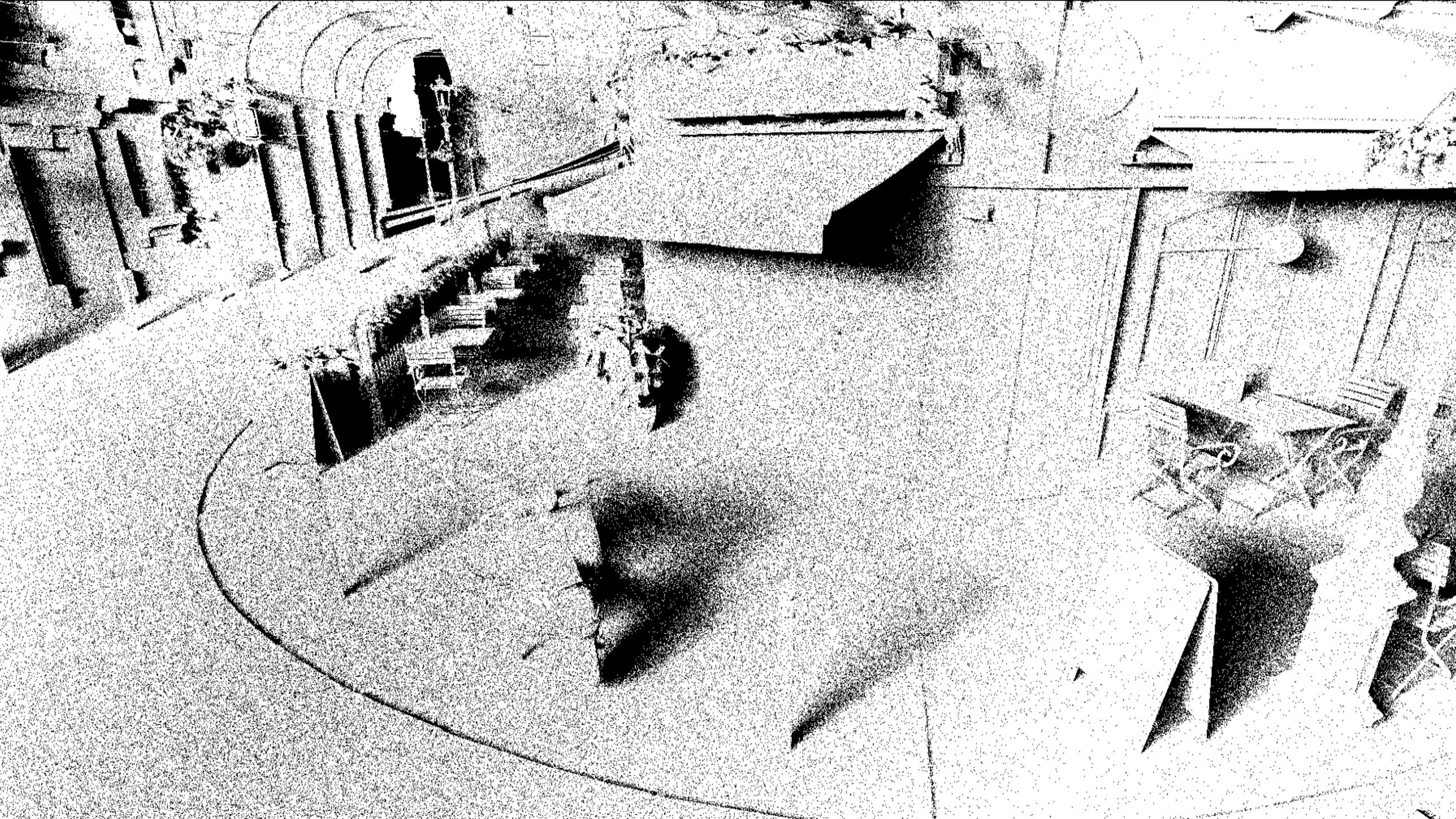
AREA LIGHTS

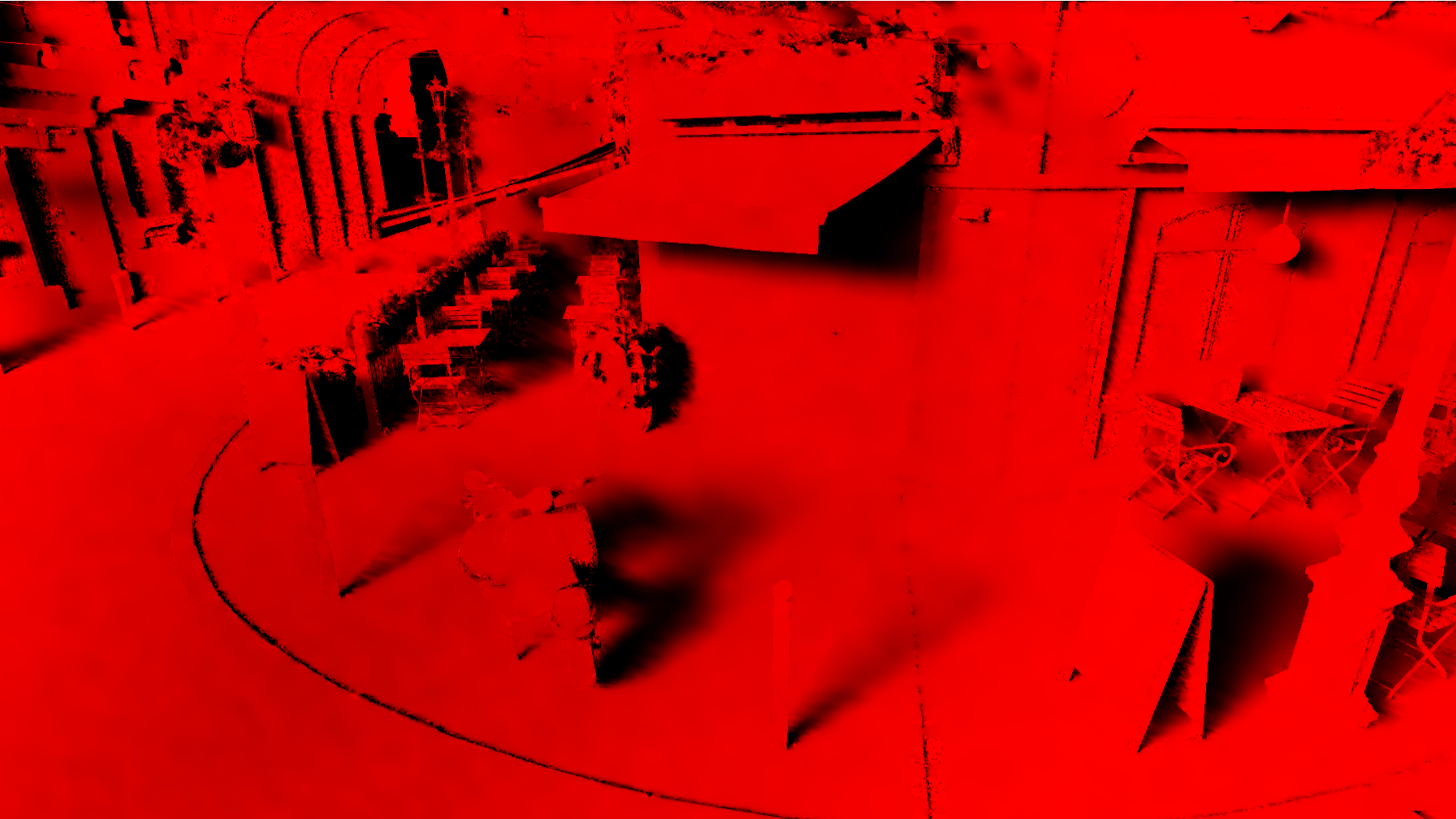

MENU

MPC

AREA LIGHTS

- Our shots make heavy use of area lights
- Previously using in house solution with raymarched depth map.





AREA LIGHTS

- 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

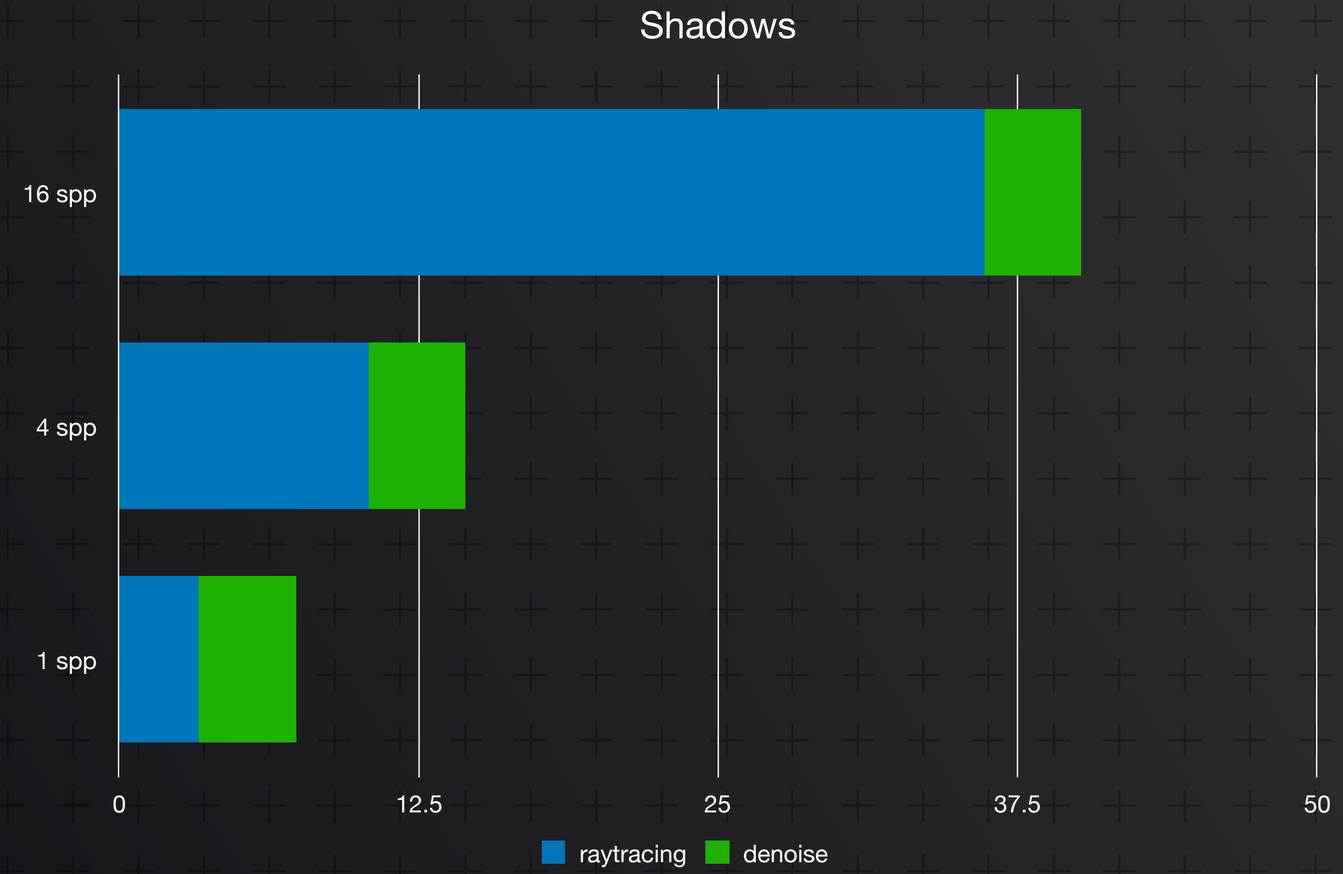
AREA LIGHTS

Experimenting with several ways to combine multiple area lights

MPC

AREA LIGHTS: TIMINGS

	1 spp	4 spp	16 spp
Raytracing	3.29	10.41	36.11
Denoising	4.08	4.01	4.06




MENU

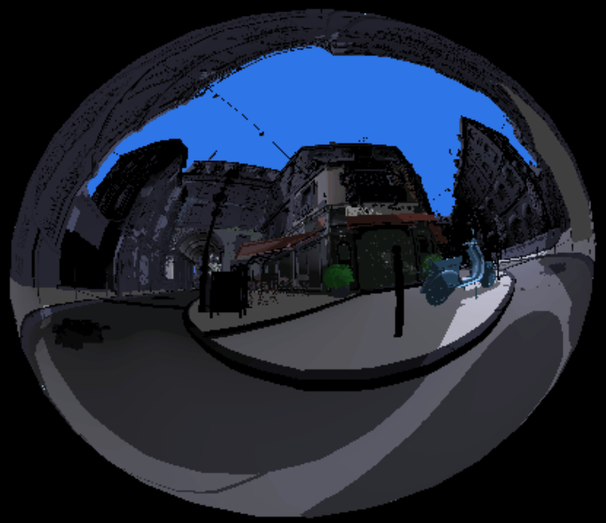
MPC

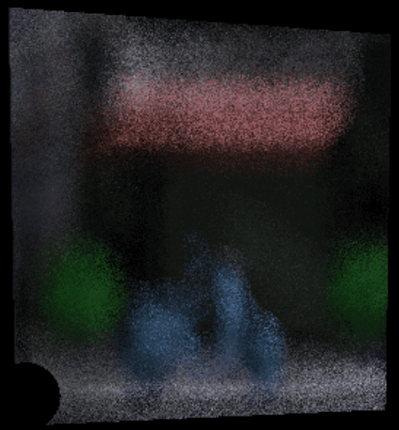
REFLECTIONS

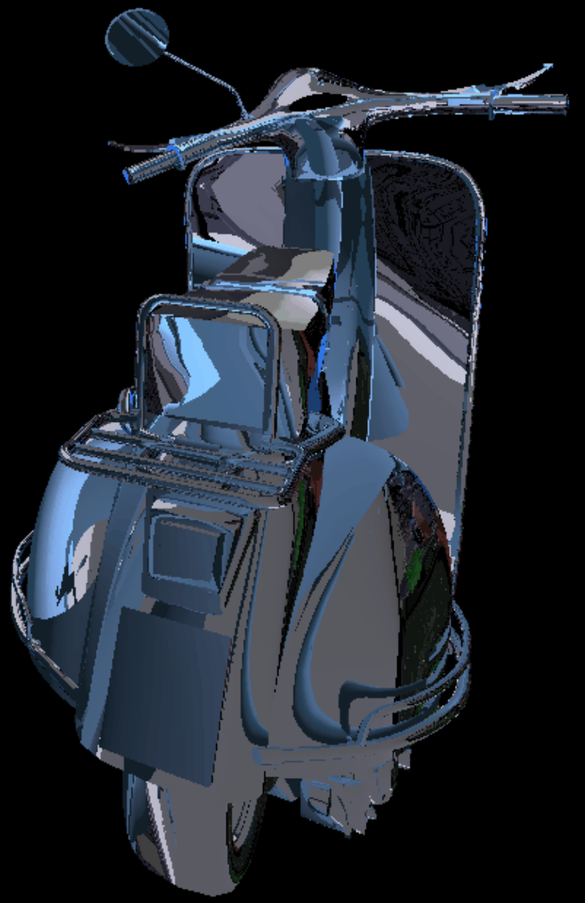
REFLECTIONS

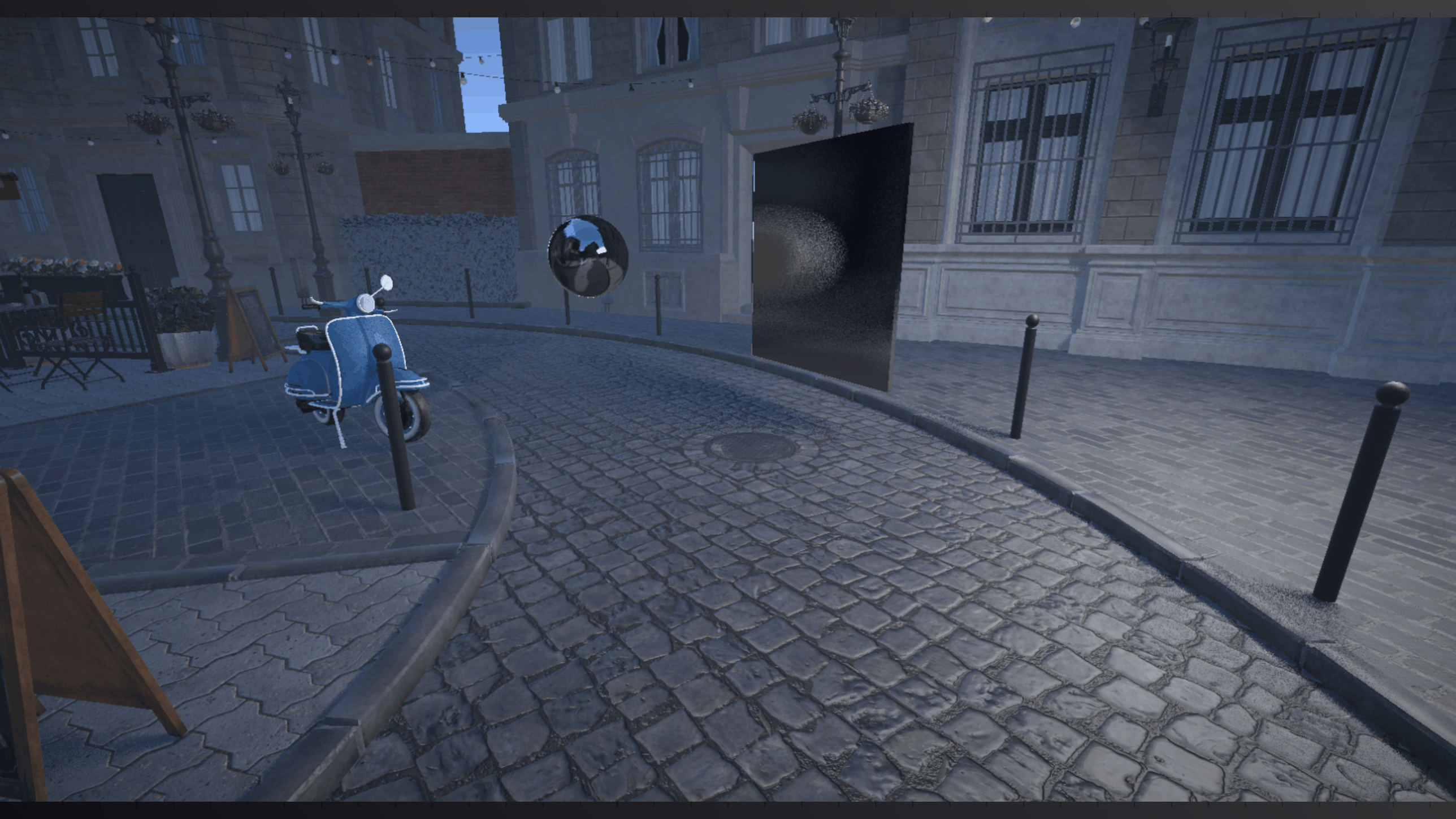
Most tricky effect to deal with:

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









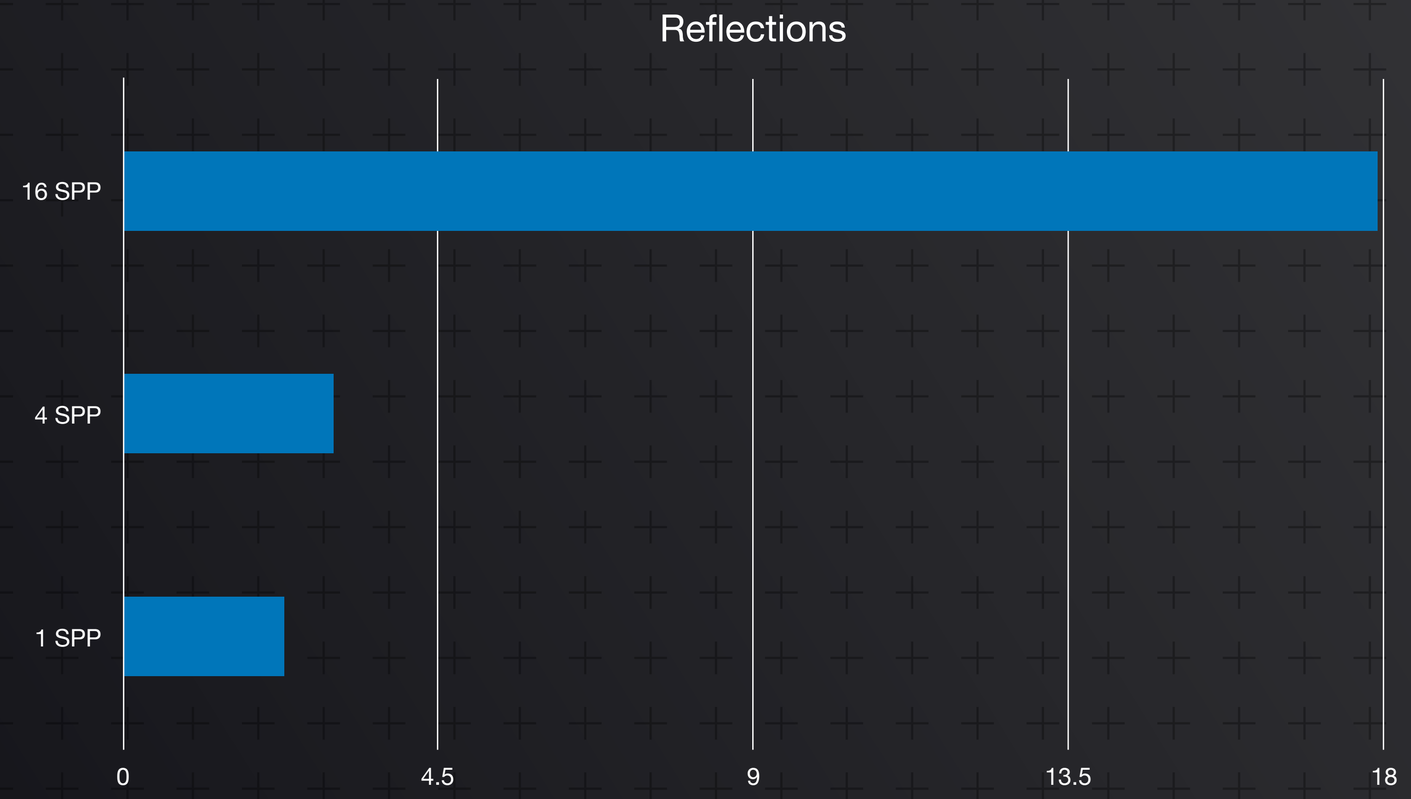
REFLECTIONS

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

MPC

REFLECTIONS: TIMINGS

1 SPP	4 SPP	16 SPP
2.3	3.01	17.9



MPC

REFLECTIONS

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'S NEXT?

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


THANK YOU!

APPLY AT
www.moving-picture.com
www.mpc-rnd.com
OR EMAIL
recruitment@moving-picture.com