



The Latest Graphics Technology in Remedy's Northlight Engine

Tatu Aalto
Lead Graphics Programmer



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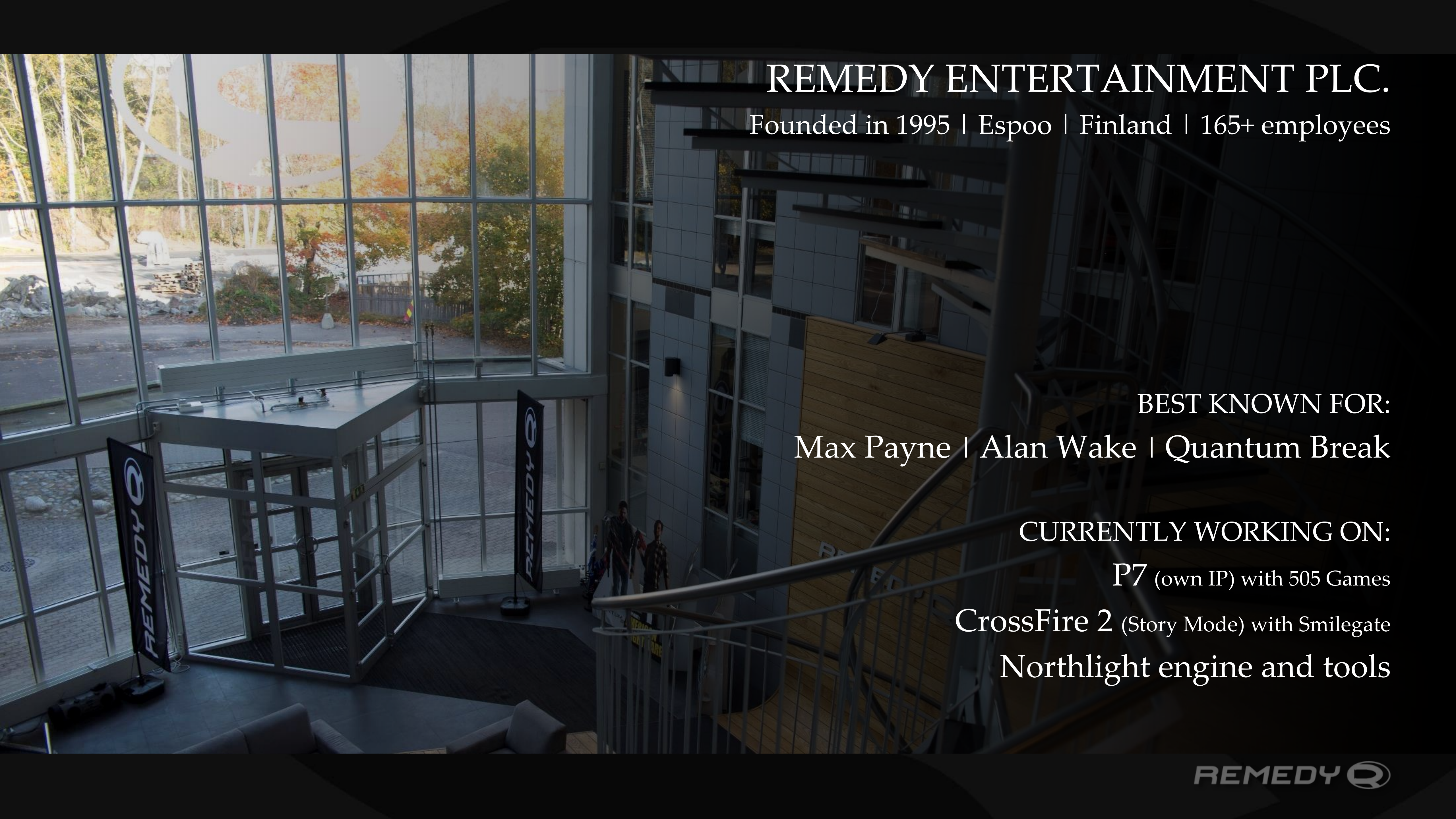
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Experiments with DirectX Raytracing in Remedy's Northlight Engine

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A high-angle, wide shot of a modern office interior. The space is characterized by large glass windows on the left side, offering a view of an outdoor area with trees and a paved path. The office has a contemporary design with grey walls, wooden paneling, and a curved staircase with a metal railing. Several people are visible working at desks in the background. Two vertical banners with the Remedy logo are positioned near the entrance. The overall atmosphere is bright and professional.

REMEDY ENTERTAINMENT PLC.

Founded in 1995 | Espoo | Finland | 165+ employees

BEST KNOWN FOR:

Max Payne | Alan Wake | Quantum Break

CURRENTLY WORKING ON:

P7 (own IP) with 505 Games

CrossFire 2 (Story Mode) with Smilegate

Northlight engine and tools

Agenda

Quick introduction to DirectX Raytracing

Area shadows

Ambient occlusion

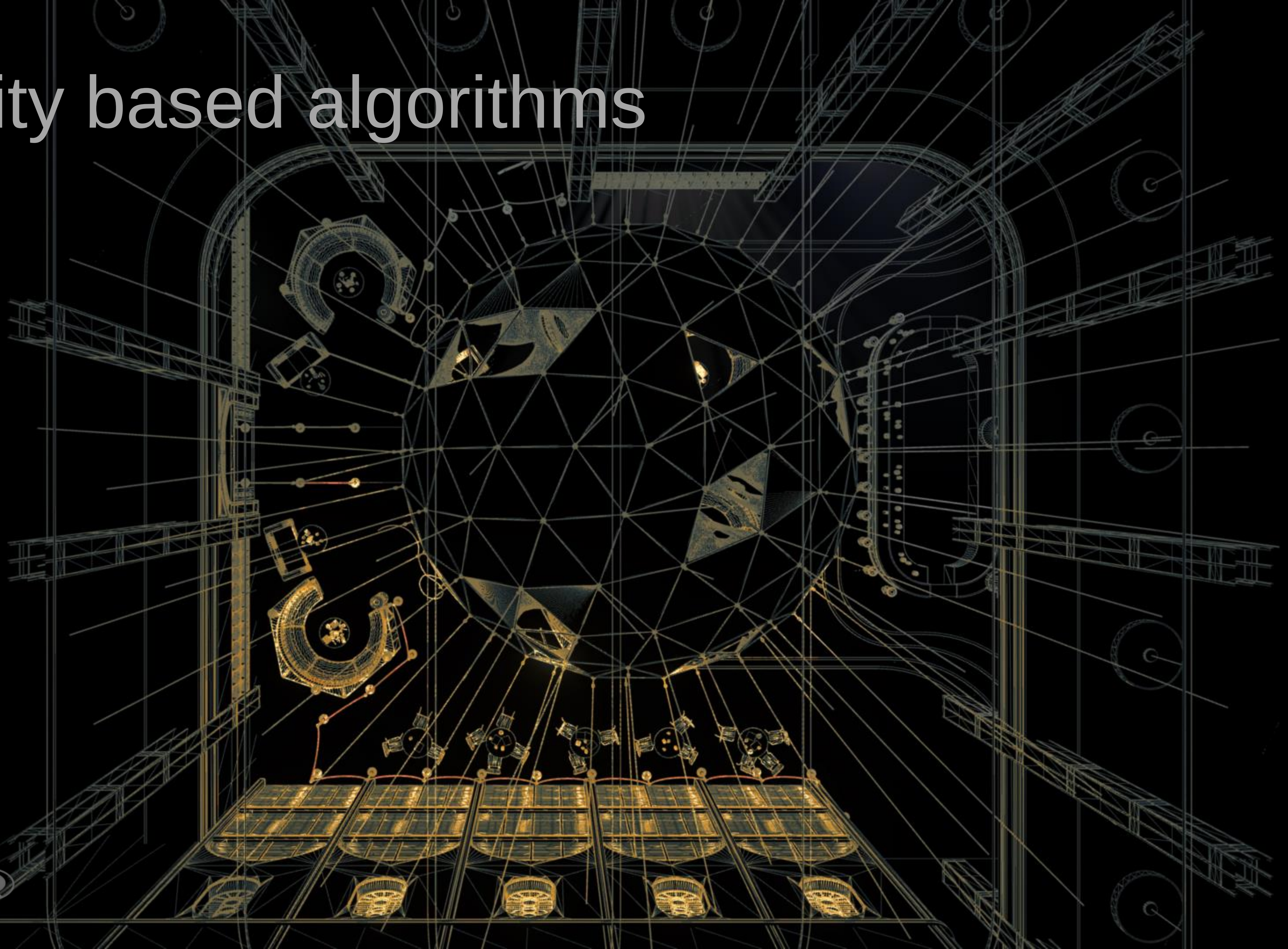
Reflections

Indirect Diffuse

Experiments with DirectX Raytracing in Northlight

<https://youtu.be/70W2aFr5-Xk>

Visibility based algorithms



Visibility based algorithms

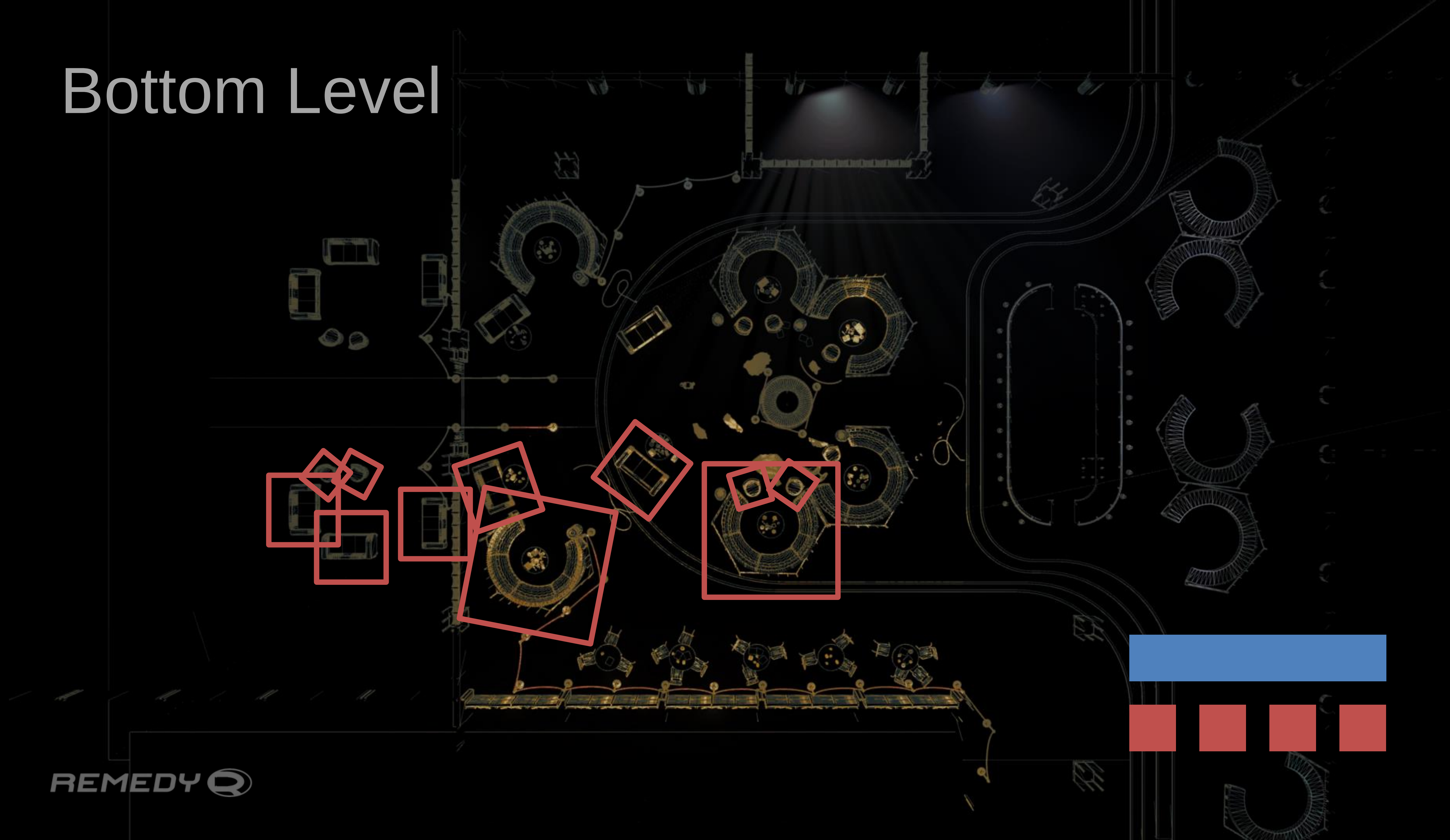
Top Level



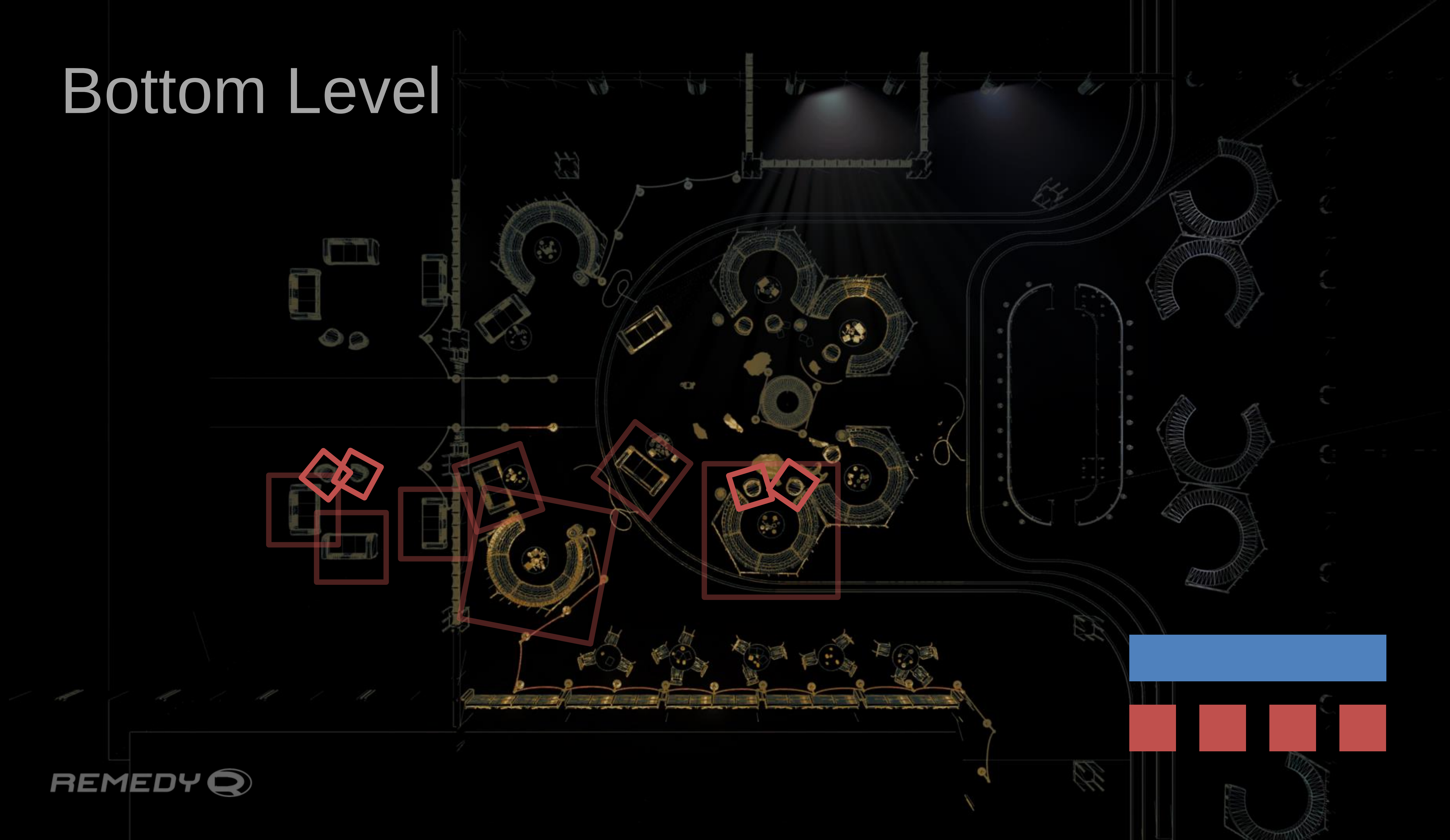
Bottom Level



Bottom Level



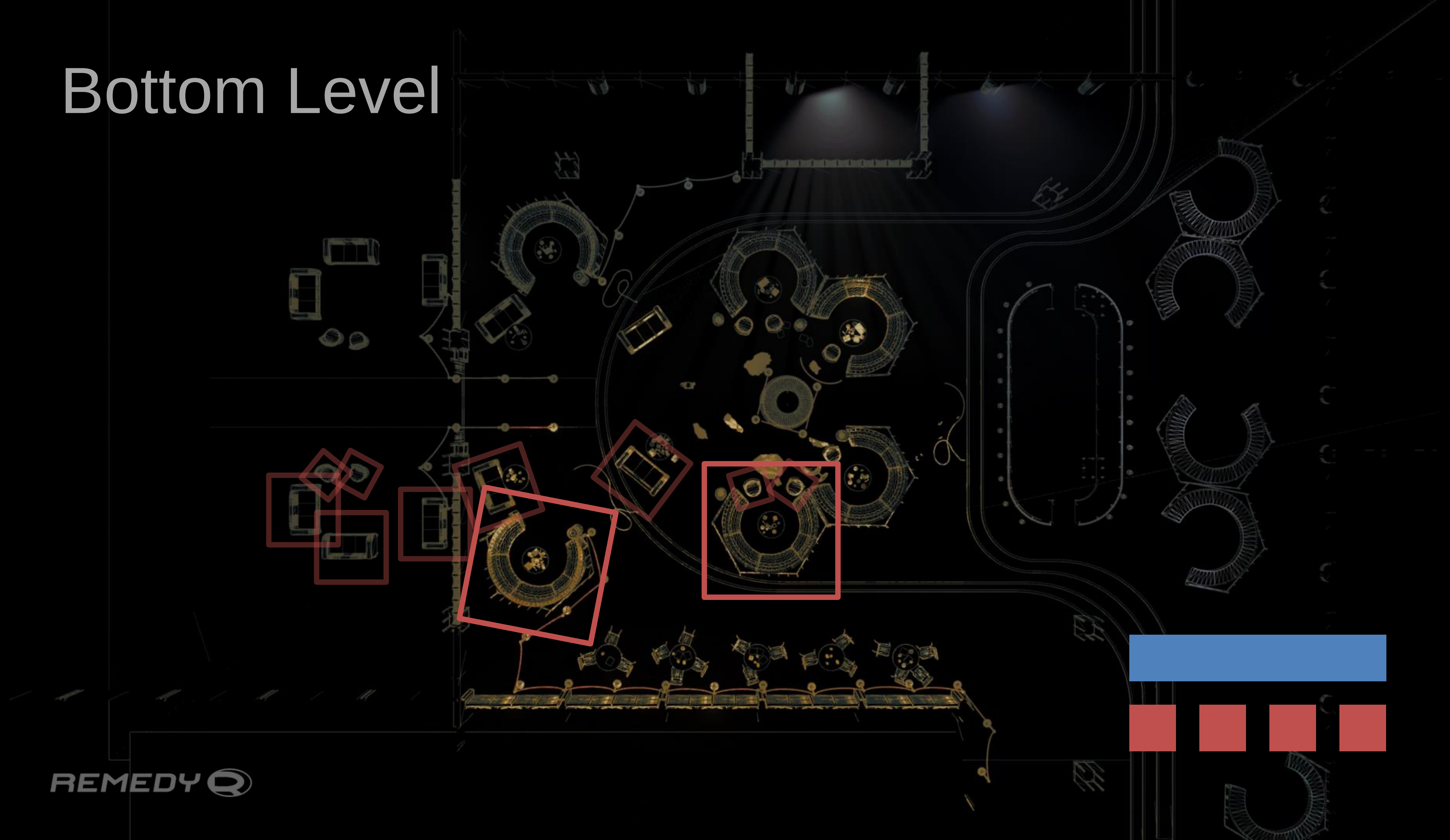
Bottom Level



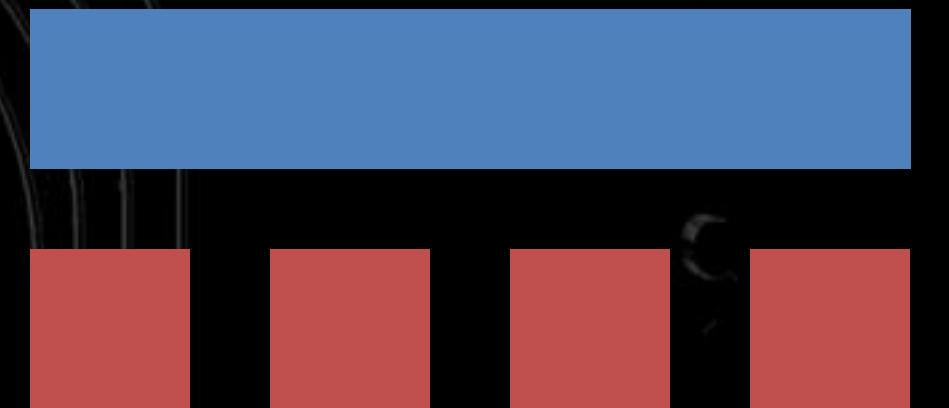
Bottom Level



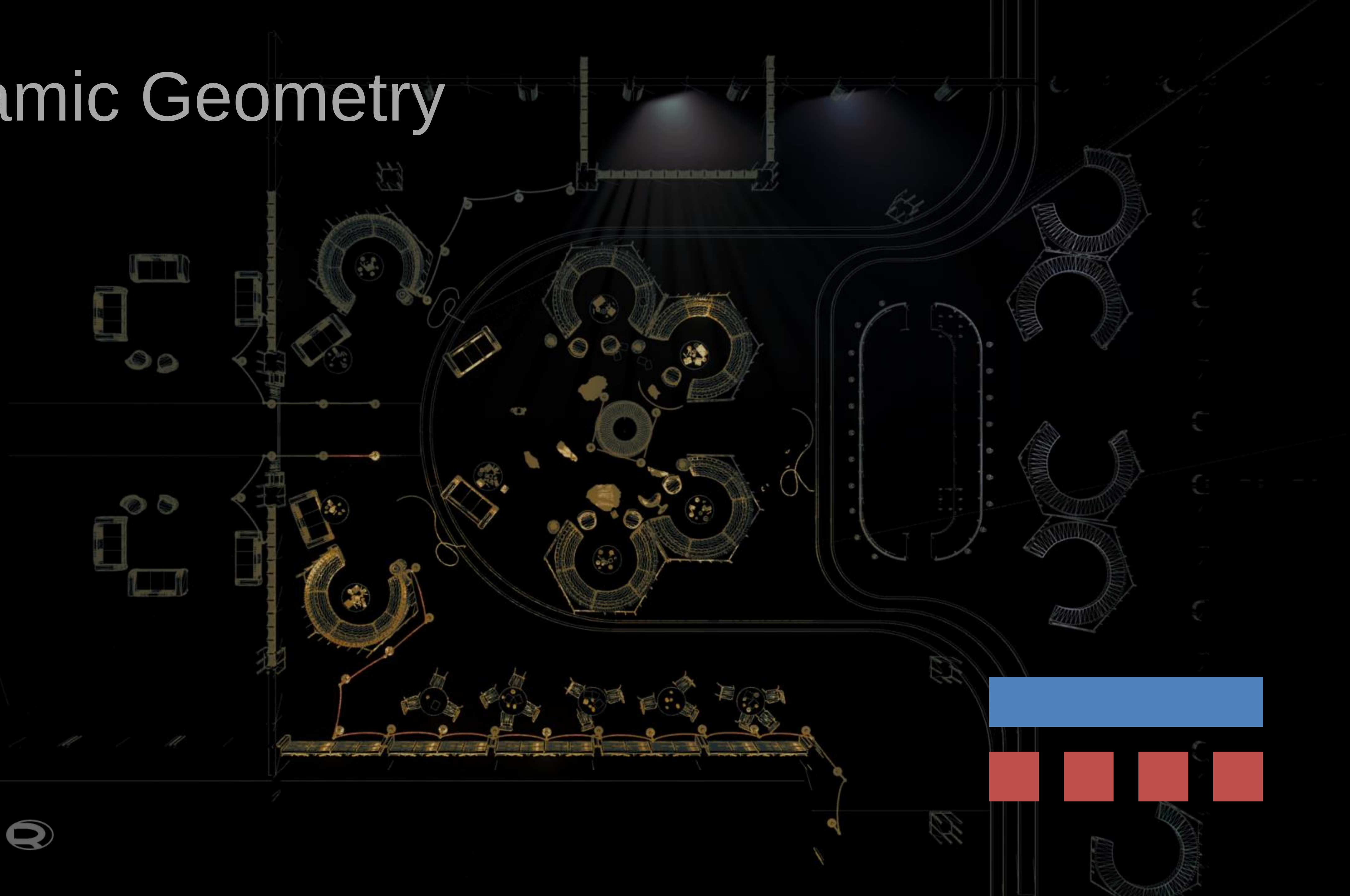
Bottom Level

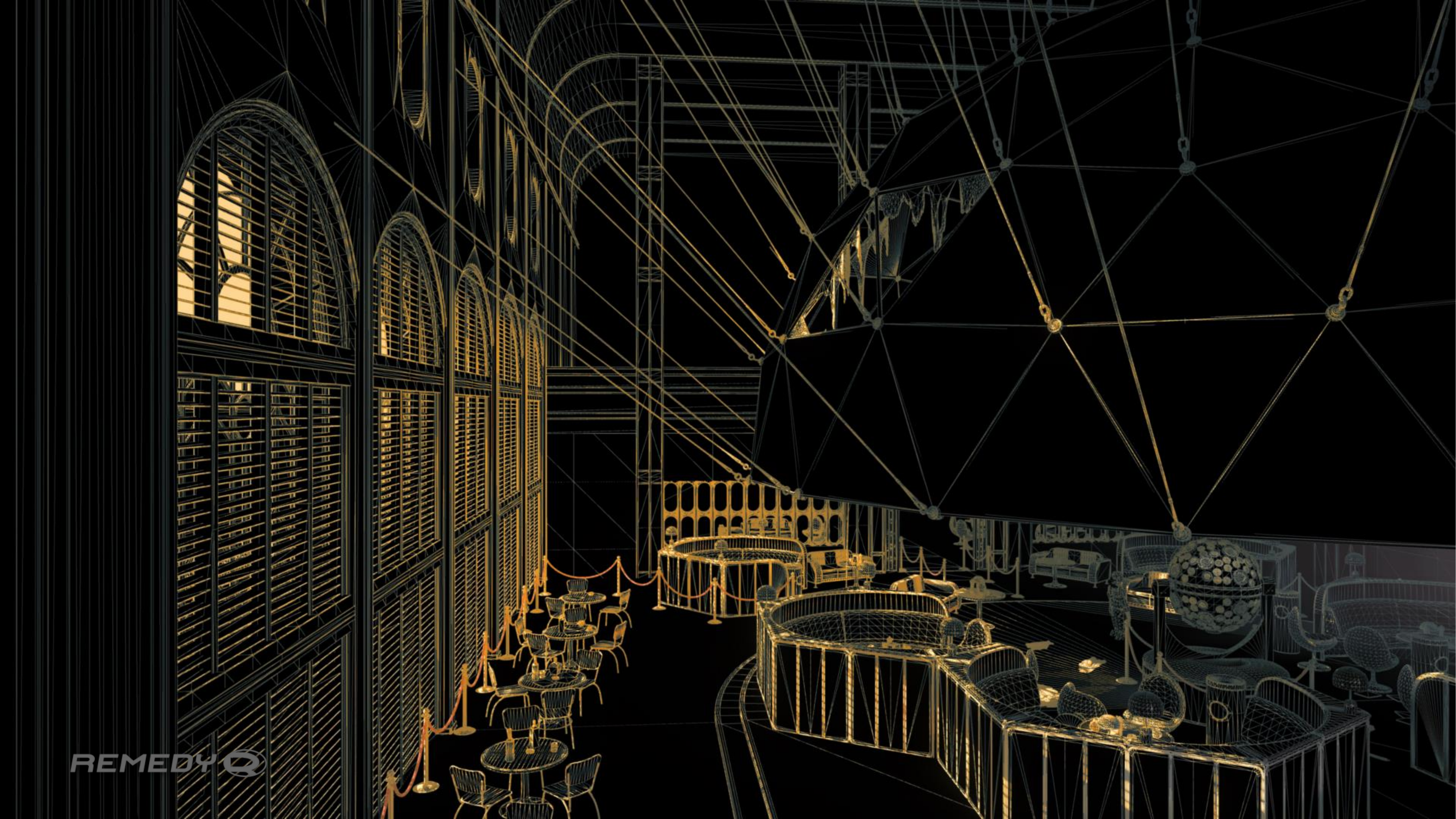


Top Level

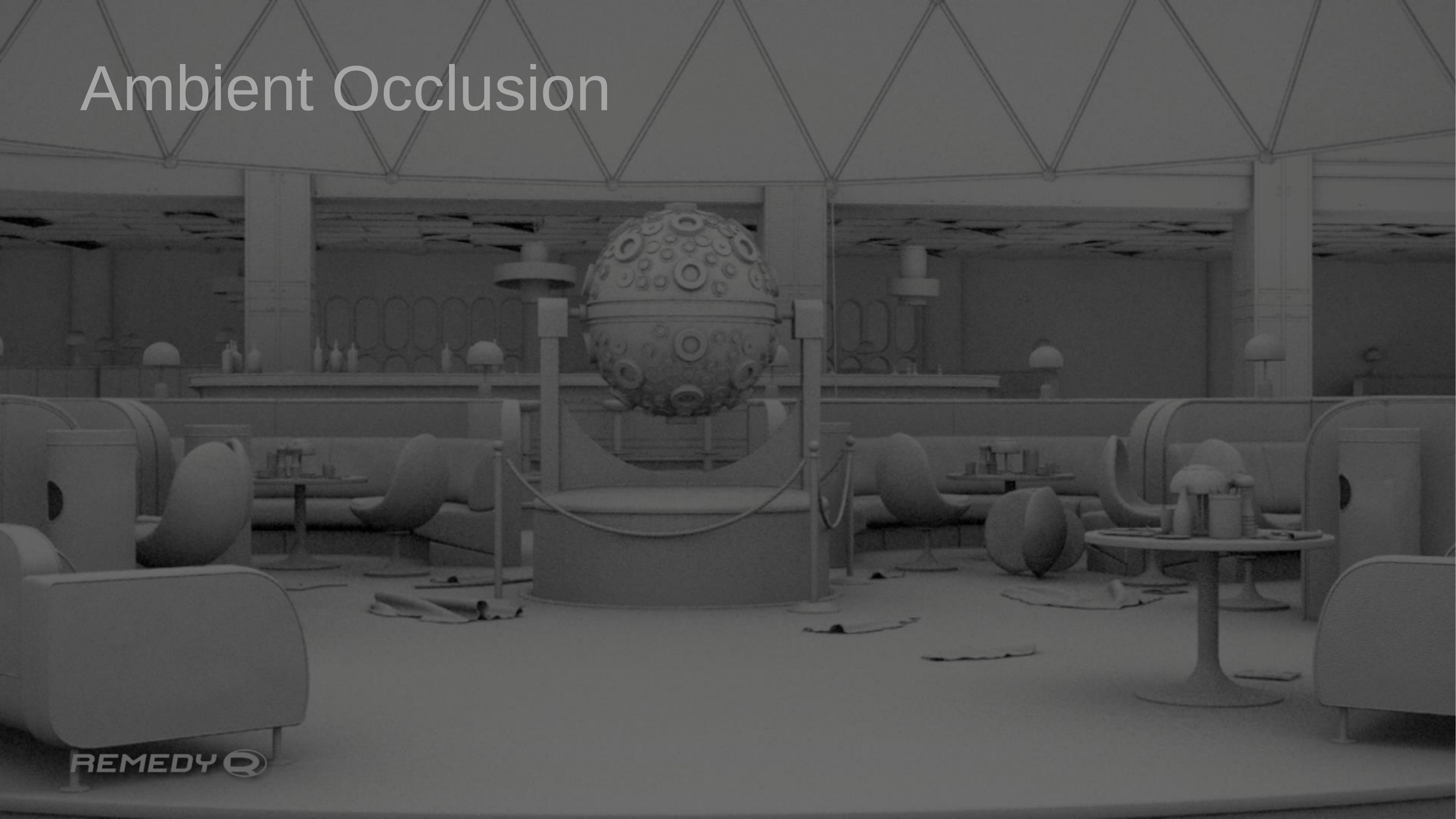


Dynamic Geometry





Ambient Occlusion



Ambient Occlusion

Screen Space

Raytraced

Ambient Occlusion

Single ray per pixel on 1080p is roughly 5ms

Ambient Occlusion

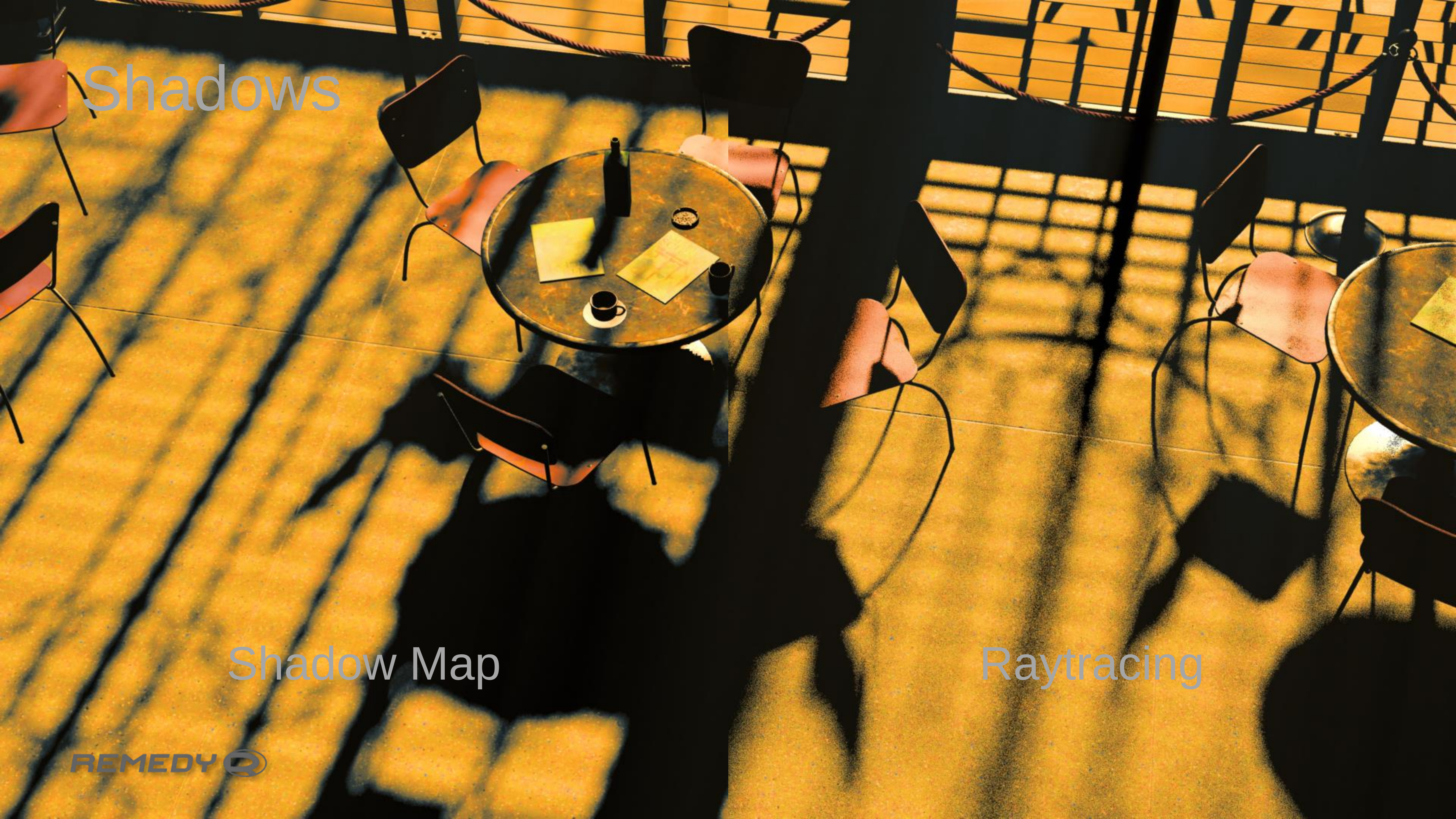
1 rpp

2 rpp

4 rpp

16 rpp

Shadows



Shadows

Shadow Map

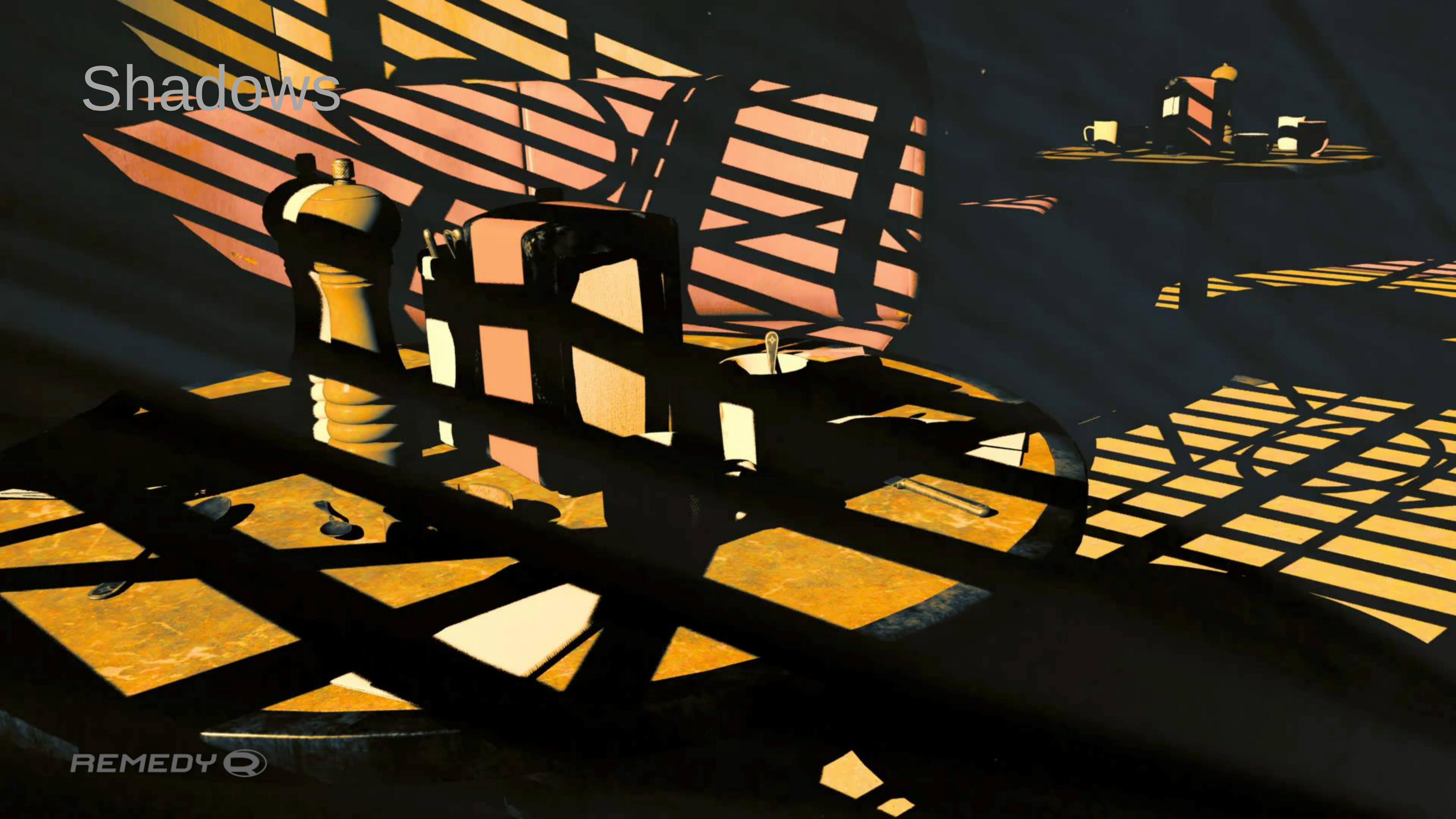
Raytracing



Shadows

Shadows

Shadows



Shadows

Single ray per pixel on 1080p is under 4ms

More than visibility



More than visibility

Geometry



More than visibility

Geometry

Chair 1

1	2	3	4	5
2				

Chair 2

6	7	8	9	10
2				

More than visibility

Material parameters in buffer

1	2	3	4	5	6
---	---	---	---	---	---

Textures in descriptor heap

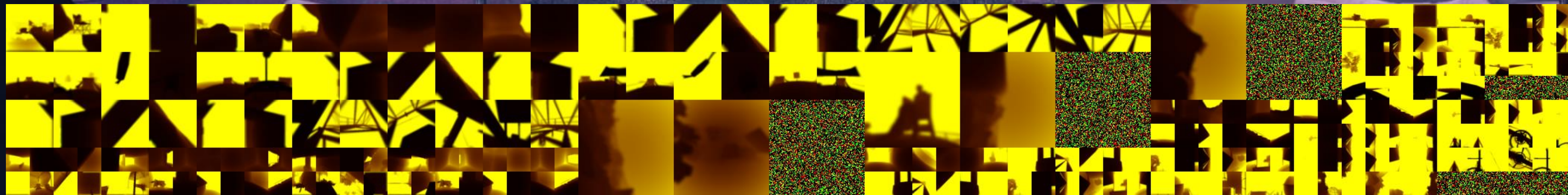
1	2	3	4	5	6	Draw calls
---	---	---	---	---	---	------------

More than visibility

Lighting

```
struct DeferredLightingPointData
{
    m::Vector3      vPositionInView;
    float           fShadowMapShrink;
    m::Vector3      vColor;
    float           fClipRange;
    m::Vector4      vFalloff;
    m::Vector3      vDirectionInView;
    float           fInvShadowMapRange;
    m::Matrix4      mViewToShadowClip;
    m::Vector4      vShadowAtlasOffsetScale;
    float           fRadius;
    float           fBoundsRadius;
    float           fScatterIntensityMul;
    unsigned int     uTechniqueProperties;
};
```

SAVE OUR
LIBRARY



Reflections



Reflections

Screen Space

Raytraced

Reflections

Screen Space

Reflections

Screen Space

Reflections

Screen Space

Reflections

Screen Space

Reflections

Raytraced

Reflections

Distance intrinsic

Reflections

Texture Coordinates

Reflections

Diffuse Albedo

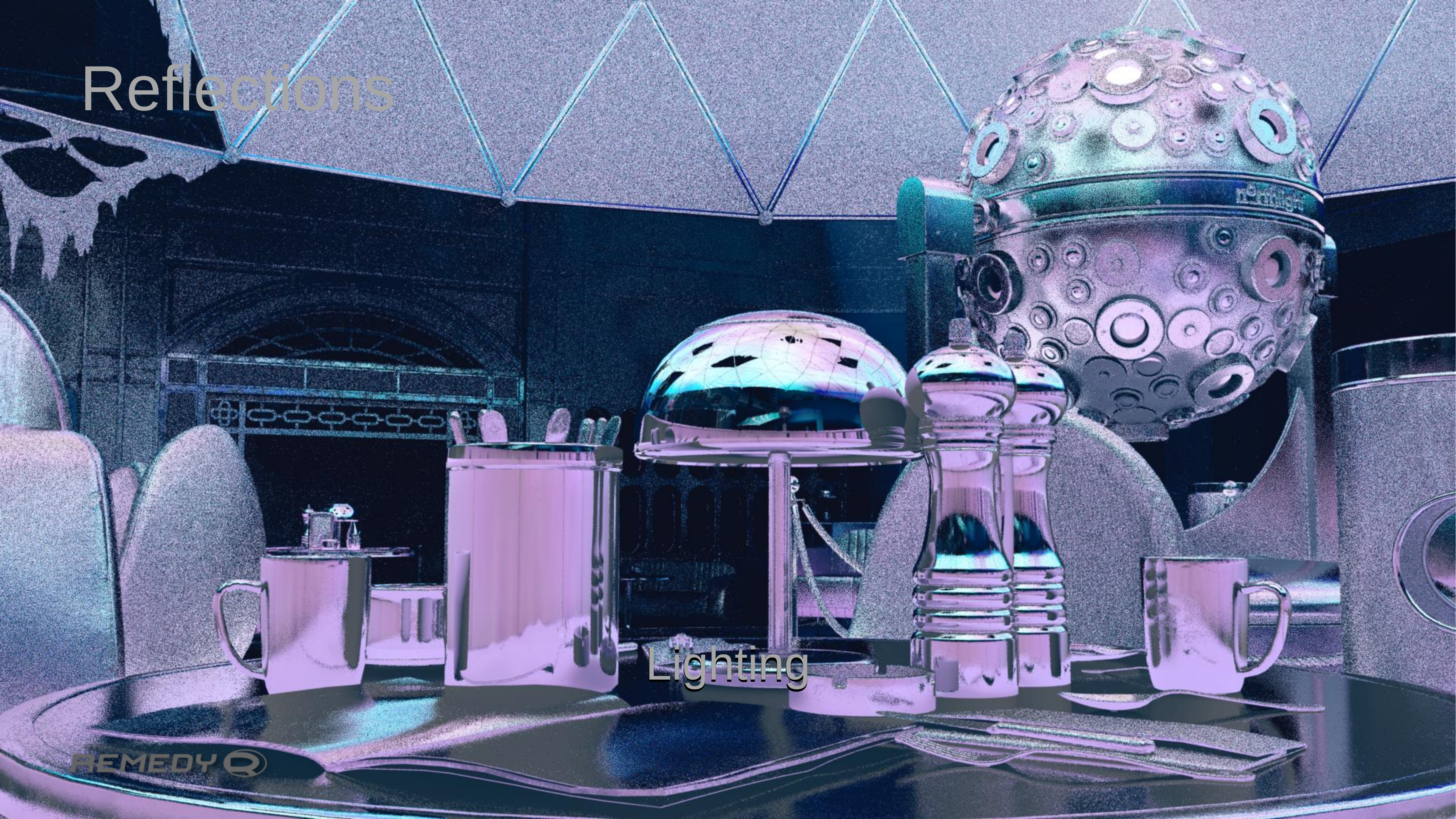
REMEDY Q



Reflections

Lighting

REMEDY 



Reflections

Fresnel * Lighting * Material

Reflections



Reflections

1 ray per pixel



Reflections

+ 3 rays on bright pixels



Reflections

and combine with small damping

Reflections

Optimise by using shadow maps



Indirect Diffuse



Indirect Diffuse

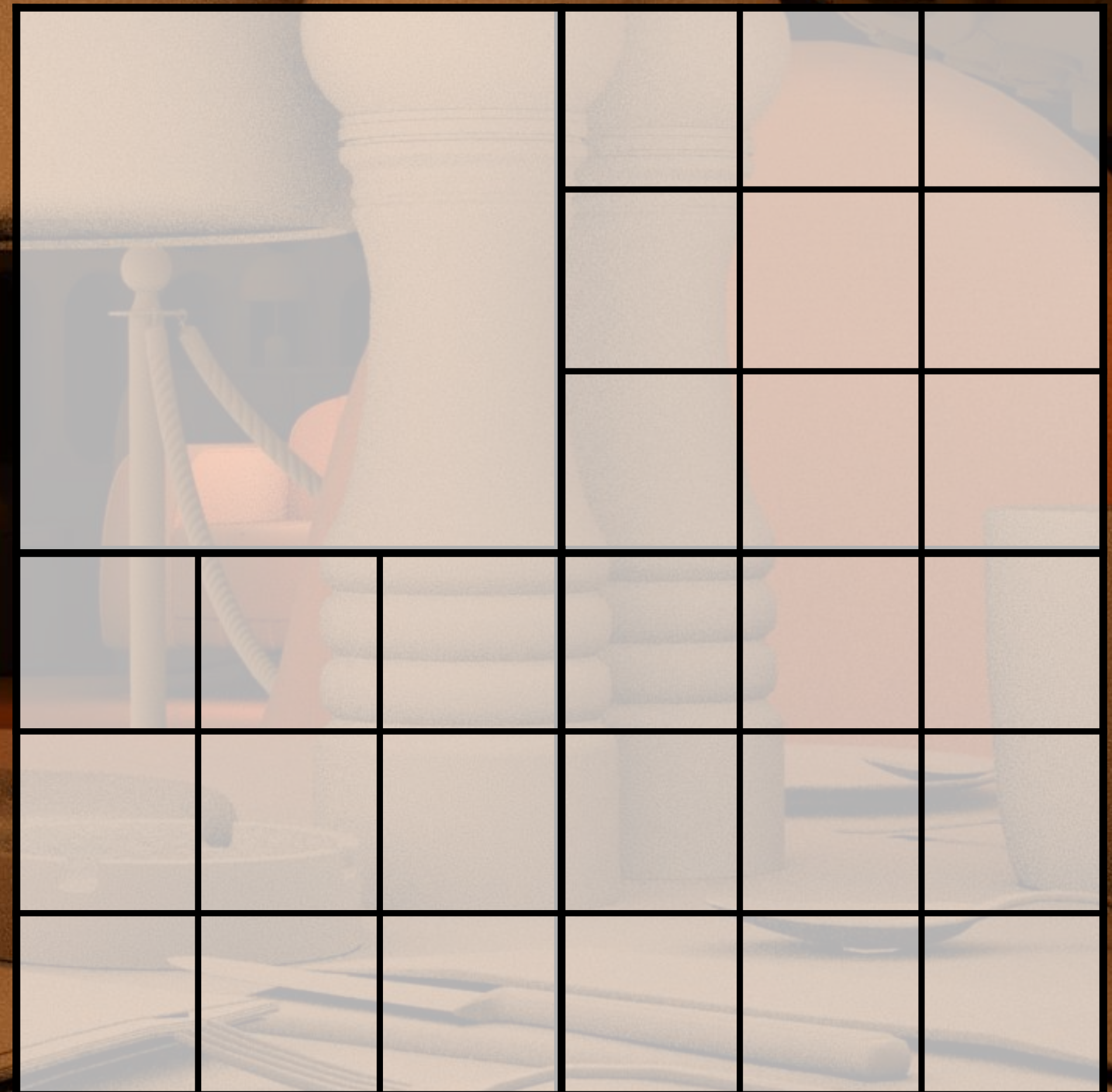


Indirect Diffuse

Similar to AO, lots of non-coherent rays

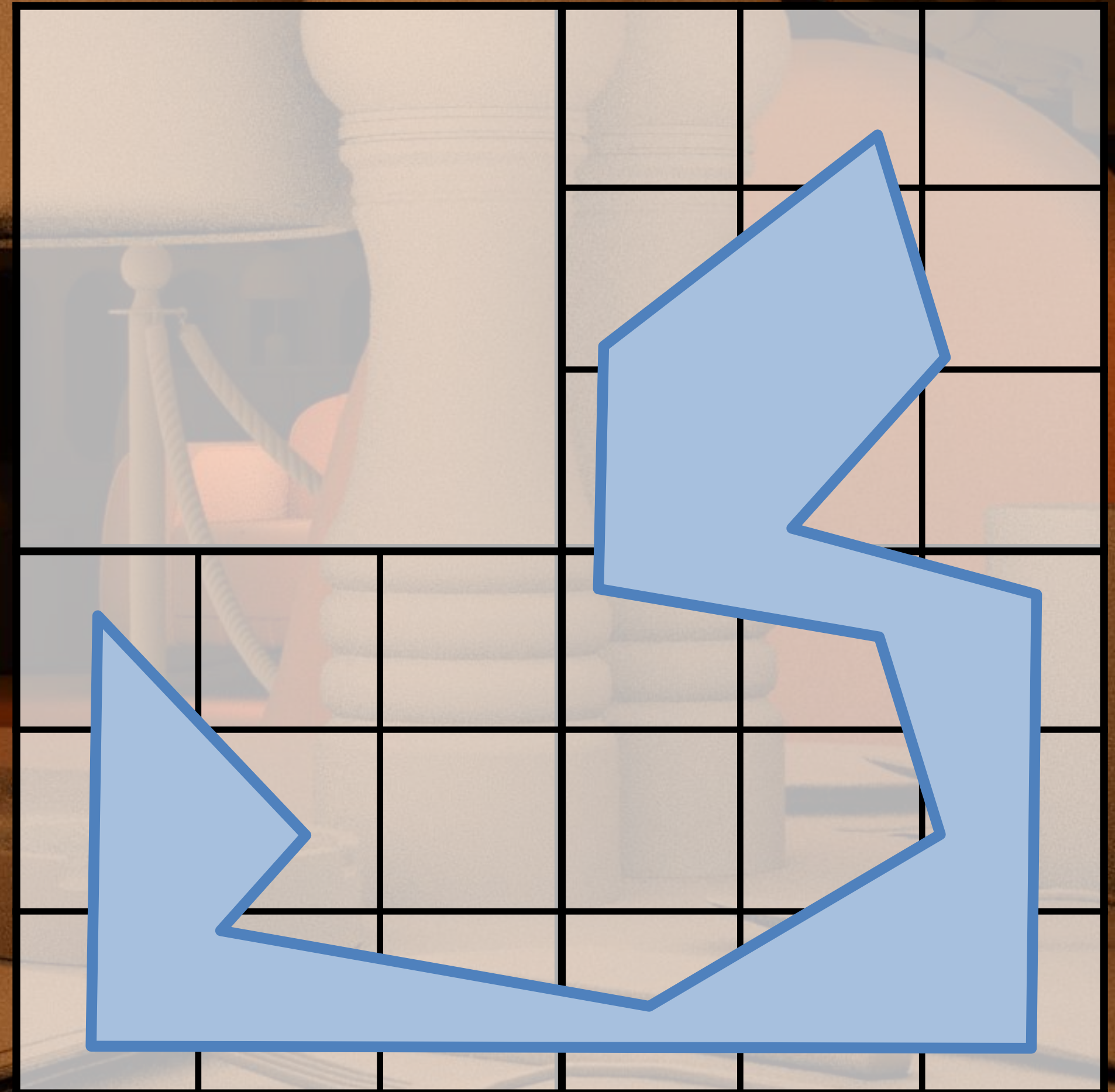
Indirect Diffuse

GI stored in sparse grid
volume



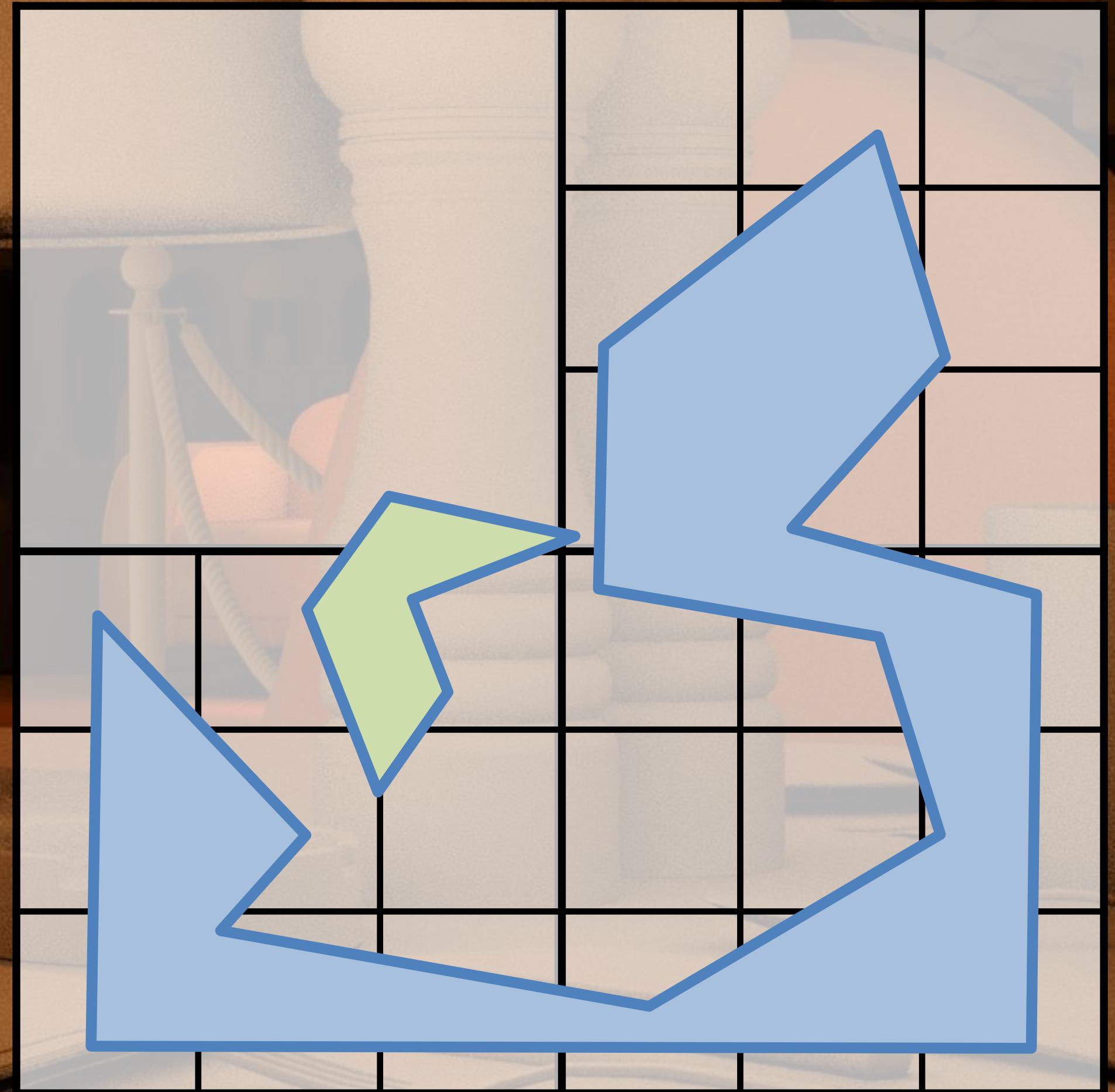
Indirect Diffuse

Irradiance calculated
based on static geometry
and static set of lights



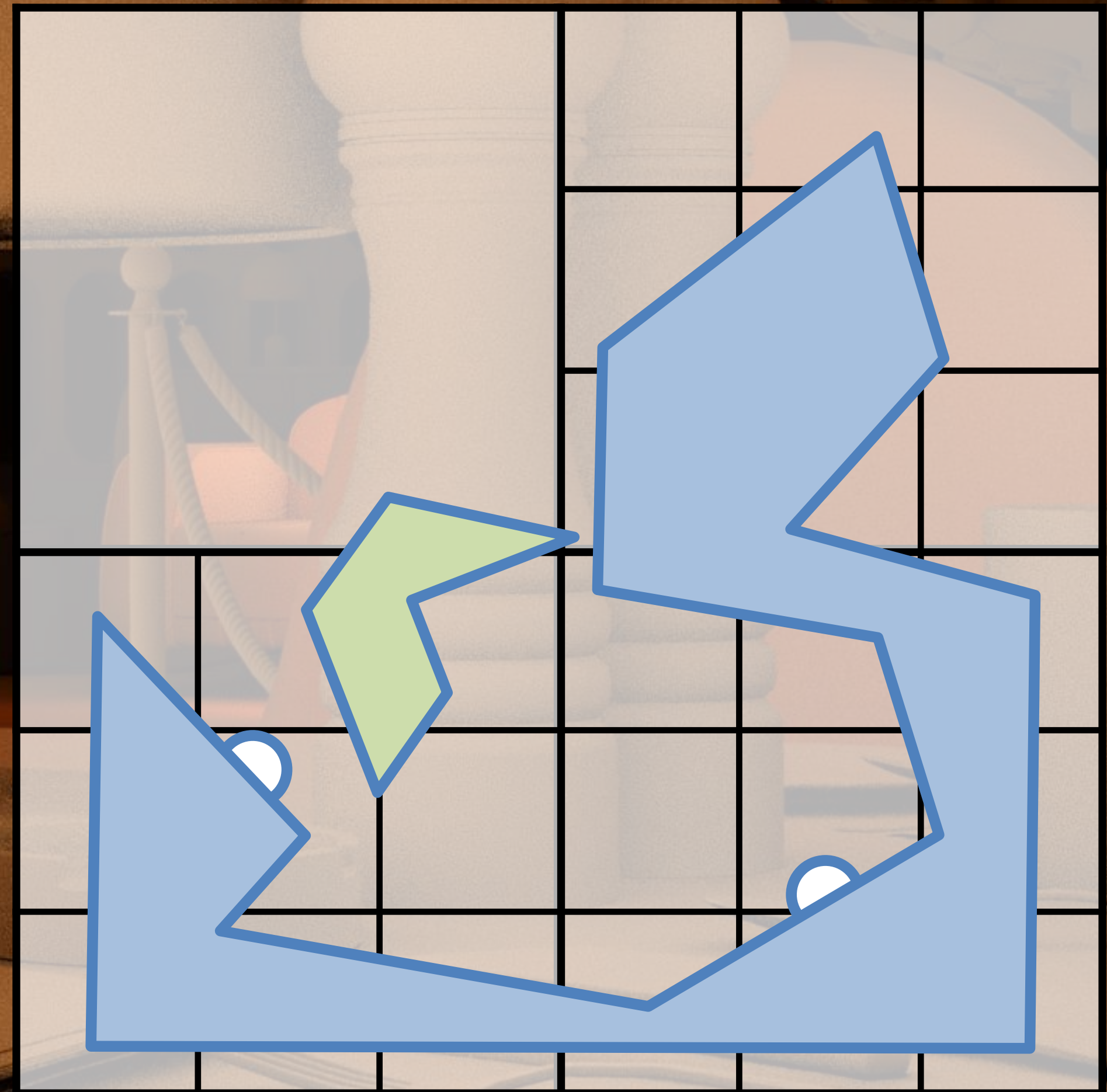
Indirect Diffuse

Dynamic geometry can receive light, but does not contribute to calculated irradiance



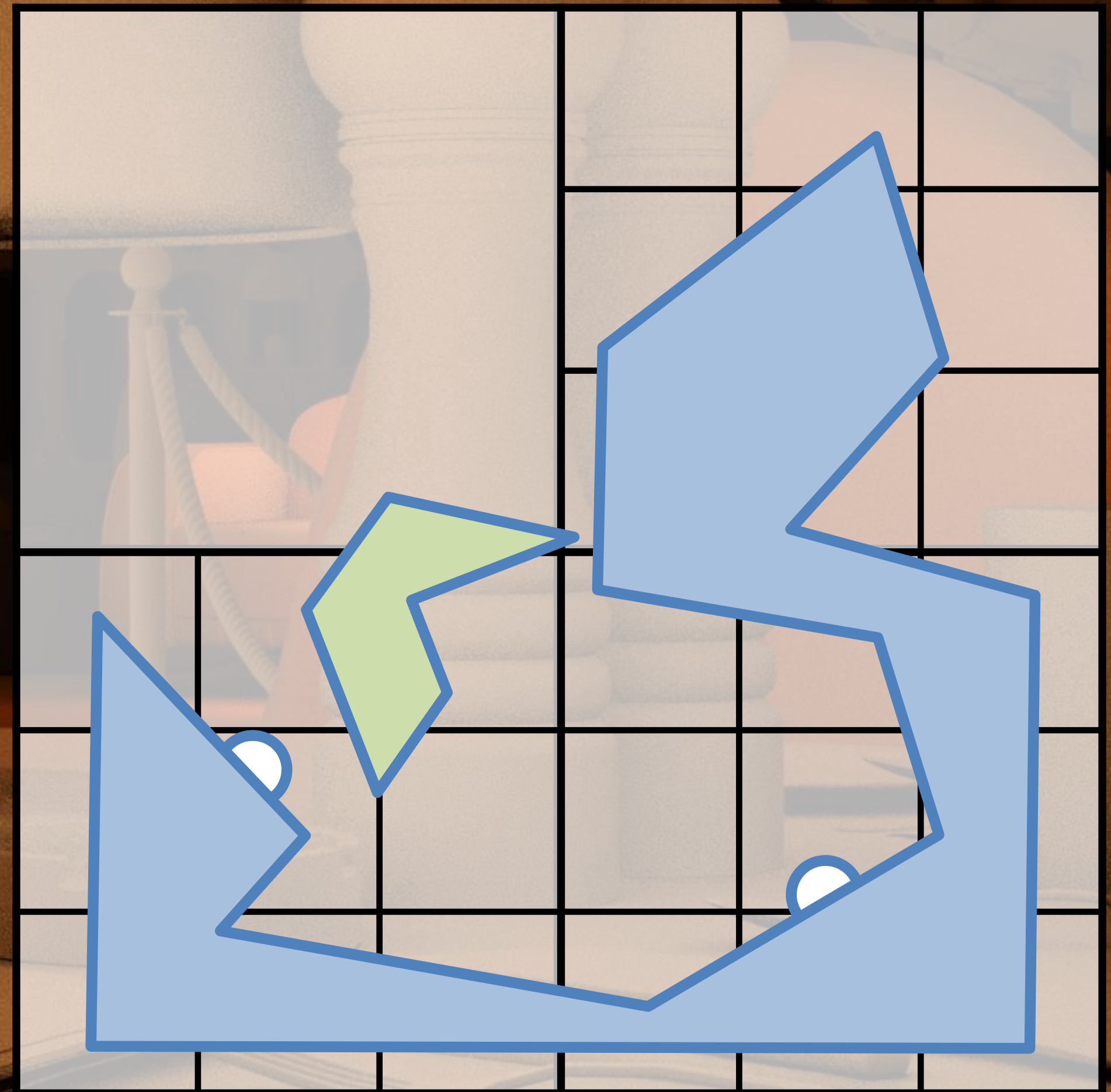
Indirect Diffuse

No contribution from
dynamic geometry



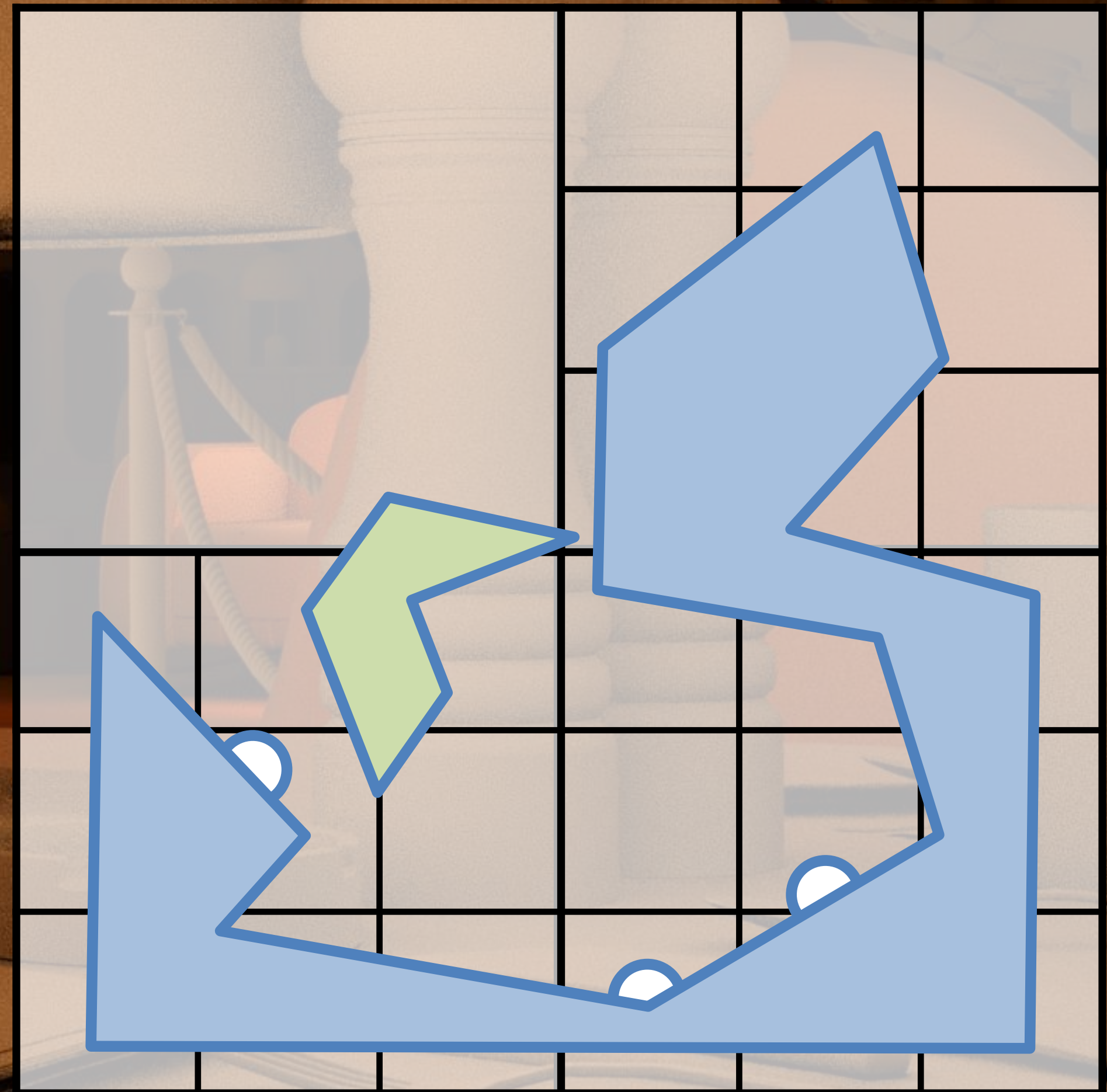
Indirect Diffuse

Trilinear sampling creates
stair casing



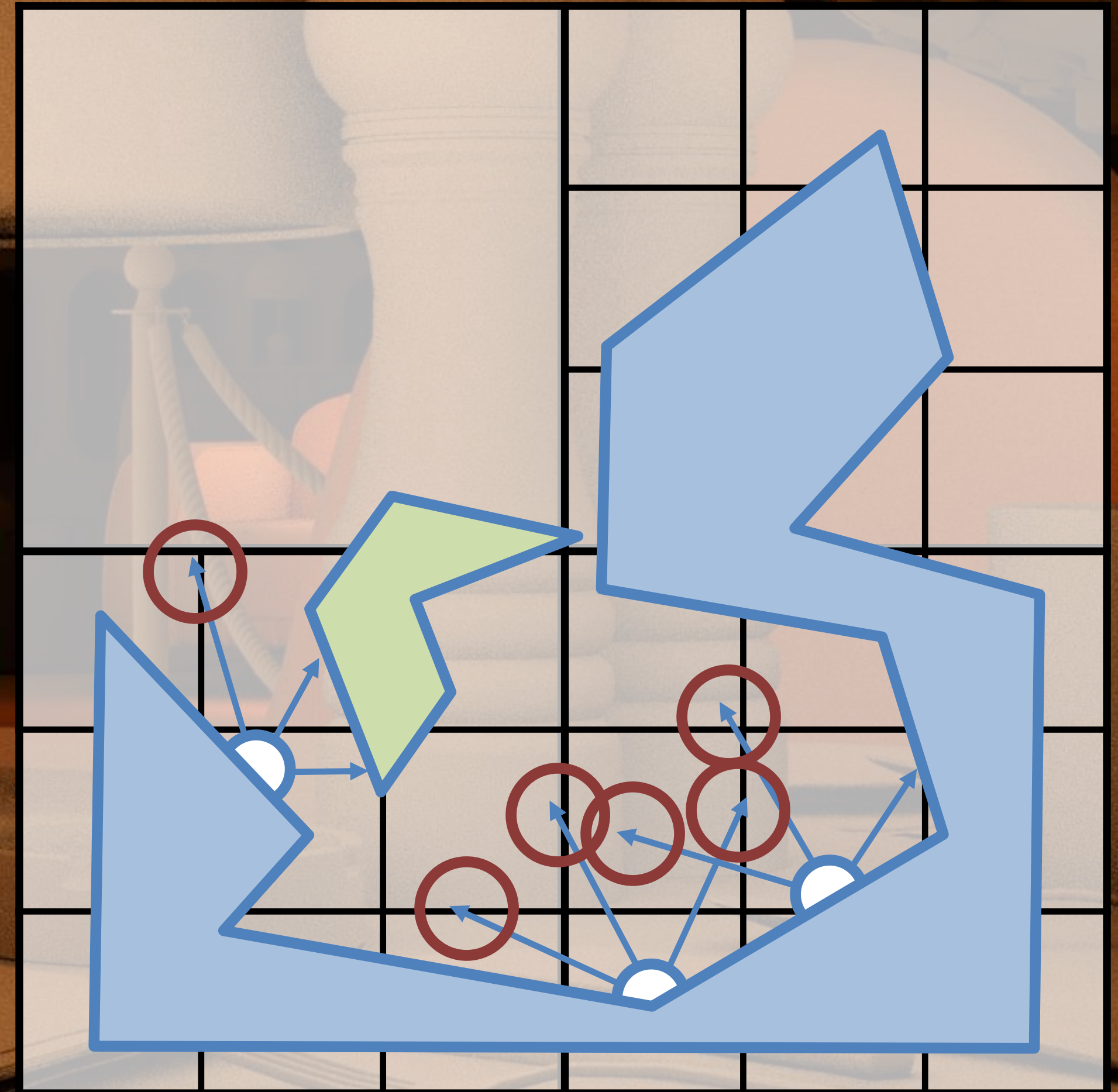
Indirect Diffuse

Thin geometry causes light
leaking



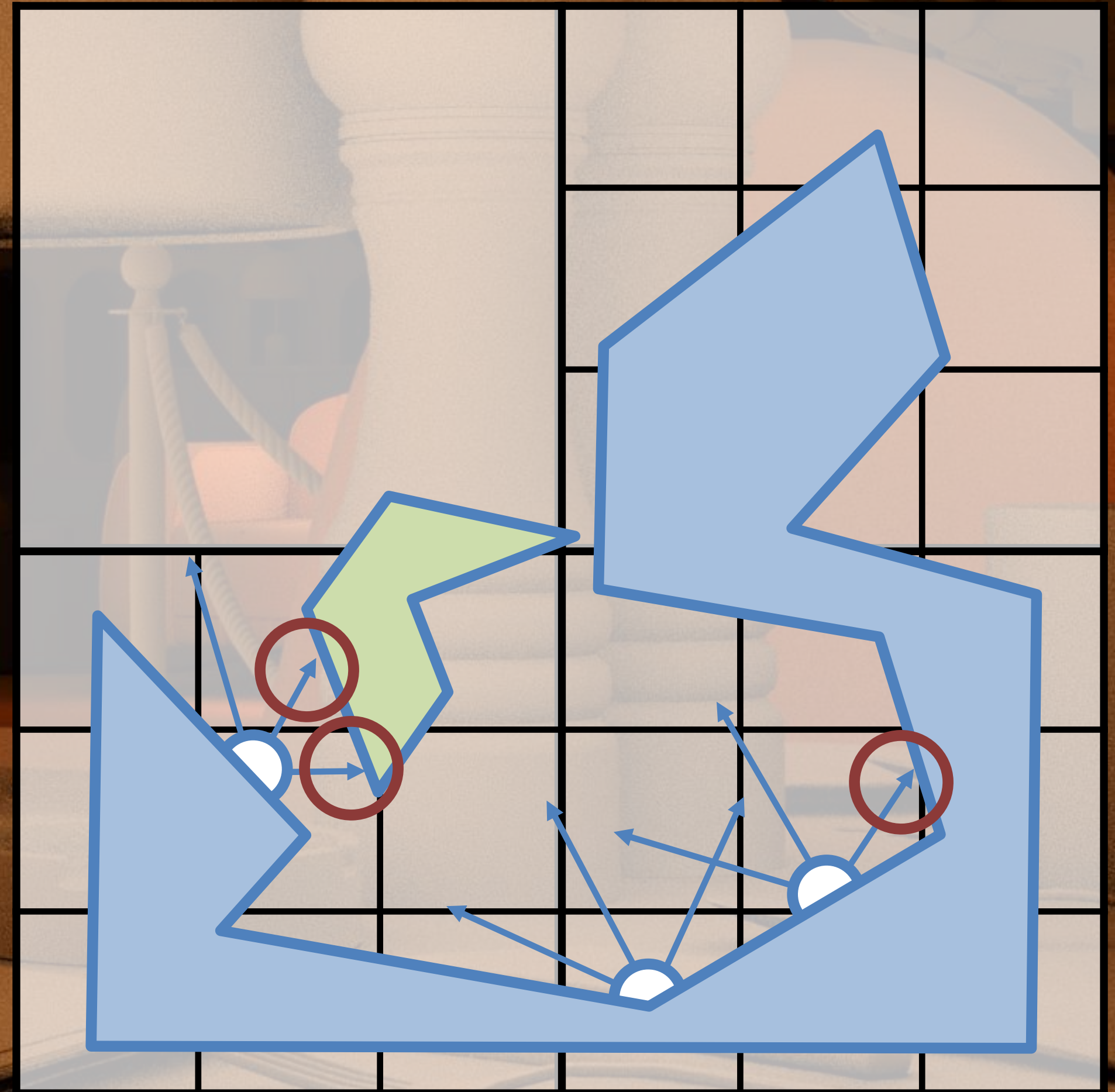
Indirect Diffuse

Gather lighting by
sampling radiance over
cosine distribution



Indirect Diffuse

Account missing geometry



Indirect Diffuse



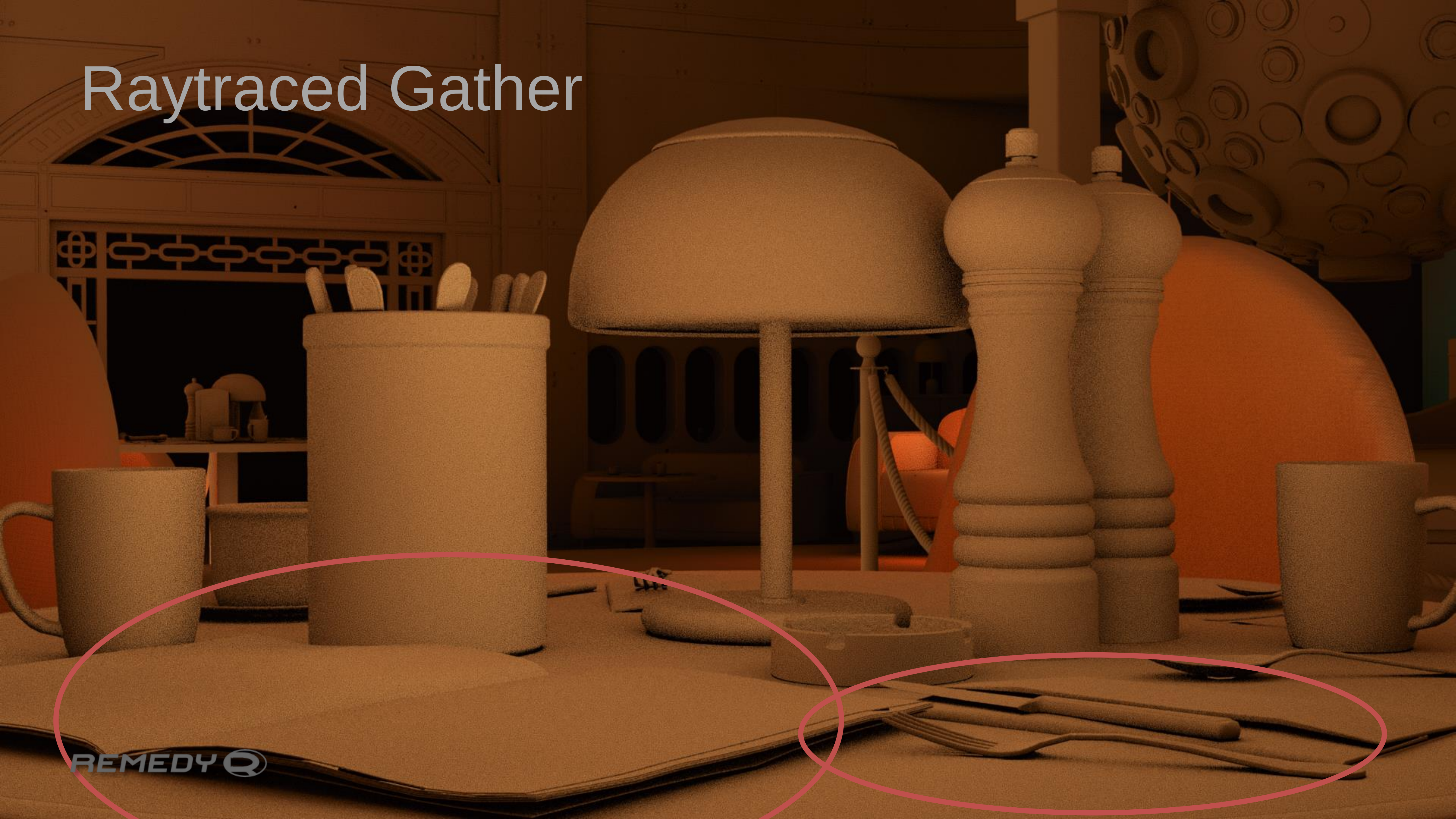
Indirect Diffuse



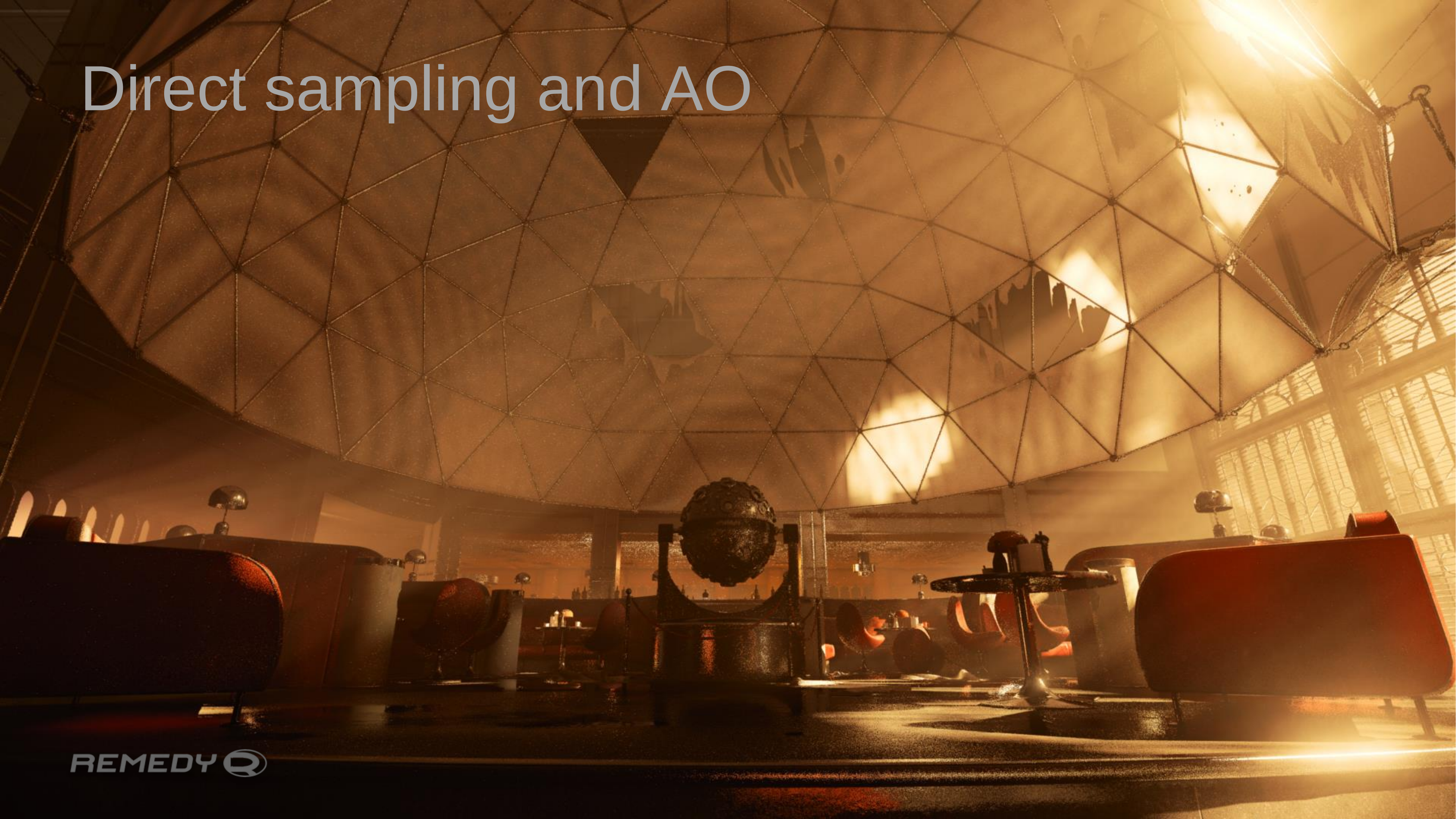
Direct sampling and AO



Raytraced Gather



Direct sampling and AO

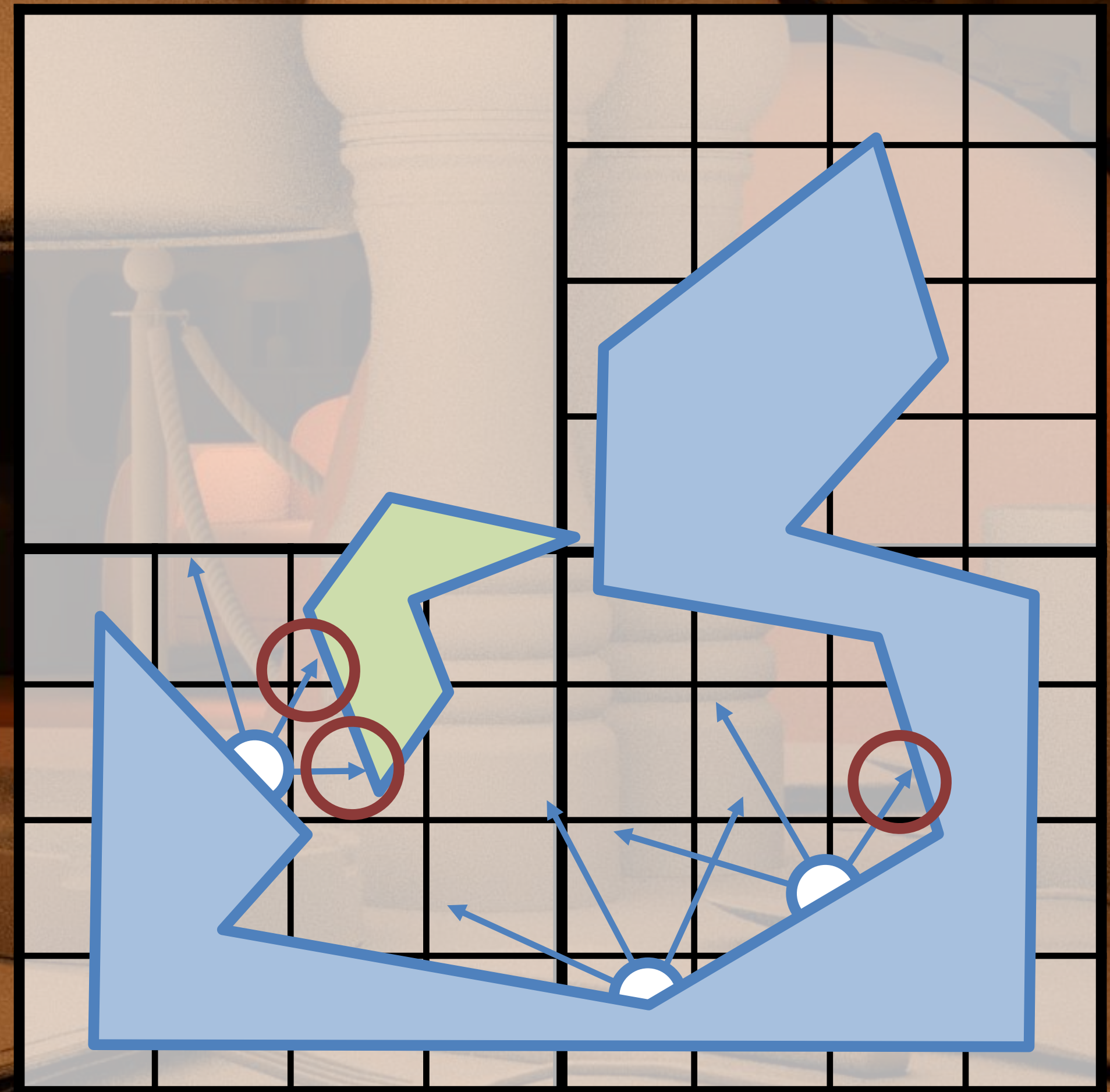


Raytraced Gather



Indirect Diffuse

We can also sample
lighting on geometry hit



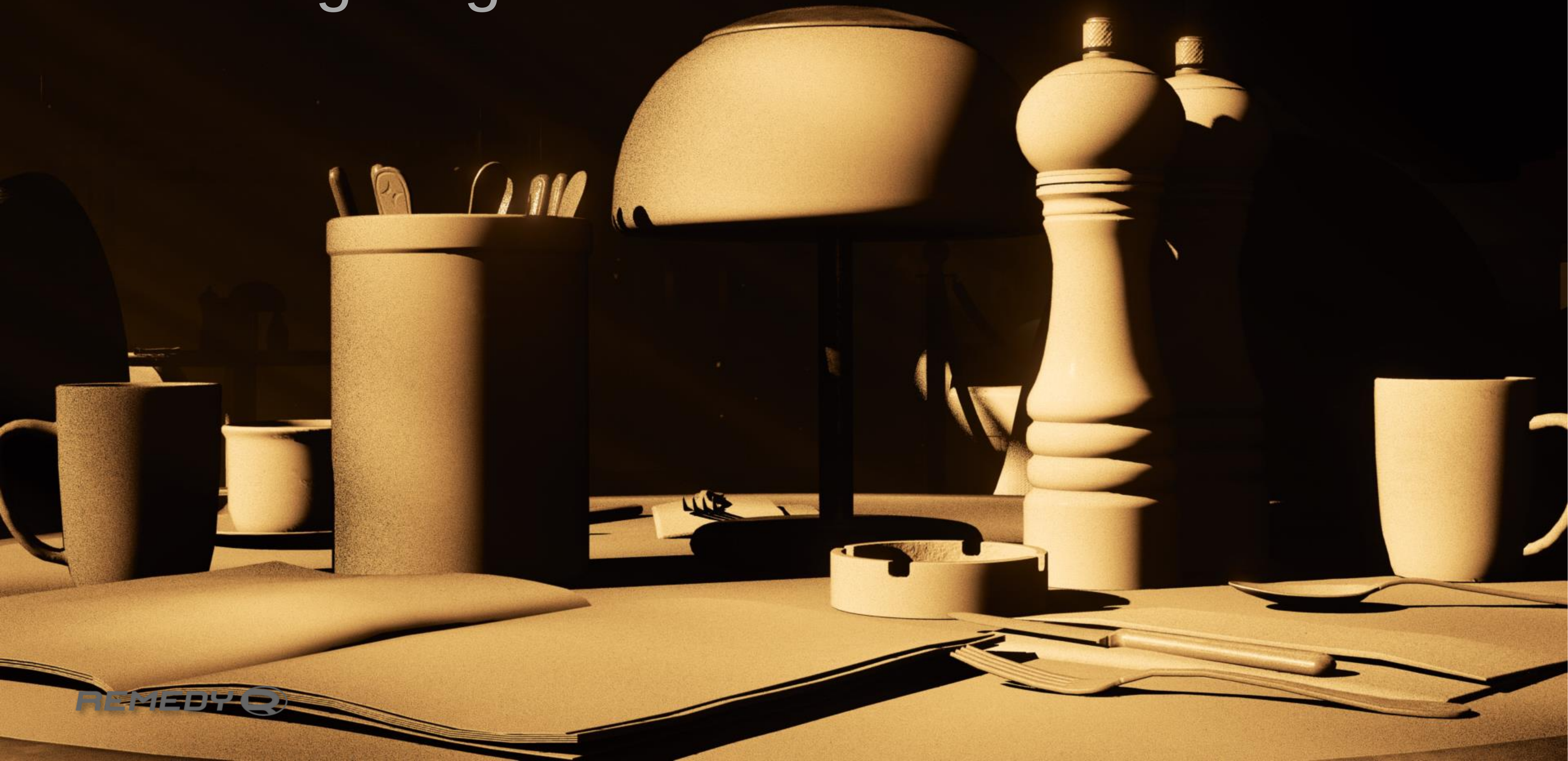
Indirect Diffuse



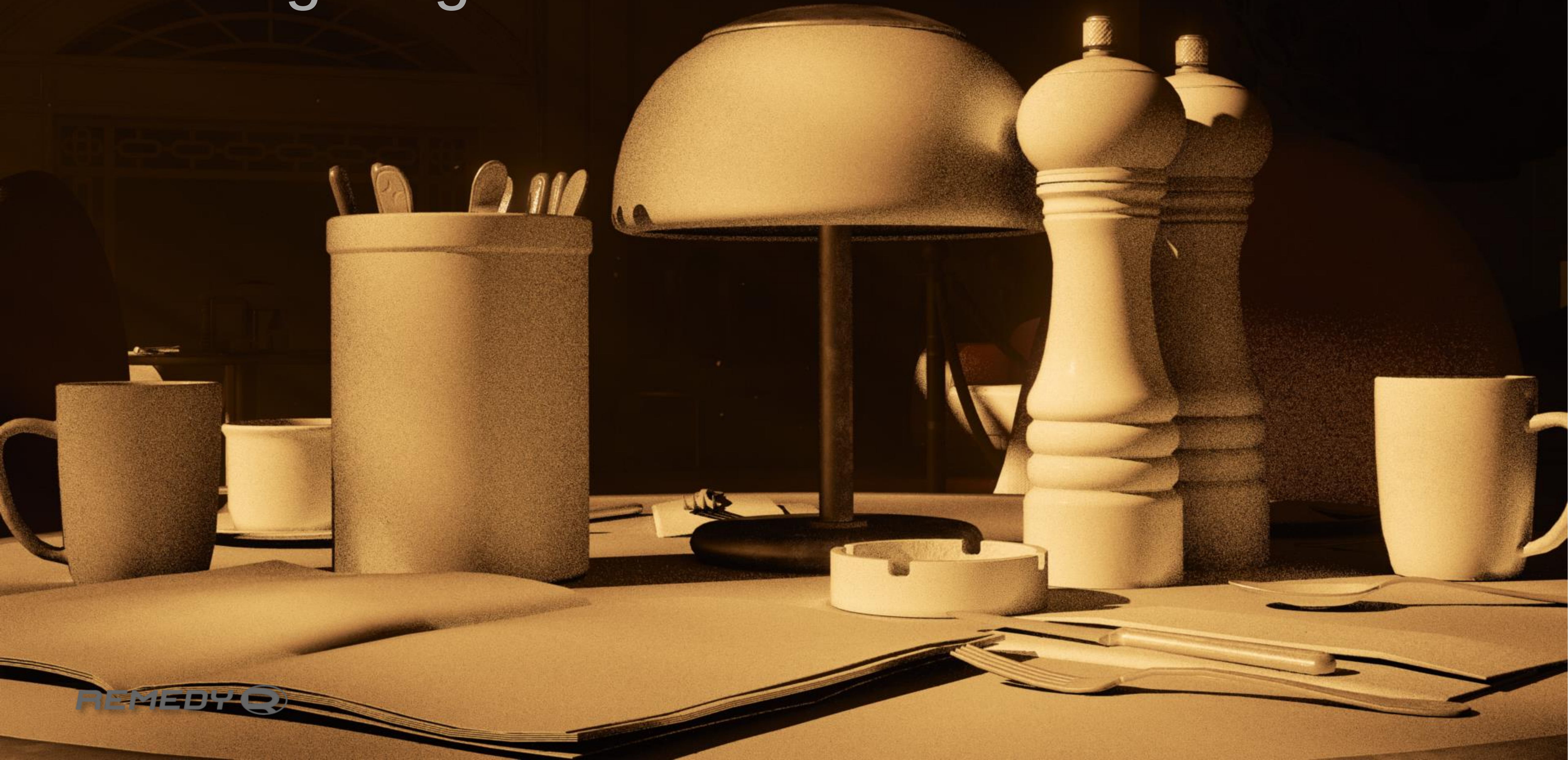
Indirect Diffuse



Direct lighting



Final lighting without reflections



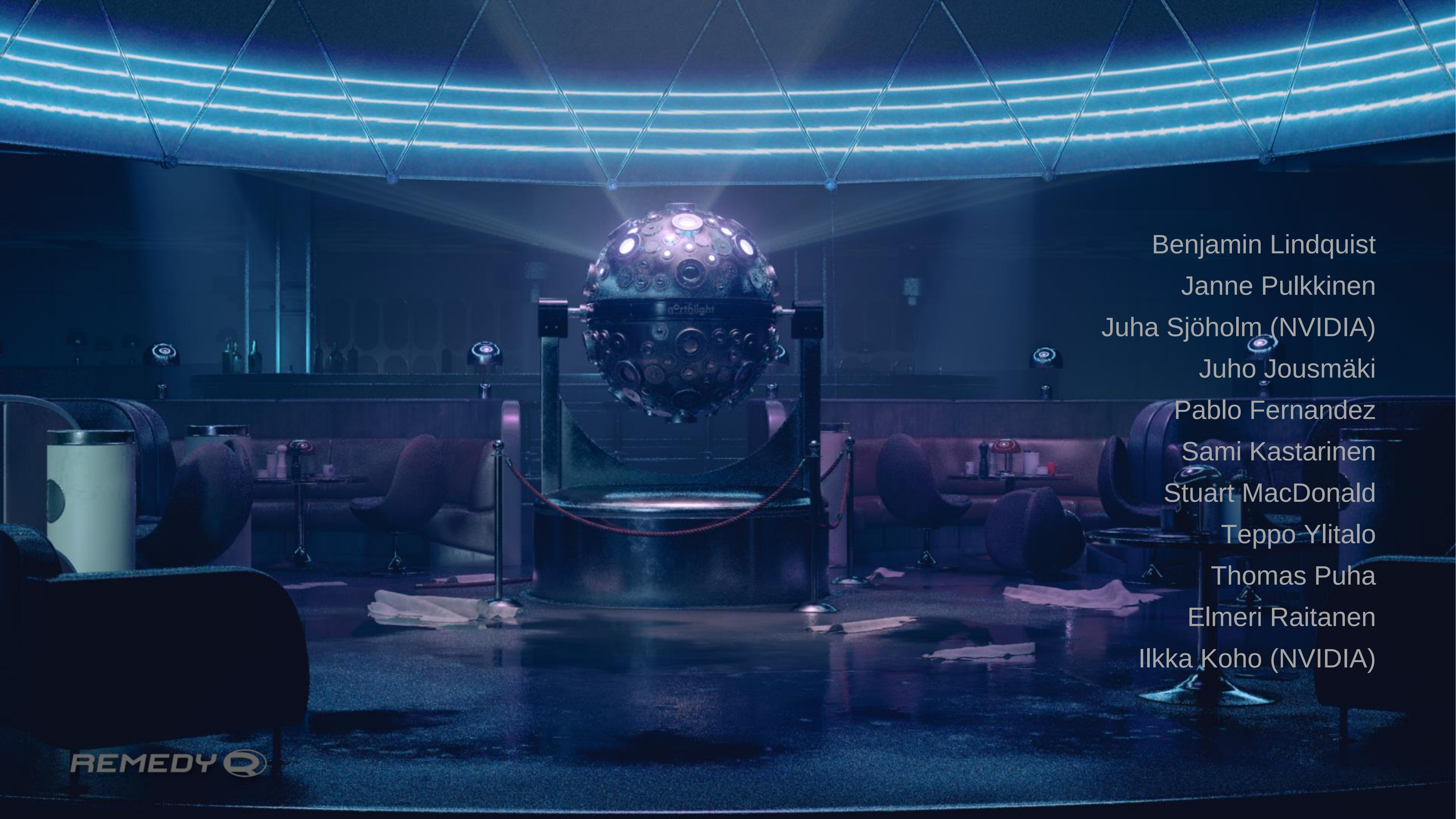
Final Lighting





Summary

- Easy access to state of the art GPU raytracing via DXR
- Performance is getting there
- Easy to prototype algorithms that don't fit to rasterisation
- Possible to combine with existing low frequency structures



Benjamin Lindquist
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Juha Sjöholm (NVIDIA)
Juho Jousmäki
Pablo Fernandez
Sami Kastarinen
Stuart MacDonald
Teppo Ylitalo
Thomas Puha
Elmeri Raitanen
Ilkka Koho (NVIDIA)

The image depicts a futuristic, circular interior space. The ceiling is a large, illuminated geodesic dome with glowing blue lines forming concentric circles. The floor is dark and reflective. In the center, a spherical, metallic object with intricate details sits on a pedestal, surrounded by a red rope barrier. The room is furnished with dark, curved seating and small tables. The overall atmosphere is high-tech and mysterious.

HIRING

