



中国移动开发者大会  
Mobile Developer Conference China 2016

# 将桌面级VR通过Vulkan和UE4移植到移动平台

# 总概

- 项目目的
- 平台差距
- 准备工作
- 对比Vulkan和GLSL
- 问题与分析
- 执行优化
- 遇到的困难

# 项目目的

- 探索移动平台VR效果的极限
- 探索UE4下移动端， Vulkan+VR流程/当前问题

# THE "SHOWDOWN" DEMO



# 平台的差距

2160 x 1200

90 fps

GTX 970

Instanced Stereo

Deferred Renderer

DX11

2560x1440? (1920 x 1080)

60 fps

Adreno 530

Multi-view?

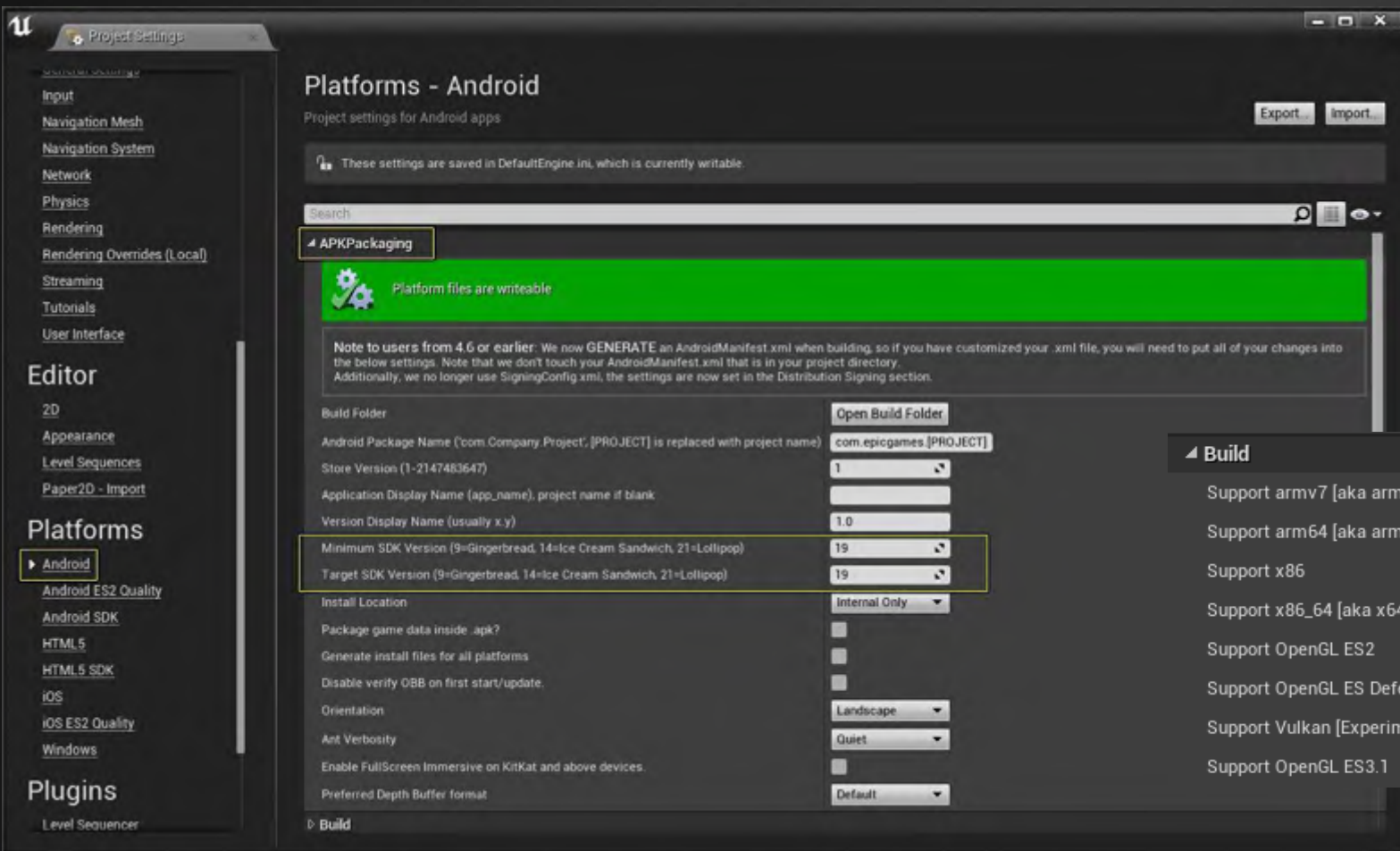
Mobile Forward Renderer

Vulkan?

# 准备工作

- 硬件： Galaxy S7(latest rom), Nexus 6P(Android N)?
- 桌面开发环境驱动：
  - Nvidia: Driver > 367.27
  - AMD: Driver > 16.3
  - UE: >= 4.13(4.14) 源码版本
- Vulkan SDK：
  - 最新（<https://vulkan.lunarg.com/signin>）
  - 确定环境变量中有VULKAN\_SDK指向SDK目录

# 准备工作



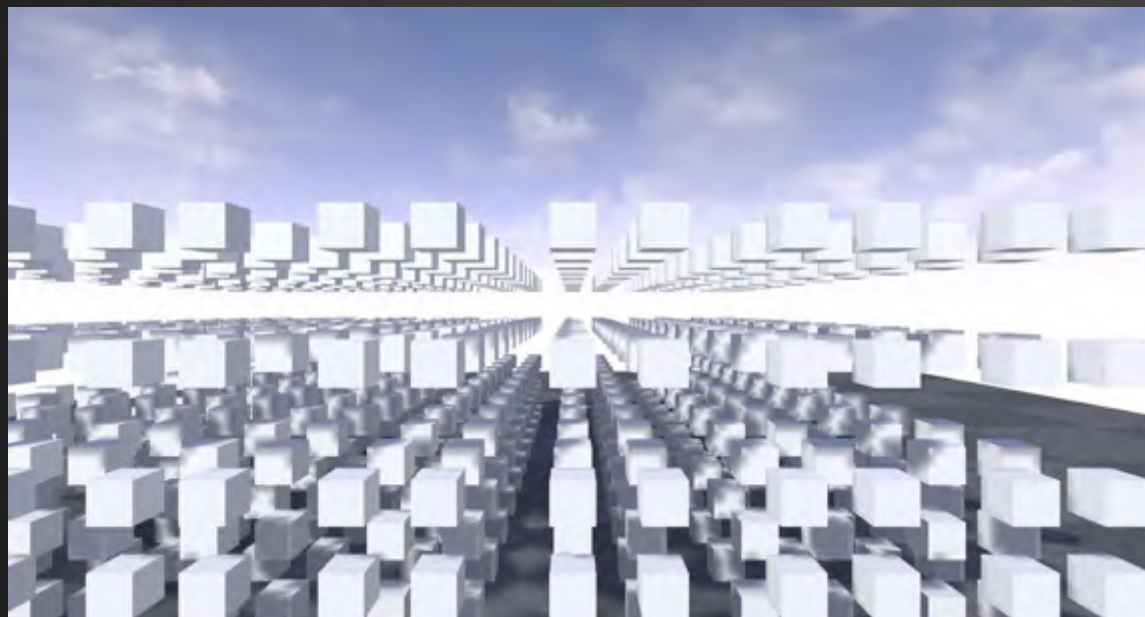
# 准备工作

- 因为需要反复比较和迭代，所以需要提高迭代效率
  - 打开Shader分布式编译
  - 设置好Swarm
  - SharedDDC: DefaultEngine.ini中[DerivedDataBackendGraph]中加入Shared路径共享shader cache和cook数据
  - ResavePackagesCommendlet:
    - GarbageCollectionFrequency=100
    - -StripEditorOnly -OnlySaveDirtyPacakges -IgnoreChangelist
- Packaing和cooking设置
  - Cook only maps, 指定入口地图
  - 压缩pak (压缩解压的cpu时间比把更大的obb推到手机上要快很多)
  - 去除EditorContent
  - Build/Android/PakBlacklist.txt
    - ../../../../Engine/Content/EngineDebugMaterials/
    - etc



# 准备工作

先拿个测试场景做一下Vulkan和ES的比较吧



# ES2/3.1 vs Vulkan

## OpenGL:

如果compile出错，在运行时会crash

做绘制调用的时候会有hitch，驱动只在第一次绘制时才真的编译

## Vulkan:

可离线编译shader

在开发时可编译成SPIR-V二进制数据

所有shader的验证都在离线时完成

所有上层的shader优化都在离线时完成

# ES2/3.1 vs Vulkan

## OpenGL:

Set vertex and pixel shaders

Shader uniform parameters

Bound textures

Set blending states

Set depth states

Set rasterizer states

Etc...

## Vulkan:

把这些属性和状态都封装在一个对象中  
切换不同的状态相当高效!

# ES2/3.1 vs Vulkan

Vulkan有显式的RenderPass

```
vkBeginRenderPass(...)
```

```
vkEndRenderPass(...)
```

每个render pass可以指定哪些数据需要load到tile memory里，哪些数据需要存回framebuffer

# 测试结果

Counters	Average	Max
Present time	1.70 ms	1.97 ms
Mesh draw calls	1,071.00	1,071.00
Static list draw calls	1,071.00	1,071.00
Lights in scene		8.00
Translucency GPU Time (MS)	0.00	0.00

Mobile HDR is enabled  
Bloom is enabled  
Separate Translucency is enabled  
Motion Blur is enabled  
Auto Exposure is enabled  
Ambient Occlusion is enabled  
Lens Flares (Image based) is disabled  
Anti-Aliasing Method is Temporal AA  
Use Mouse for Touch is disabled  
Use Splitscreen is enabled

Mobile HDR is disabled (modified)  
Bloom is disabled (modified)  
Separate Translucency is disabled (modified)  
Motion Blur is disabled (modified)  
Auto Exposure is disabled (modified)  
Ambient Occlusion is disabled (modified)  
Lens Flares (Image based) is disabled  
Anti-Aliasing Method is None (modified)  
Use Mouse for Touch is enabled (modified)  
Use Splitscreen is disabled (modified)

# 问题与分析

当前数据:

800+ drawcall

120w+面

有部分复杂度一般的matinee和bp逻辑

有大量对移动平台来说过于复杂的材质

大量粒子的overdraw

静态光照为主，不投影

# 问题与分析

普通的优化策略:

查找瓶颈()

{

    return max3(逻辑线程开销, 渲染线程开销, gpu开销);

}

While( 测试帧数 < 目标帧数 )

{

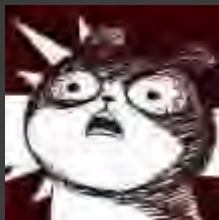
    瓶颈对象 = 查找瓶颈();

    优化(瓶颈对象);

}

# 问题与分析

那我们开始吧！  
先定位瓶颈？  
不，先要能跑起来。



Crash主要来自于：

- 内存爆炸
  - 最大的数据来源于贴图 – 强制在DeviceProfile中把所有的TextureGroup的LODBias先改成2
  - JVM出事堆内存过高 – 手动设置layout
- 一些不支持的shader没有fallback回default
  - 手动删除导致crash的材质
- vkAllocateMemory超过设备上限(S7上4096)
  - 暂时先用MergeActor工具强制合并了大量mesh和材质

以下省略1000字和各种琐碎的crash做斗争。。。





# 问题与分析

跑起来了（非VR）！



开始定位瓶颈：

stat unit

game 80ms

render 80ms

gpu 80ms



任何地方都是瓶颈！

怎么才能简单粗暴的找出合适的优化目标呢？

# 问题与分析

- GPU:
  - simplygon直接减面合并放到LOD中，强制所有meshactor使用LOD1
  - 关闭MobileHDR
  - MaterialQuality设置
    - Force Fully Rough, Force Non-metal, Disable Lightmap directionality, Force low quality reflections
  - r.MobileContentScaleFactor 0.5
    - 为了能快速迭代，我稍微改了下引擎，让这个值可以实时生效
- CPU:
  - 逻辑线程：为什么逻辑线程也会要那么久？不科学！
    - Stat startfile/stopfile, stat dumpave -ms=1
    - 竟然没有启用渲染线程！
    - ToggleRenderingThread
    - NativizeBP - 8ms -> 2.5ms !
  - 渲染线程：
    - 同GPU的优化合并MeshActor和材质的时候一并降低了开销

# 问题与分析

- 非VR下能跑到60fps了！
- 通过这些测试，能确定在这个复杂度的场景下，单屏渲染线程瓶颈的阈值在差不多500 dc
- 渲染分辨率在720p的时候，瓶颈在渲染线程(13ms)
- 1080p后到gpu上(16ms)
- 接下来就是细节优化和放大部分渲染参数来迭代了

# 问题与分析

- 最终没能做到在S7 GearVR上跑到60fps
  - 对于MultiView的支持还没有完成
    - 目前只支持PS4， Mobile的版本可能在这两周会有一个内部的版本
    - DD的Scanline
  - GearVR和DD的Compositor还没有完好的支持vulkan的实现
    - 在下个月应该就会有更新
  - Vulkan还在进化中
  - UE4对于Vulkan的支持还有很多改善空间
    - 正在让更多上层逻辑变得更PSO-awareness
    - RHI的refactor

# 内容优化

- 顶点数;
- Actor数量;
- 材质数量;
- 材质复杂度;
- 贴图尺寸;
- 渲染品质设置;

# Statistics

Primitive Stats Refresh Export

Object	Actor(s)	Type	Count	Inst Sections	Tris	Sum Tris	Size	VC	
SK_InfiltratorOculus	7 Actors	SkeletalMesh	7	56	60,688	424,816	24,688.00 KB	0	
SM_BankSet_Tiling04	Actors	StaticMesh	4	28	7,866	31,464	433.0860 KB	0	
SM_Midtown05_Build3	Actors	StaticMesh	3	27	7,136	21,408	473.3550 KB	0	
SM_CinderBlockSet_5	Actors	StaticMesh	5	20	1,025	5,125	86.0250 KB	6	
SM_HU_Deco_Sm_B19	Actors	StaticMesh	19	19	2,248	42,712	133.2270 KB	0	
Set_Corner17	Actors	StaticMesh	17	17	584	9,928	42.6250 KB	0	
b	7 Actors	StaticMesh	17	17	10	170	6.51 KB	0 KB	0
Deco_Street16	Actors	StaticMesh	16	16	500	8,000	41.9770 KB	0	

Primitive Stats Refresh Export

Object	Actor(s)	Type	Count	Inst Sections	Tris	Sum Tris
SK_InfiltratorOculus	7 Actors	SkeletalMesh	7	56	60,688	424,816
SM_RocketTrail	3 Actors	StaticMesh	3	3	102,400	307,200
teds	explosionme	StaticMesh	1	1	159,200	159,200
SK_Samaritan_Bot_G	BP_Bot_C_1	SkeletalMesh	1	7	96,536	96,536
SK_Oculus_Male	SK_Oculus_M	SkeletalMesh	1	2	78,976	78,976
SM_HU_Deco_Sm_Bc19	Actors	StaticMesh	19	19	2,248	42,712
SM_NYC_Deco_Exter4	Actors	StaticMesh	4	8	8,372	33,488
SM_BankSet_Tiling014	Actors	StaticMesh	4	28	7,866	31,464
SM_CarExplosionCus	SM_CarExplo	StaticMesh	1	1	25,105	25,105
SM_MET_Car_Interior	SM_MET_Cor	StaticMesh	1	5	22,334	22,334
CivilianCar_NoGlass	CarFlip	StaticMesh	1	4	21,856	21,856
SM_Midtown05_Build3	Actors	StaticMesh	3	27	7,136	21,408
SM_HU_Deco_SM_Tr13	Actors	StaticMesh	13	13	1,609	20,917
CarWithoutWheels	BP_Car_C_1	StaticMesh	1	5	20,852	20,852
MatineeCam_SM	4 Actors	StaticMesh	4	4	4,528	18,112
SM_HU_Deco_SM_Tr15	Actors	StaticMesh	15	15	1,167	17,505
VrRoom_ROOT_floor	VrRoom_ROC	StaticMesh	1	1	17,376	17,376
SM_GEN_Sign_LowPr	SM_GEN_Sig	StaticMesh	1	2	17,350	17,350
SM_BuildingFull1	SM_BuildingF	StaticMesh	1	4	14,251	14,251
SM_CinderBlockSet_17	Actors	StaticMesh	7	14	1,868	13,076
SM_BGBuilding5	7 Actors	StaticMesh	7	7	1,794	12,558
SM_Midtown05_Build	SM_Midtown	StaticMesh	1	4	11,802	11,802
S_MET_Vehicles_Tax	S_MET_Vehic	StaticMesh	1	1	11,080	11,080
SM_GEN_Sign_BIGXX	SM_GEN_Sig	StaticMesh	1	2	10,782	10,782
SK_Oculus_Male_Head	Head	SkeletalMesh	1	2	10,606	10,606

Primitive Stats Refresh Export

Object	Actor(s)	Type	Count	Inst Sections
SM_HU_Deco_Sm_Box19	Actors	StaticMesh	19	19
SM_ShopSet_Corner_17	Actors	StaticMesh	17	17
CircleBlob	7 Actors	StaticMesh	17	17
SM_NYC_Deco_Street16	Actors	StaticMesh	16	16
SM_HU_Deco_SM_Tra15	Actors	StaticMesh	15	15
SM_HU_Deco_SM_Tra13	Actors	StaticMesh	13	13
SM_OverPassPillar	8 Actors	StaticMesh	8	8
SM_ColaCan	8 Actors	StaticMesh	8	8
SM_HU_Deco_SM_Tra8	Actors	StaticMesh	8	8
SM_ColaCan2	8 Actors	StaticMesh	8	8
SM_NYC_Deco_Exteric7	Actors	StaticMesh	7	7
SK_InfiltratorOculus	7 Actors	SkeletalMesh	7	56
SM_CinderBlockSet_W7	Actors	StaticMesh	7	14
SM_BGBuilding5	7 Actors	StaticMesh	7	7
SM_HU_Deco_SM_Tra6	Actors	StaticMesh	6	6
SM_CinderBlockSet_S5	Actors	StaticMesh	5	20
SM_TrashBag_03_High5	Actors	StaticMesh	5	5
SM_CinderBlockSet_W4	Actors	StaticMesh	4	8
SM_Midtown05_BuildC4	Actors	StaticMesh	4	4
WheelStandalone	BP_Car_C_1	StaticMesh	4	4
SM_Overpass	4 Actors	StaticMesh	4	4
SM_BankSet_Tiling01	4 Actors	StaticMesh	4	28
SM_NYC_Deco_Exteric4	Actors	StaticMesh	4	8
MatineeCam_SM	4 Actors	StaticMesh	4	4

Object	Actor(s)	Type	Count	Inst Sections	Tris	Sum Tris
SK_InfiltratorOculus	7 Actors	SkeletalMesh	397	640	890,419	1,768,477
			7	56	60,688	424,816





# 烘焙合并材质

**Capture Settings**

Render Type: Unwrapped Mesh

Viewport Size (See Tooltip): 1024

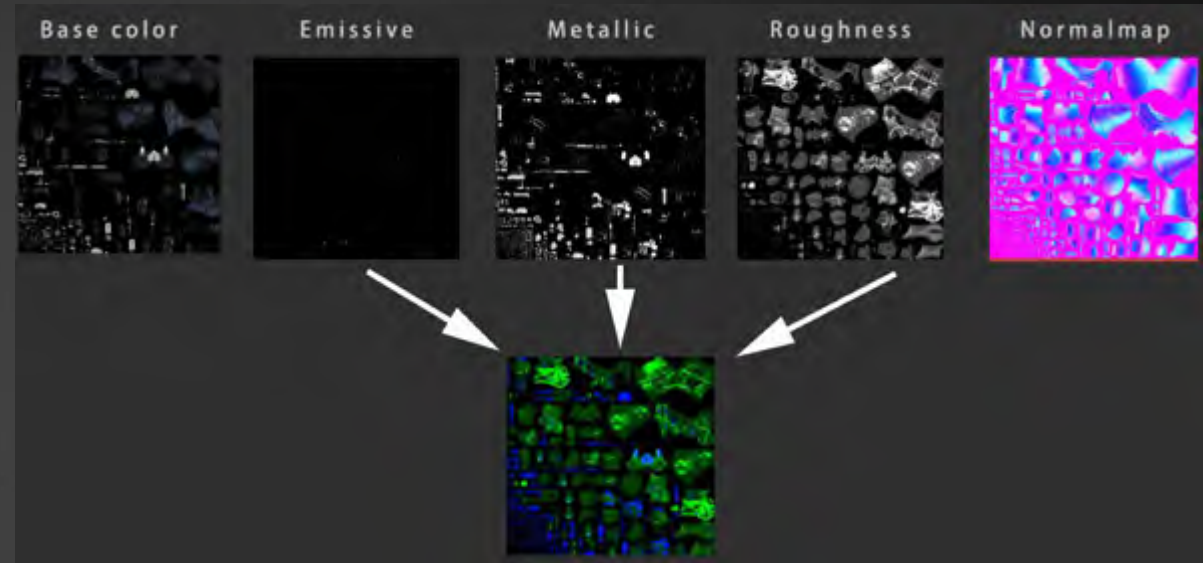
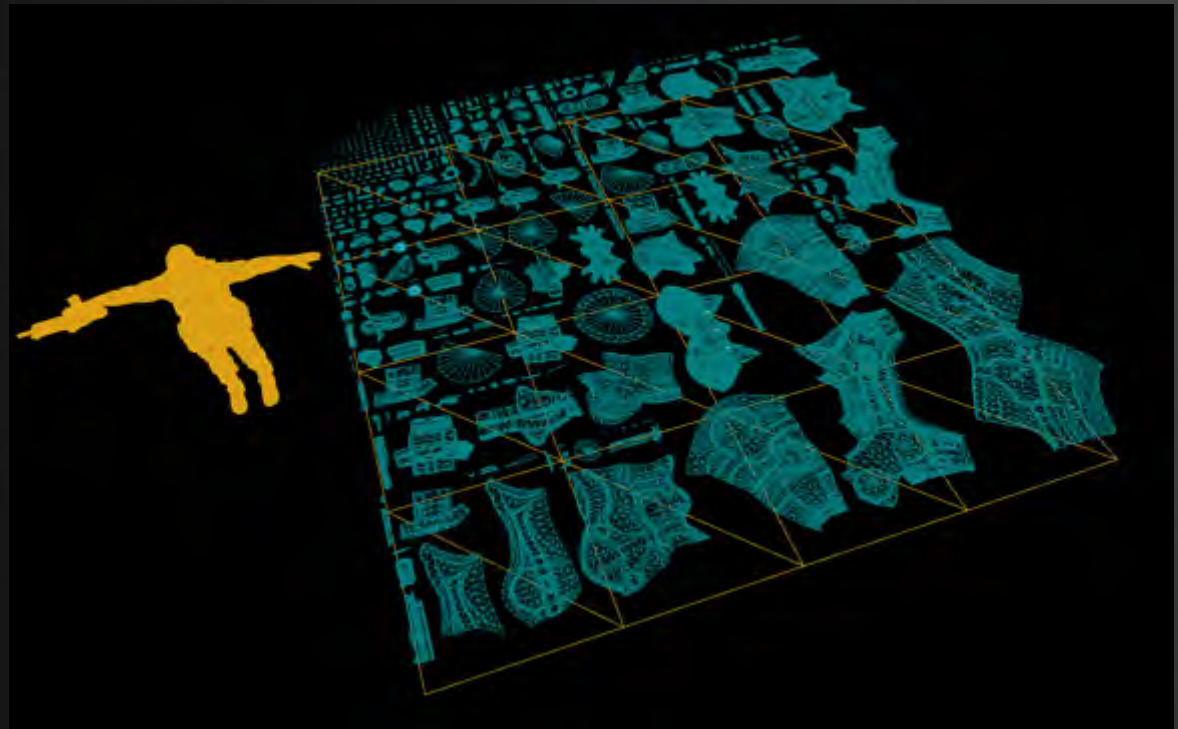
Resolution Multiplier: 3

**Render Unwrapped Mesh**

Render To Texture Mesh: SK\_InfiltratorOculus\_static

Unwrap:

- Base Color
- Specular
- Metallic
- Normal
- Opacity
- Roughness
- Ambient Occlusion
- Material Ambient Occlusion
- Decal Mask
- Lighting Only
- Subsurface Color
- Scene Depth World Units



TexCoord[1]

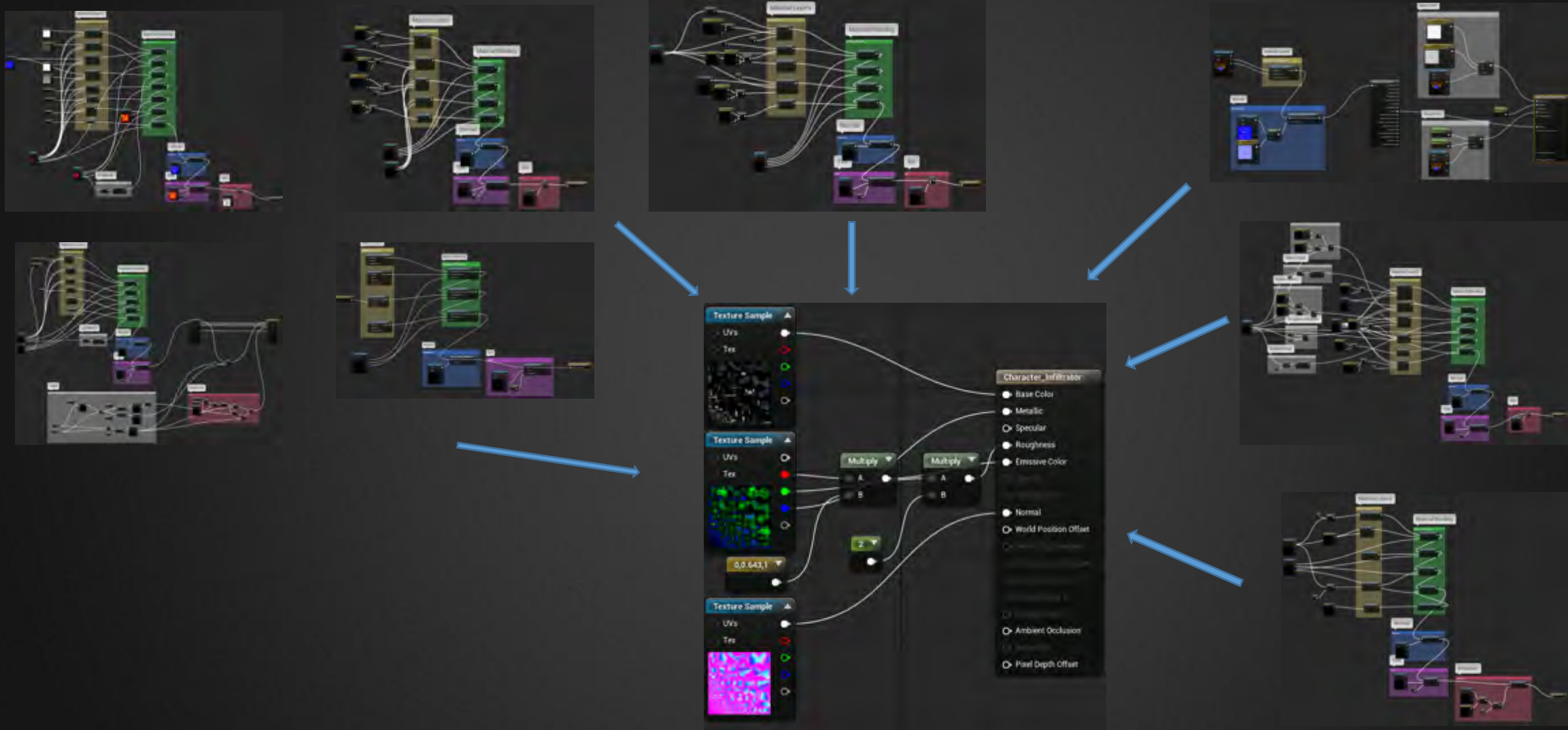
**UnwrapUVsForRender**

- UVs (V2)
- Frontface or Backface (S)
- WorldPositionOffset

Mask

- Normal
- World Position Offset
- World Displacement
- Tessellation Multiplier
- Subsurface Color
- Quads VSM (Q)

# 烘培合并材质



# 烘焙合并材质

Statistics

Texture Stats Refresh Export **优化前贴图使用情况**

Name	Actor(s)
T_RocketSmoke_M	CharacterSkelMeshes_C_6
Inf11_Redshirt_Torso_N	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Legs_MaterialMask01	CharacterSkelMeshes_C_6
Inf11_Redshirt_Legs_N	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Helmet_DetailMask01	CharacterSkelMeshes_C_6
Inf11_Redshirt_Helmet_N	CharacterSkelMeshes_C_6
T_Concrete01_D	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Torso_MaterialMask01	CharacterSkelMeshes_C_6
T_Metal_Tiling01_N	CharacterSkelMeshes_C_6
T_Infil1_ArmorMetal01_N	CharacterSkelMeshes_C_6
TilingNoise05_N	CharacterSkelMeshes_C_6
Inf11_Infil3_v3_normals	CharacterSkelMeshes_C_6
Inf11_Redshirt_Head_Arms_N	CharacterSkelMeshes_C_6
T_Infil1_MilitaryFabric01_N	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Helmet_MaterialMask01	CharacterSkelMeshes_C_6
T_Infil1_Infil3_v3_M	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Pouches_MaterialMask01	CharacterSkelMeshes_C_6
T_Infil1_MilitaryFabric01	CharacterSkelMeshes_C_6
T_Metal_Dark_Gun_metal_D	CharacterSkelMeshes_C_6
T_Metal_Dark_Gun_metal_N	CharacterSkelMeshes_C_6
Inf11_Redshirt_Pouches_N	CharacterSkelMeshes_C_6
Inf11_Infil3_v3_HoloScope_normals	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Helmet_DetailMask02	CharacterSkelMeshes_C_6
Inf11_Infil3_v3_emissive	CharacterSkelMeshes_C_6
Inf11_Infil3_v3_HoloScope_M	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Arms_Head_DetailMask01	CharacterSkelMeshes_C_6
T_Camo_Grey01	CharacterSkelMeshes_C_6
Inf11_Infil3_v3_HoloScope_DetailMask	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Torso_DetailMask01	CharacterSkelMeshes_C_6
ML_Light_rubber	CharacterSkelMeshes_C_6
T_Infil1_Infil3_v3_DetailMask	CharacterSkelMeshes_C_6
T_Metal_Metal03_D	CharacterSkelMeshes_C_6
T_ApertureBlades_01	CharacterSkelMeshes_C_6
T_BlobShadow	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Legs_DetailMask01	CharacterSkelMeshes_C_6
A05	CharacterSkelMeshes_C_6
T_Infil1_Metal_Scratches_03_D	CharacterSkelMeshes_C_6
A01	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Pouches_DetailMask01	CharacterSkelMeshes_C_6
A02	CharacterSkelMeshes_C_6
T_Infil1_Fabric_Padded01	CharacterSkelMeshes_C_6
T_Infil1_Fabric_Padded01_normals	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Arms_Head_MaterialMask01	CharacterSkelMeshes_C_6
A03	CharacterSkelMeshes_C_6
T_GreyComposite01	CharacterSkelMeshes_C_6
T_Infil1_ArmorMetal01	CharacterSkelMeshes_C_6
T_ApertureBlades_02	CharacterSkelMeshes_C_6
T_MetalDiscoloration2	CharacterSkelMeshes_C_6
T_Infil1_Redshirt_Pouches_MaterialMask02	CharacterSkelMeshes_C_6
P_Impact_MetalBurst_Electrical_ThumbnailTexture	CharacterSkelMeshes_C_6
T_SparkSingle2	CharacterSkelMeshes_C_6
T_ApertureBlades_03	CharacterSkelMeshes_C_6

Statistics

Texture Stats Refresh Export **Selected Actor(s)**

**优化后**

Name	Actor(s)	Typ	Max	Curr	Form	Group	LOI	Curr	Full	L Use	Las	Path
Character_Base	CharacterSkelMeshes_C_7	21	2,048x2,048	PF	D	Worl	0	2,7302,730	661	109.8	/Game/Chara	
Character_ERM	CharacterSkelMeshes_C_7	21	2,048x2,048	PF	D	Worl	0	2,7302,730	661	456.6	/Game/Chara	
HighresScreenshot00010_WorldNor	CharacterSkelMeshes_C_7	21	2,048x2,048	PF	D	Worl	0	2,7302,730	661	456.6	/Game/Chara	
T_RocketSmoke_M	CharacterSkelMeshes_C_7	21	512x5512x5	PF	F	Worl	2	2,7302,730	661	127.5	/Game/Partic	
P_Impact_MetalBurst_ElectricalThui	CharacterSkelMeshes_C_7	21	512x5512x5	PF	D	Worl	0	170.6	170.68	11	60.80	/Game/Effects
T_SparkSingle2	CharacterSkelMeshes_C_7	21	256x5256x5	PF	D	Worl	0	85.3	85.352	11	74.61	/Game/Effects

# Simplygon 減面

**LOD0**

Character\_Infiltrator

Element 0

- Highlight
- Isolate

Textures

Cast Shadows

Recompute Tangent

Delete

**LOD Info**

6 members

Screen Size: 0.0

LODHysteresis: 0.02

Removed Bones: 0 elements

**LOD: 0**

Current Screen Size: 2.64

Triangles: 60688

Vertices: 37310

UV Channels: 1

Approx Size: 237x75x224

**LOD1 (generated)**

Character\_Infiltrator

Element 0

- Highlight
- Isolate

Textures

Cast Shadows

Recompute Tangent

Delete

**LOD Info**

6 members

Screen Size: 1.0

LODHysteresis: 0.02

Removed Bones: 0 elements

**Reduction Settings**

Percent Triangles: 12.5

Max Deviation: 0.0

**LOD: 1**

Current Screen Size: 2.64

Triangles: 7586

Vertices: 8607

UV Channels: 1

Approx Size: 237x75x224

**Rendering**

**TextureStreaming**

- Ignore Instance for Texture S
- Force Mip Streaming

**LOD**

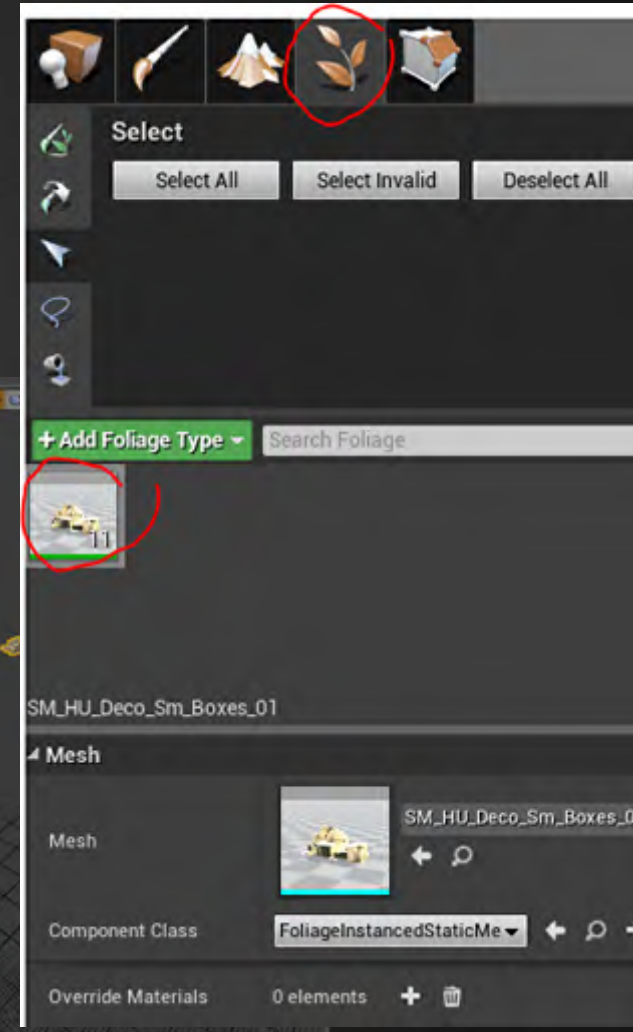
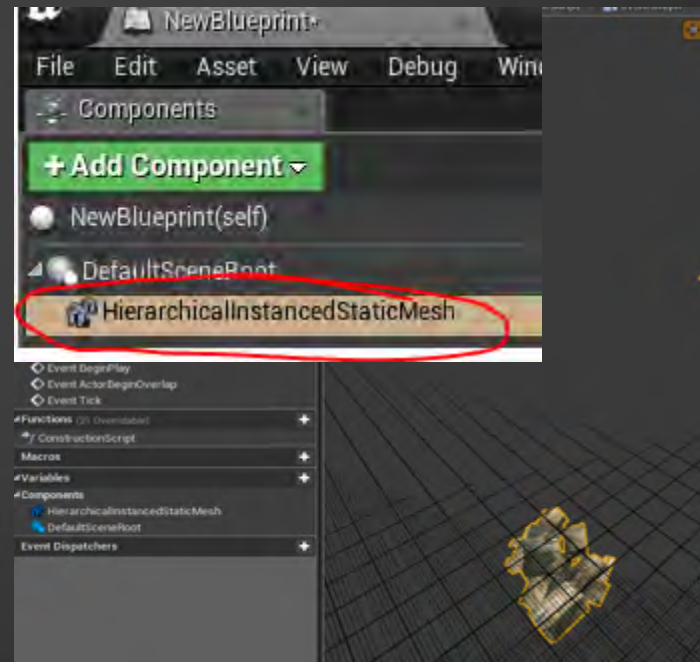
Forced Lod Model: 2

Treat as Background for Occlu

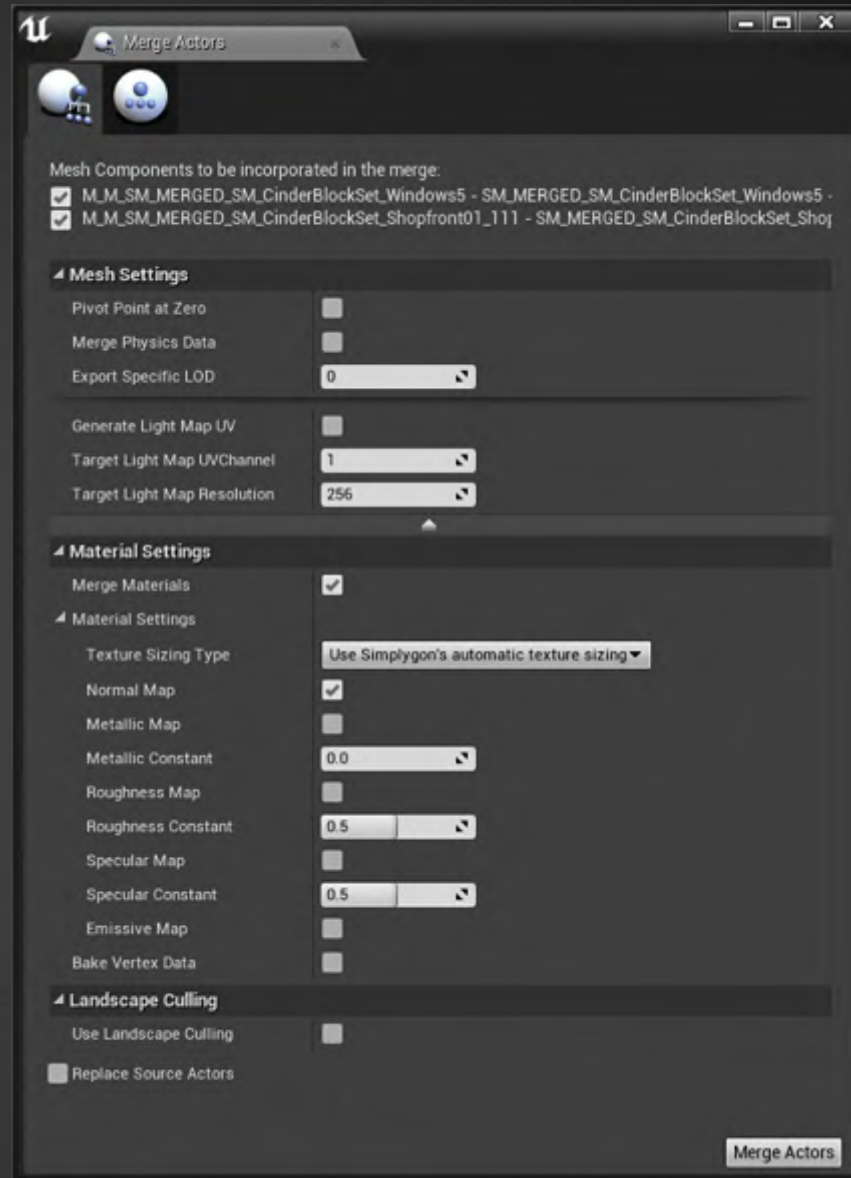
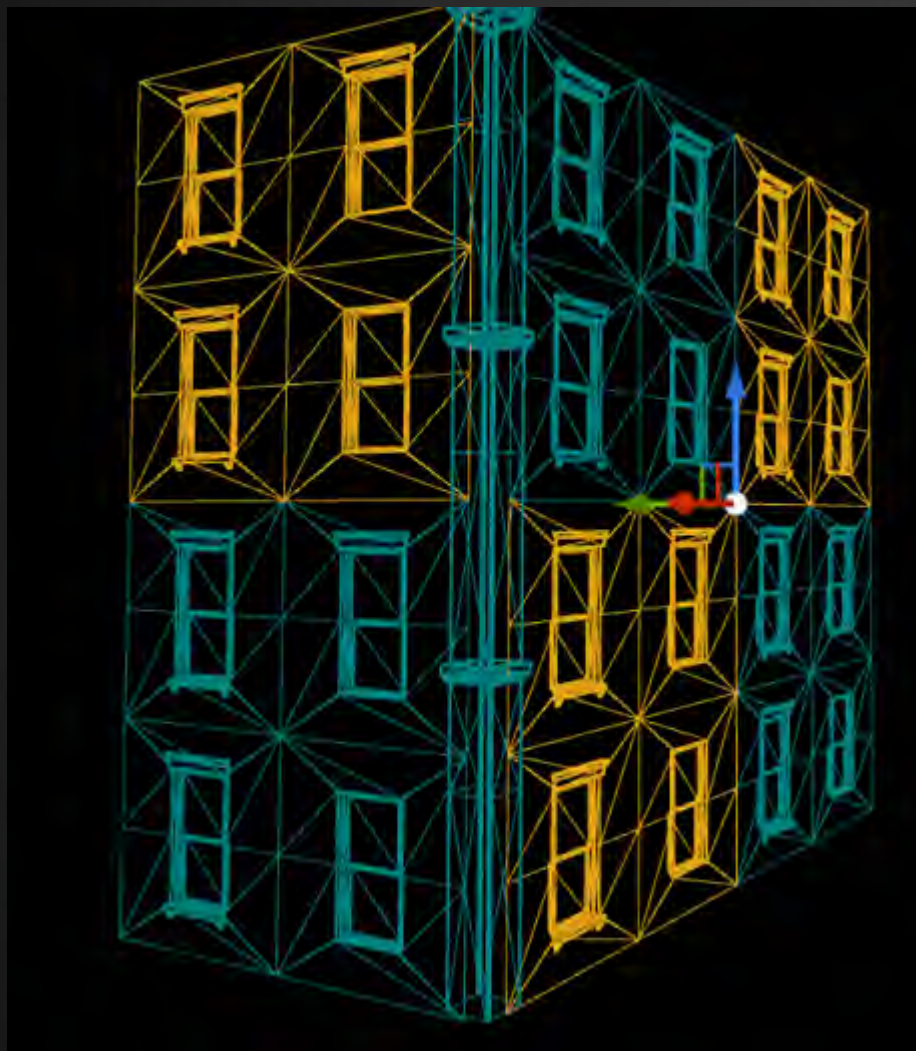
# Instancing Staticmeshes(Batch Staticmeshes)

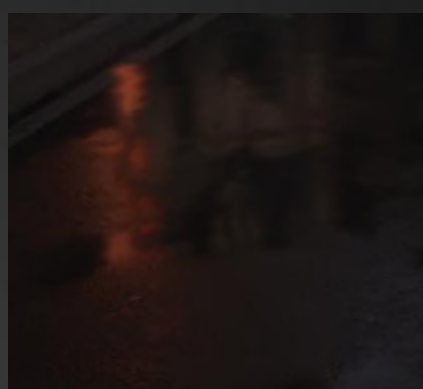
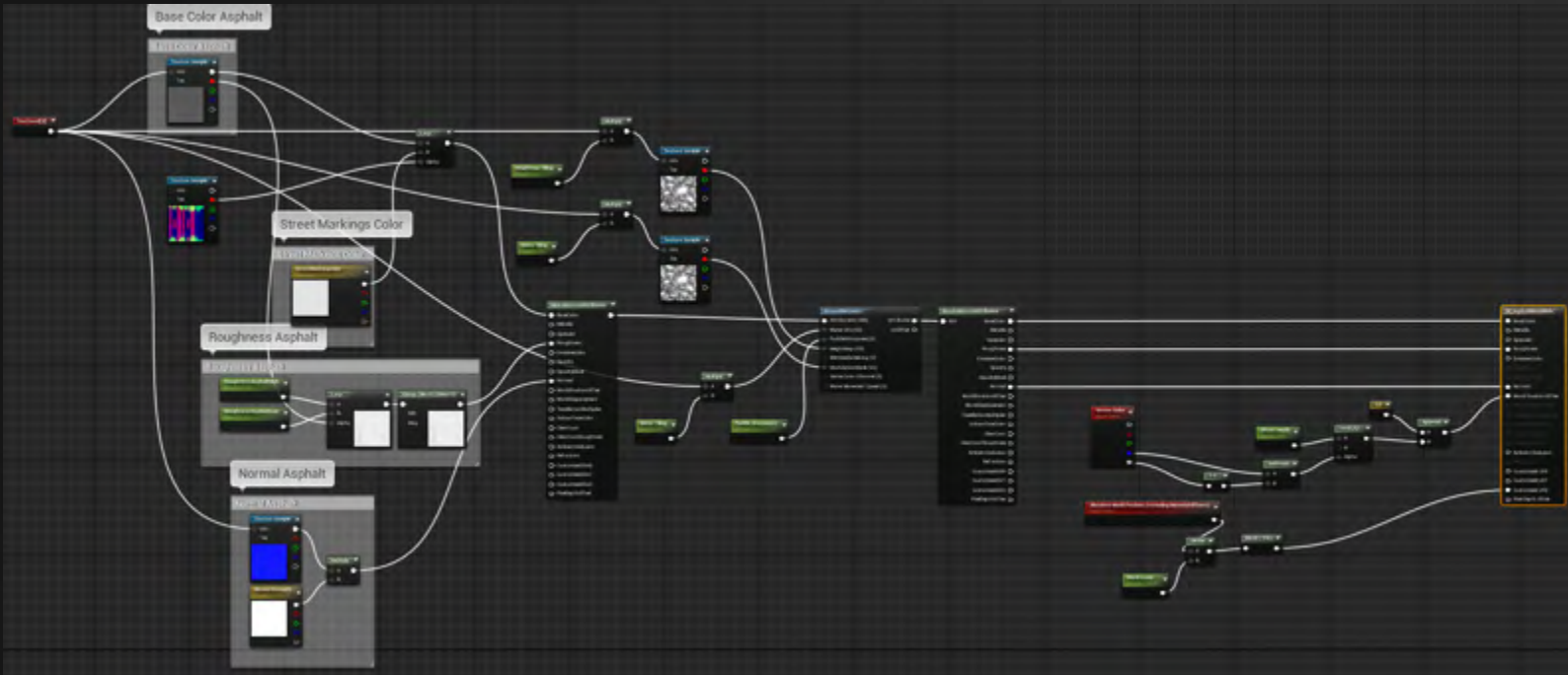


Object	Actor(s)	Type	Count	Inst Section	Tris	Sum Tris
SM_HU_Deco_Sm_Bo	19 Actors	StaticMesh	19	19	2,248	42,712

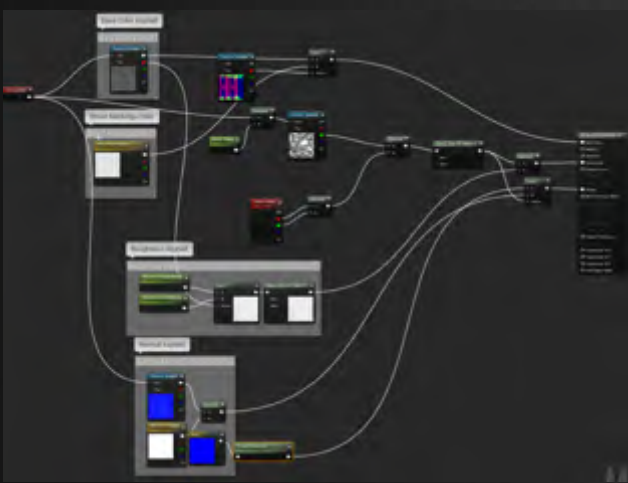


# 选择需要合并的Actors





- Base pass shader with static lighting: 113 instructions
- Base pass shader with only dynamic lighting: 84 instructions
- Vertex shader: 39 instructions
- Texture samplers: 7/16
- Mobile base pass shader with only dynamic lighting (LDR): 136 instructions
- Mobile base pass vertex shader (LDR): 48 instructions
- Mobile texture samplers: 8/8



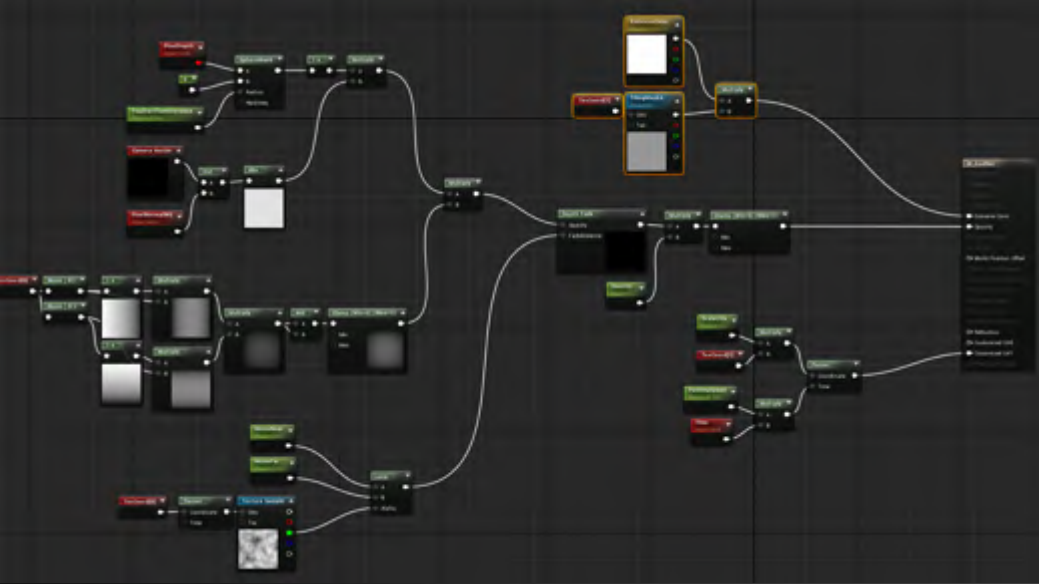
- Base pass shader with static lighting: 79 instructions
- Base pass shader with only dynamic lighting: 53 instructions
- Vertex shader: 33 instructions
- Texture samplers: 6/16
- Mobile texture samplers: 4/8

## 优化材质/大范围

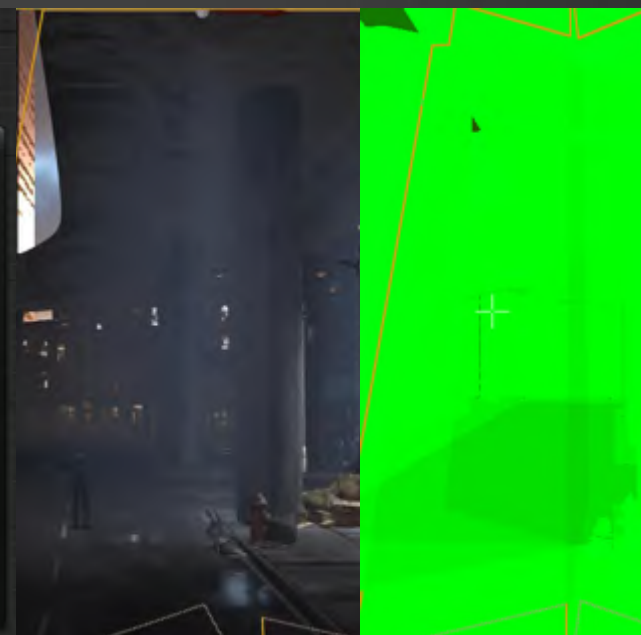
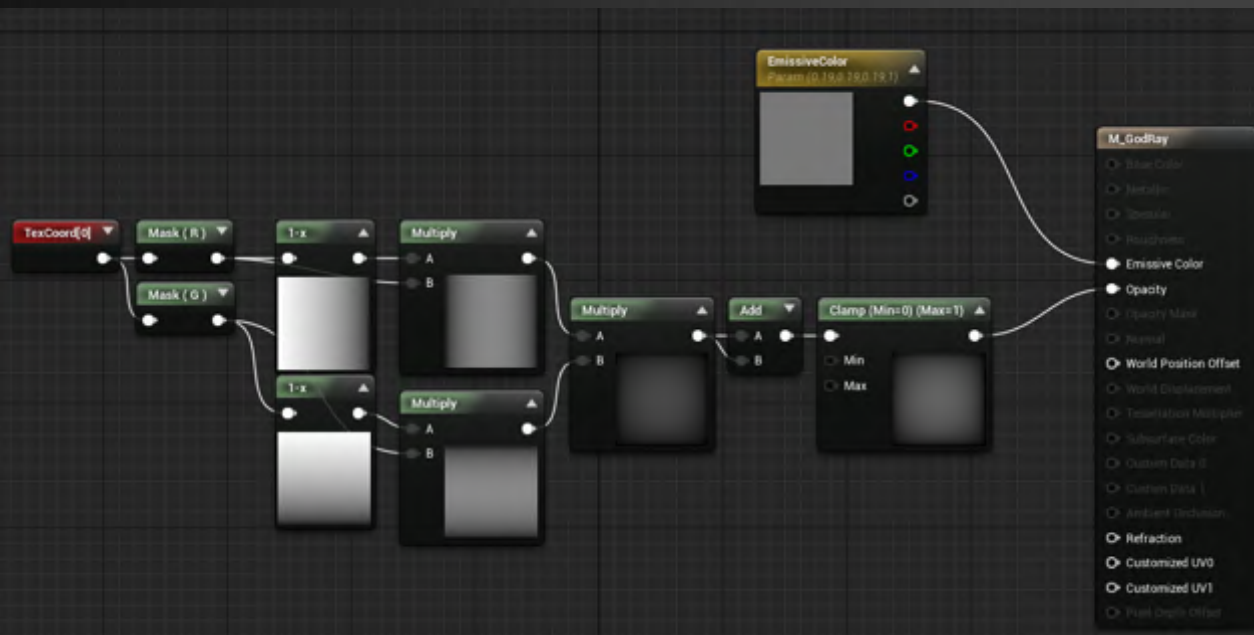




# 材质优化/透明

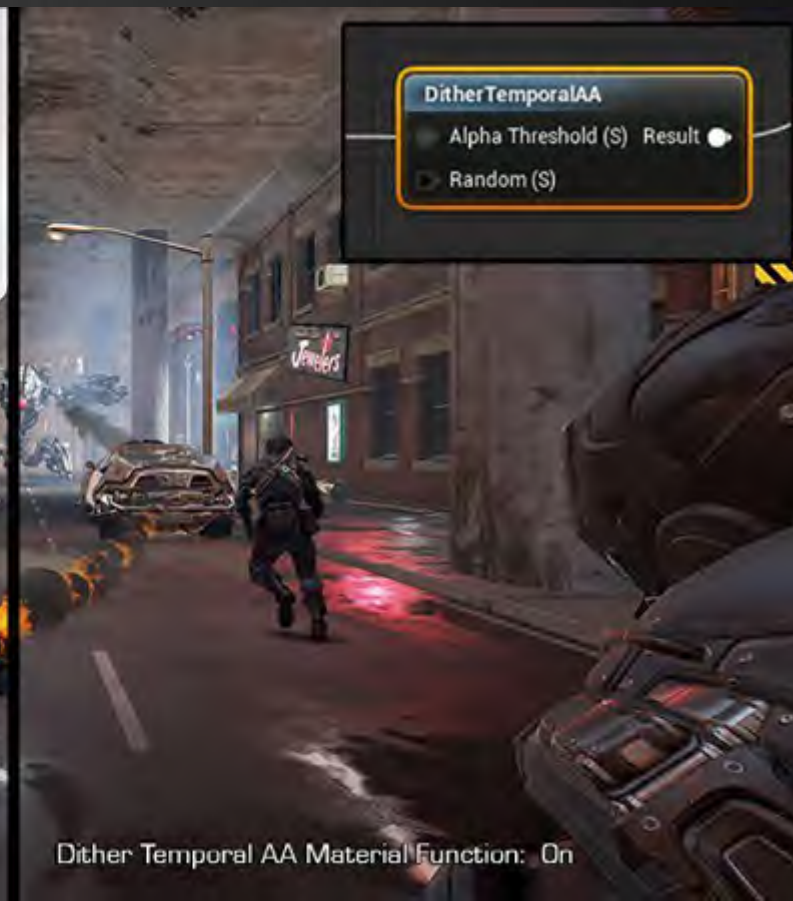
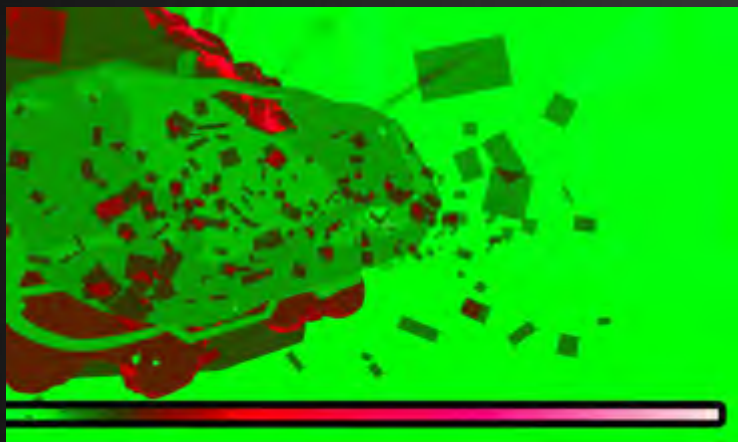


- Base pass shader without light map: 54 instructions
- Vertex shader: 72 instructions
- Texture samplers: 3/16
- Mobile base pass shader without light map (LDR): 56 instructions
- Mobile base pass vertex shader (LDR): 46 instructions
- Mobile texture samplers: 3/8



- Mobile base pass shader without light map (LDR): 10 instructions
- Mobile base pass vertex shader (LDR): 15 instructions
- Mobile texture samplers: 0/8

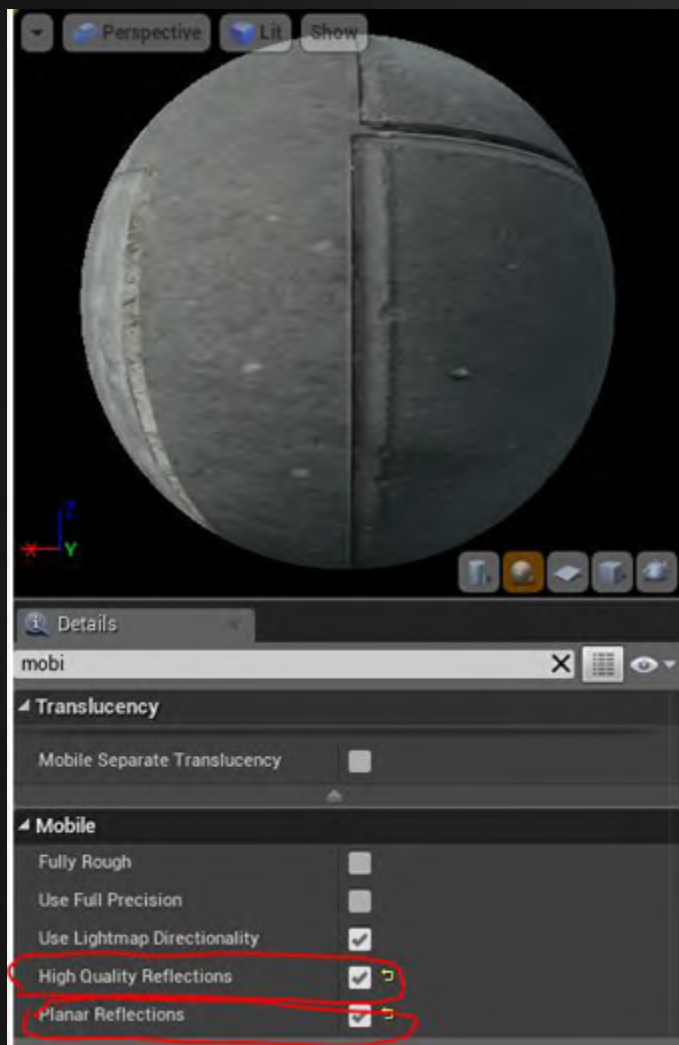
# 材质优化/粒子特效



优化材质/删除不必要的视觉元素



# 减少贴图sampler



## Engine - Rendering

Rendering settings.

Export... Import...

These settings are saved in DefaultEngine.ini, which is currently writable.

Search

### Mobile

Mobile HDR



Max Dynamic Point Lights

4

Use Shared Dynamic Point Light Shaders



Enable Combined Static and CSM Shadowing



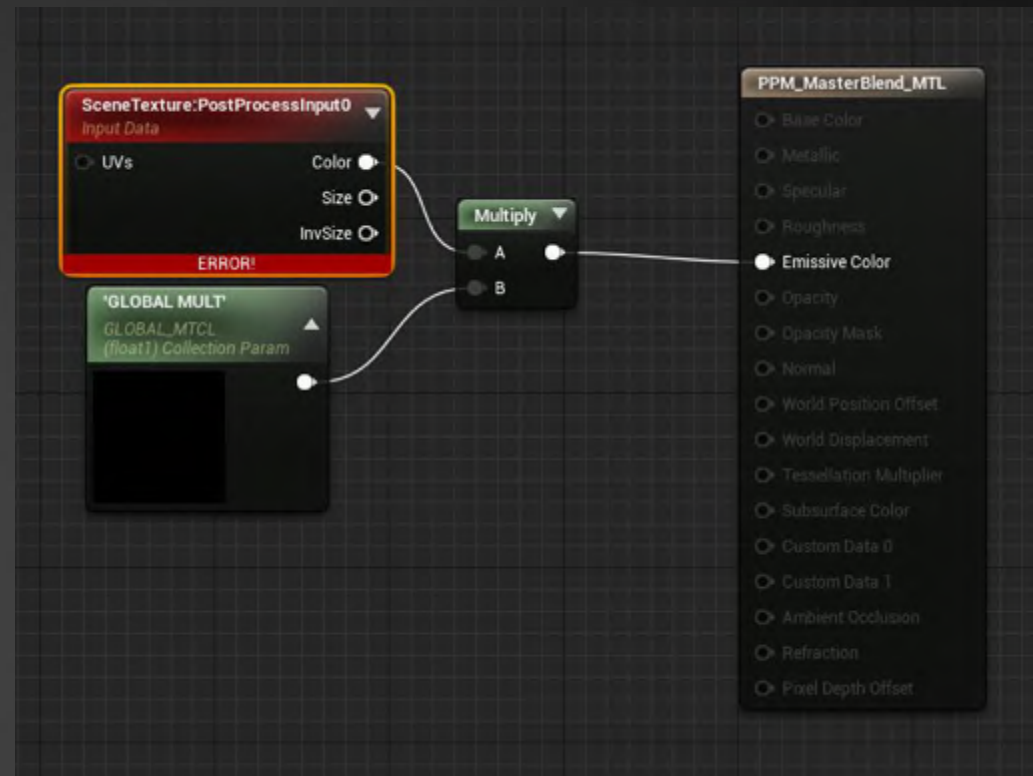
### Materials

Allow primitives to receive both static and CSM shadows from a stationary light. Disabling will free a mobile texture sampler.



#### Default Postprocessing Settings

- Bloom
- Ambient Occlusion
- Ambient Occlusion Static Fraction (AO for baked lighting)
- Auto Exposure
- Auto Exposure Histogram
- Motion Blur
- Lens Flares (Image based)
- Anti-Aliasing Method



去除后期材质和灯光function  
使用简单方式替代

# 检查清理地图警告

Message Log

- Asset Registry
- Build and Submit Errors
- Source Control (5)
- Blueprint Log
- Play In Editor (1)
- Automation Testing Log
- Localization Service (1)
- Load Errors
- Asset Reimport
- Lighting Results
- Map Check (33)**
- Editor Errors
- Packaging Results
- Asset Check
- Slate Style Log
- Compiler Log
- UDN Parse Errors

! [BP\\_Bot\\_C\\_1](#) Actor casts dynamic shadows and has a BoundsScale greater than 1! This will have a large performance hit

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! [SM\\_NYC\\_Sidewalks\\_Straight\\_77](#) More overridden materials (3) on static mesh component than are referenced (1) in source mesh 'SM\_NYC\_Sidewalks\_Straight\_77'

! [SM\\_SubwayPit2x\\_01\\_615](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayPit2x\_01'

! [SM\\_SubwayPitHall\\_01\\_624](#) 2 element(s) with zero triangles in static mesh 'SM\_SubwayPitHall\_01'

! [SM\\_SubwayEntranceSide\\_01\\_630](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayEntranceSide\_01'

! [SM\\_SubwayEntranceSide\\_2](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayEntranceSide\_01'

! [SM\\_SubwayEntranceScreen\\_01\\_642](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayEntranceScreen\_01'

! [SM\\_SubwayEntranceScreen\\_2](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayEntranceScreen\_01'

! [SM\\_SubwayEntranceScreenSign\\_01\\_646](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayEntranceScreenSign\_01'

! [SM\\_SubwayEntranceScreenSign\\_2](#) 1 element(s) with zero triangles in static mesh 'SM\_SubwayEntranceScreenSign\_01'

! [SM\\_Scaffold\\_PannelCorner\\_66](#) 1 element(s) with zero triangles in static mesh 'SM\_Scaffold\_PannelCorner\_01'

! [SM\\_NYC\\_Sidewalks\\_Straight\\_03\\_13](#) More overridden materials (3) on static mesh component than are referenced (1) in source mesh 'SM\_NYC\_Sidewalks\_Straight\_03\_13'

! [SM\\_NYC\\_Sidewalks\\_Straight\\_8](#) More overridden materials (3) on static mesh component than are referenced (1) in source mesh 'SM\_NYC\_Sidewalks\_Straight\_8'

! [explosionmesh\\_7](#) Actor casts dynamic shadows and has a BoundsScale greater than 1! This will have a large performance hit

! [explosionmesh\\_9](#) Actor casts dynamic shadows and has a BoundsScale greater than 1! This will have a large performance hit

! [explosionmesh\\_9](#) Large actor receives a pre-shadow and will cause an extreme performance hit unless bCastDynamicShadow is set to false.

! [explosionmesh\\_11](#) Actor casts dynamic shadows and has a BoundsScale greater than 1! This will have a large performance hit

! [explosionmesh\\_11](#) Large actor receives a pre-shadow and will cause an extreme performance hit unless bCastDynamicShadow is set to false.

! [explosionmesh\\_12](#) Actor casts dynamic shadows and has a BoundsScale greater than 1! This will have a large performance hit

! [explosionmesh\\_12](#) Large actor receives a pre-shadow and will cause an extreme performance hit unless bCastDynamicShadow is set to false.

! [Shape\\_Plane\\_4](#) Static mesh actor has NULL StaticMesh property

! [Shape\\_Plane\\_4](#) Static mesh actor has NULL StaticMesh property

! [Shape\\_Plane\\_2](#) Static mesh actor has NULL StaticMesh property

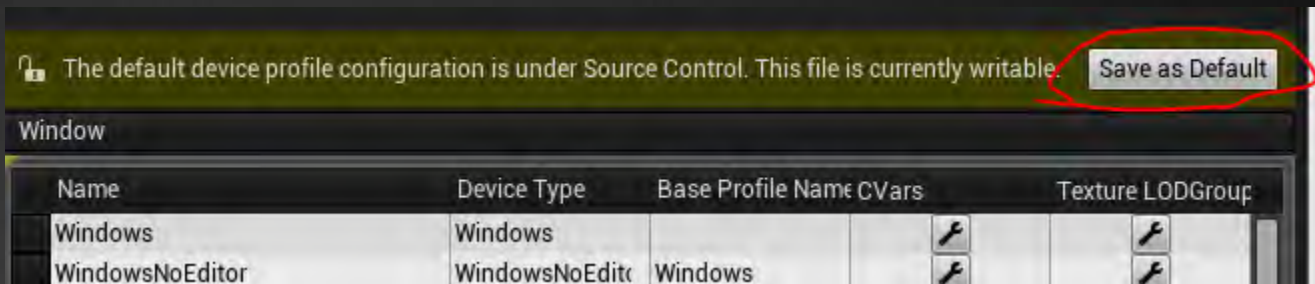
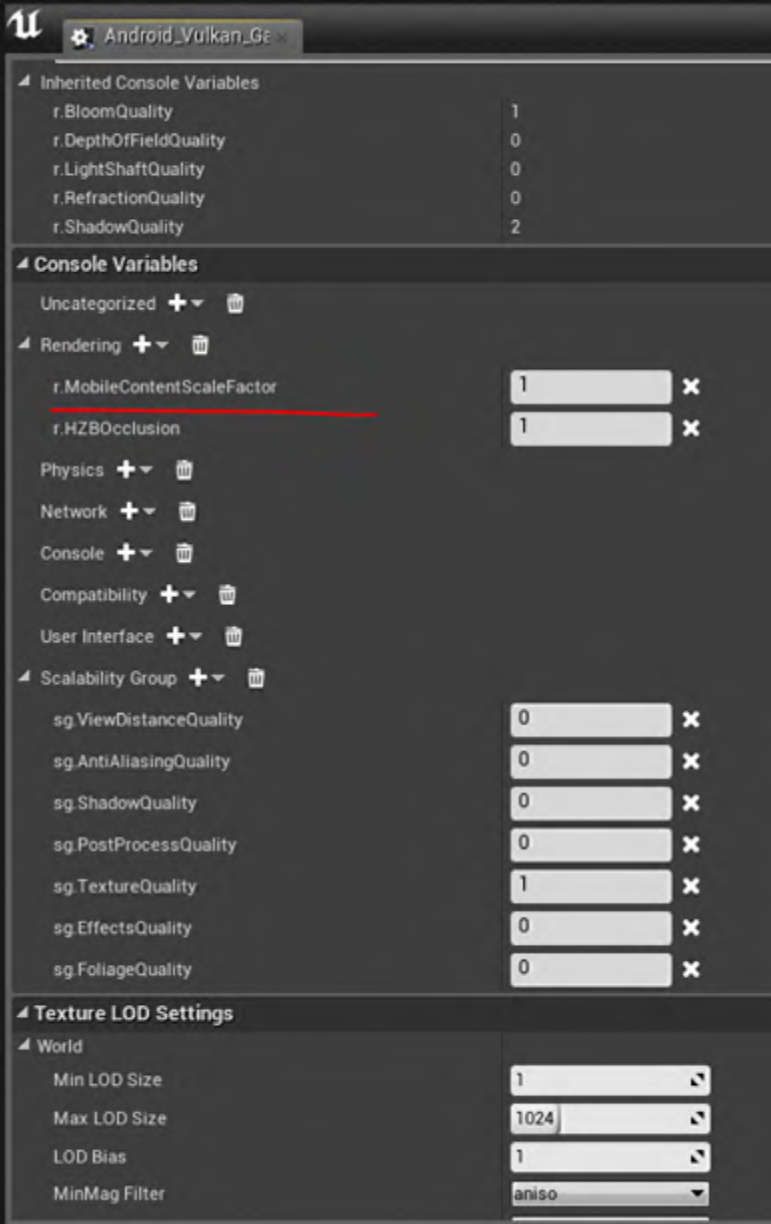
! [Shape\\_Plane\\_2](#) Static mesh actor has NULL StaticMesh property

! [Shape\\_Plane\\_3](#) Static mesh actor has NULL StaticMesh property

! [Shape\\_Plane\\_3](#) Static mesh actor has NULL StaticMesh property

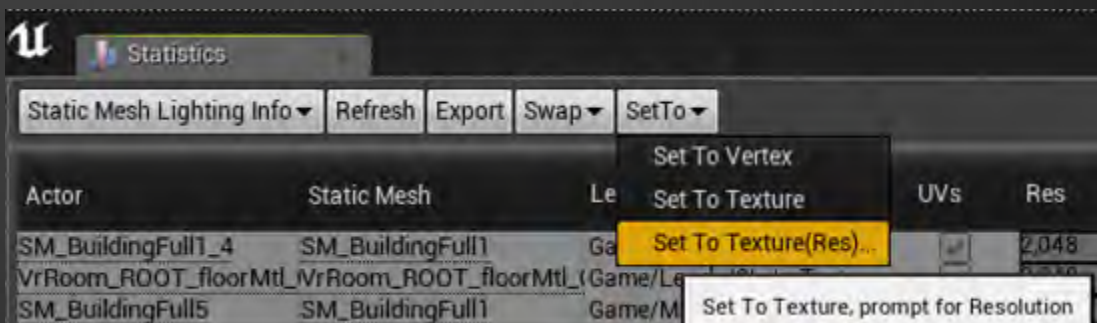
! [Shape\\_Plane\\_8](#) Static mesh actor has NULL StaticMesh property

Show Showdown\_P - Jul 18, 2016, 10:30:27 PM



设置合理目标平台Profile，记得保存！

- 调整合理的渲染品质参数
- 合理的贴图大小
- 分辨率



# 三角面

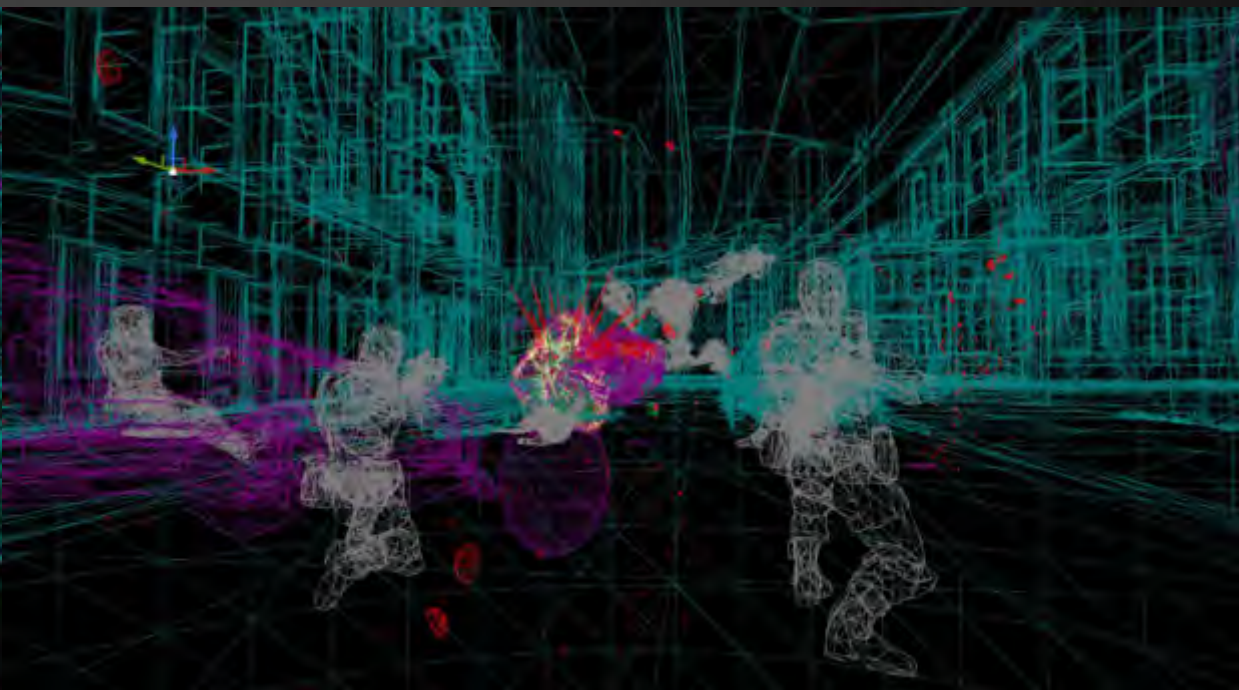
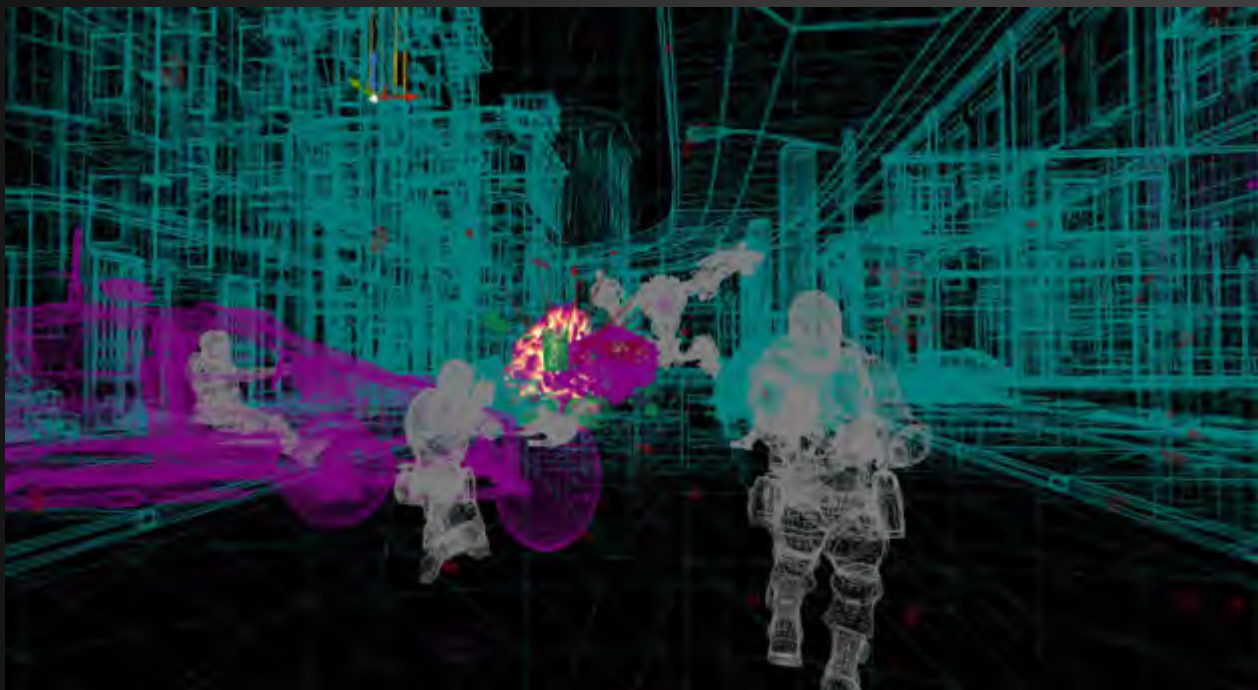
Counters	Average	Max
Static Mesh Tris	723,028.31	856,004.00
Skel Mesh Tris	344,131.31	371,257.00
Skel Verts GPU Skin	227,364.41	252,616.00
Skel Mesh Draw Calls	60.30	67.00
Seconds Per Cycle	0.00	0.00

# Drawcall

Counters	Average	Max
Present time	5.71 ms	6.89 ms
Mesh draw calls	555.35	594.00
Static list draw calls	305.08	342.00
Lights in scene		64.00

Static Mesh Tris	174,032.56
Skel Verts GPU Skin	79,252.13
Skel Mesh Tris	67,718.93
Skel Mesh Draw Calls	16.80
Seconds Per Cycle	0.00

Present time	4.55 ms	5.71 ms
Mesh draw calls	245.25	294.00
Static list draw calls	163.08	182.00
Lights in scene		64.00
Translucency GPU Time (MS)	0.02	0.02





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Q&A

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