

# BATTLEFIELD 3

## Shiny PC Graphics in Battlefield 3

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DICE



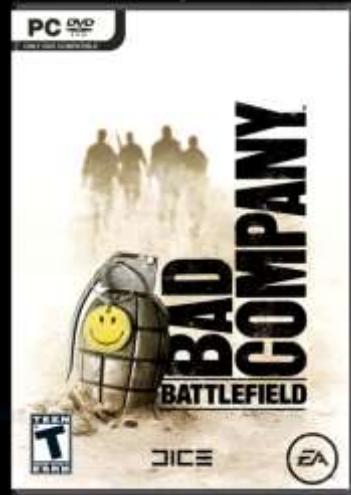
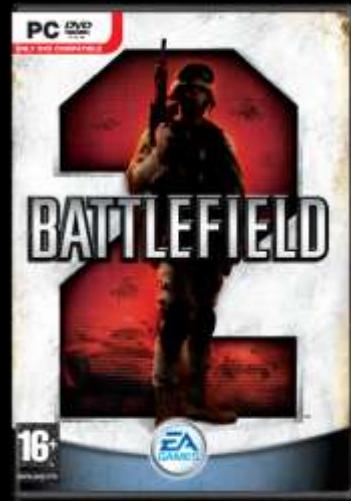
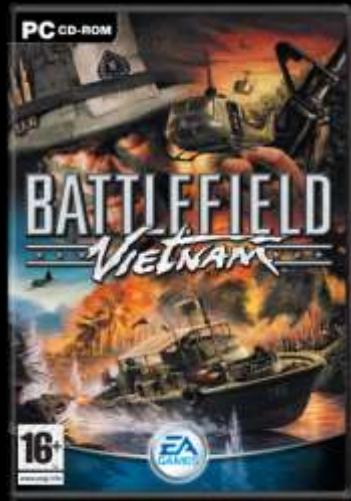
DIGITAL ILLUSIONS CREATIVE ENTERTAINMENT

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AN EA COMPANY







DICE

# Battlefield 3



- › 64-player multiplayer – Singleplayer – COOP
- › Landscape, Urban and In-door environments
- › PC is lead platform. DX10/DX11 only!



# Frostbite 2

- › Developed for Battlefield 3 and future DICE + EA games
- › Major advancements in **animation, rendering, lighting, destruction, landscapes and streaming**
- › Big focus on creating simple to use & powerful workflows



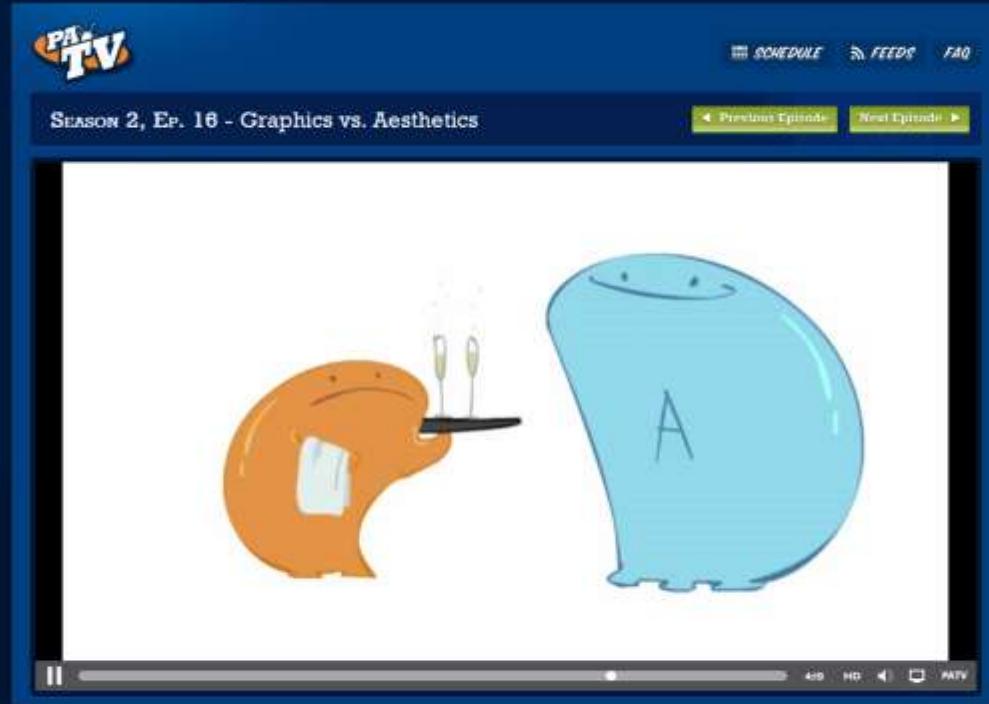
# GRAPHICS!





Ok, sir. I need you to go ahead and tap the brakes and check flaps and stabs.

<http://www.penny-arcade.com/patv/episode/graphics-vs.-aesthetics>



*Graphics exists to serve Aesthetics (and Gameplay)!*

# Graphical Components



Objects



Lighting



Effects



Terrain



Post-processing

# OBJECTS



Example of objects:

- › Gameplay: Characters, Weapons, Vehicles
- › Environment: Trees, Bushes, Rocks
- › Man-made: Buildings, Fences, Containers
- › Effects: Debris, Destruction

A wide-angle photograph of a lush green forest. Sunlight filters through the dense canopy of tall evergreen trees, creating bright highlights and deep shadows on the forest floor. A rocky outcrop is visible in the background. The foreground is filled with tall grass and low shrubs.

Levels can have 10000+ objects

- › Requires efficient & scalable handling
- › Parallel rendering & simulation
- › Occlusion culling
- › LOD & distance culling
- › Mesh & texture streaming
- › Instancing



We stream almost all meshes & textures

- › More variation
- › Increased quality
- › Shorter loading times
- › Reduced memory requirements
- › Freedom for level designers & artists

# Streaming tech

Streaming based on camera position

- › No blurry textures behind you

**DX11 concurrent creates = no stalls!**

- › Worked closely with Microsoft and the IHVs
- › Loading / creation is handled by separate thread

Per multiplayer level:

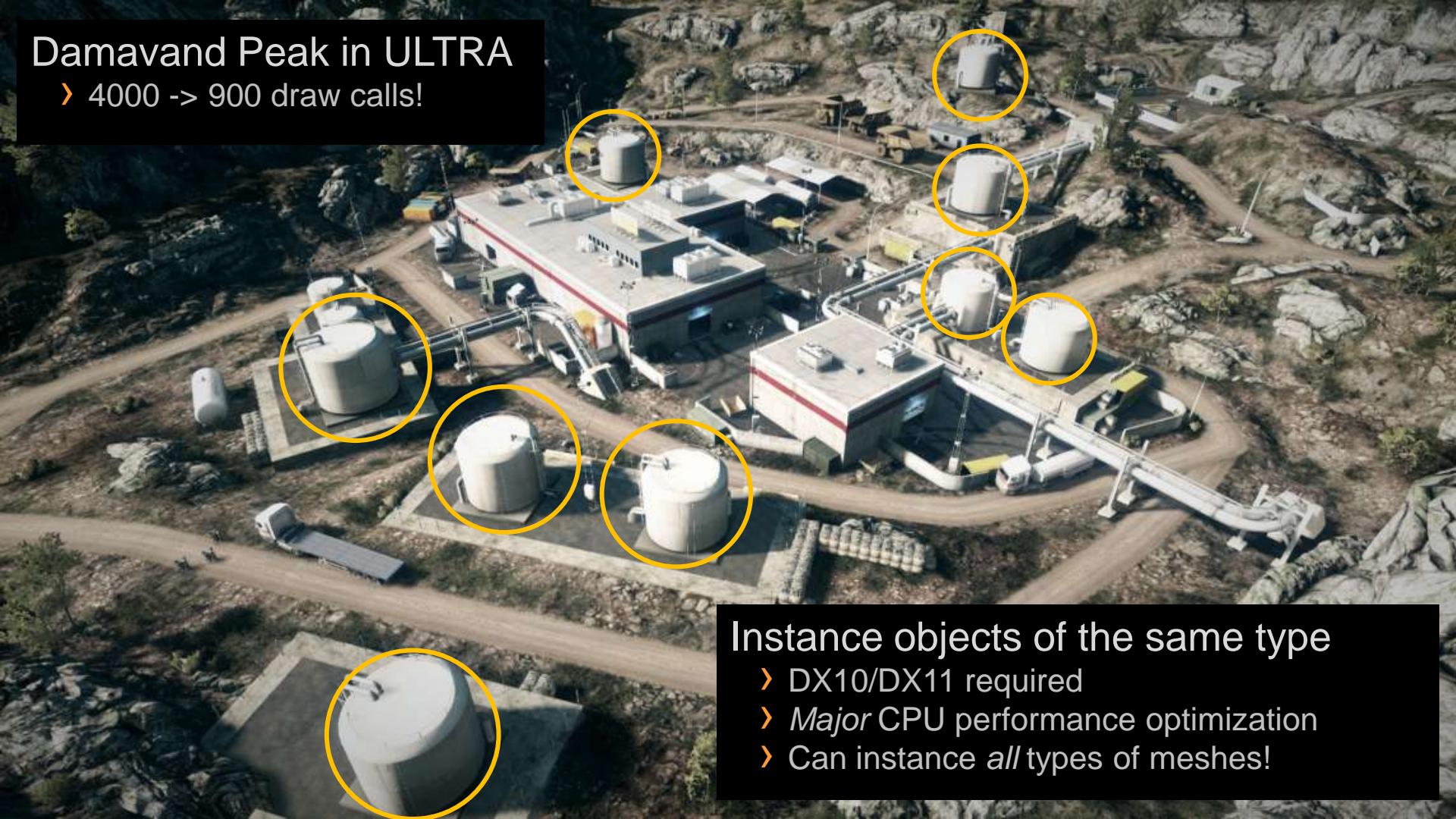
- › 200 – 250 MB of streamed object meshes
- › 1.3 – 1.5 GB of streamed object textures

**TEXTURE QUALITY** setting sets size of the texture pool:

- › Low: 150 mb
- › Medium: 200 mb
- › High: 300 mb
- › Ultra: 500 mb

# Damavand Peak in ULTRA

› 4000 -> 900 draw calls!



Instance objects of the same type

- › DX10/DX11 required
- › Major CPU performance optimization
- › Can instance *all* types of meshes!

# LIGHTING

Spot lights



Lensflare

S

Emissive particles

Point lights



Specular highlights





## HDR rendering & lighting

- › Dynamic exposure to adapt to both dark and bright areas
- › True HDR bloom = natural part of the HDR rendering pipeline

No Bloom



Bloom



# Deferred Shading

Scene is rendered to a *gbuffer*, then lit

Enables massive lighting environments

- › 100s of large dynamic light sources on screen
- › Destructible & animated lights
- › Lighting cost relative to how many *pixels* are lit not *objects*
- › Highly flexible lighting

Requires lots of GPU memory & bandwidth

- › 1080p with 4x MSAA = 158 mb gbuffer

Normals



Smoothness



Diffuse



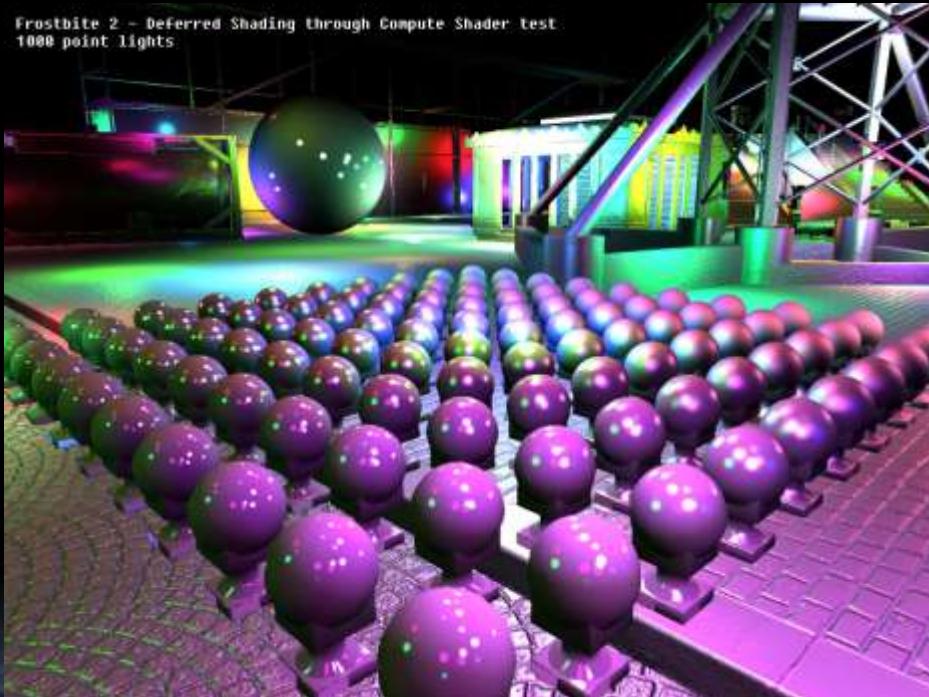
Specular



# Compute Shader lighting

## Tile-based lighting using DX11 CS

- › Reduces amount of pixels lit
- › Fixed low memory bandwidth
- › Great performance with huge amount of light sources
- › Esp. when using MSAA



Final picture



Diffuse light



Diffuse light

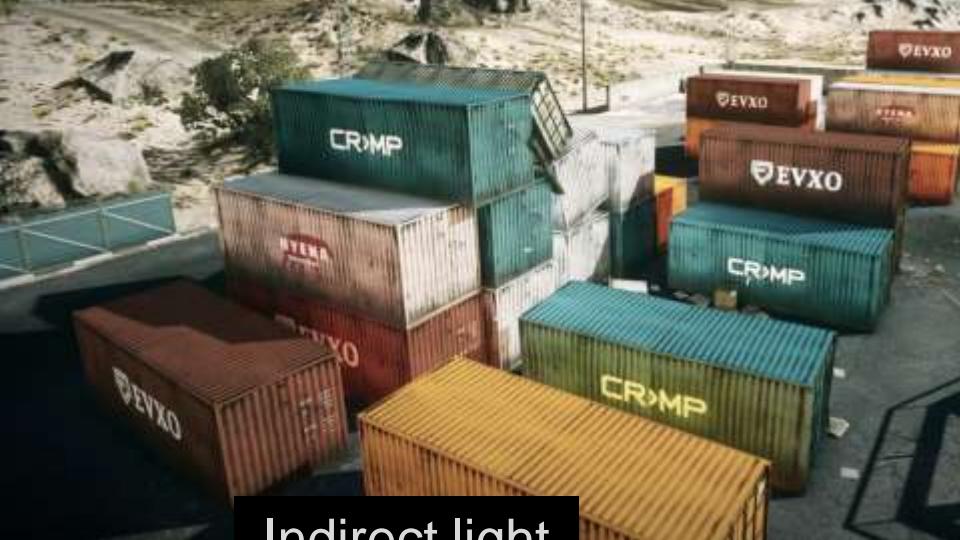


Specular light



Final picture





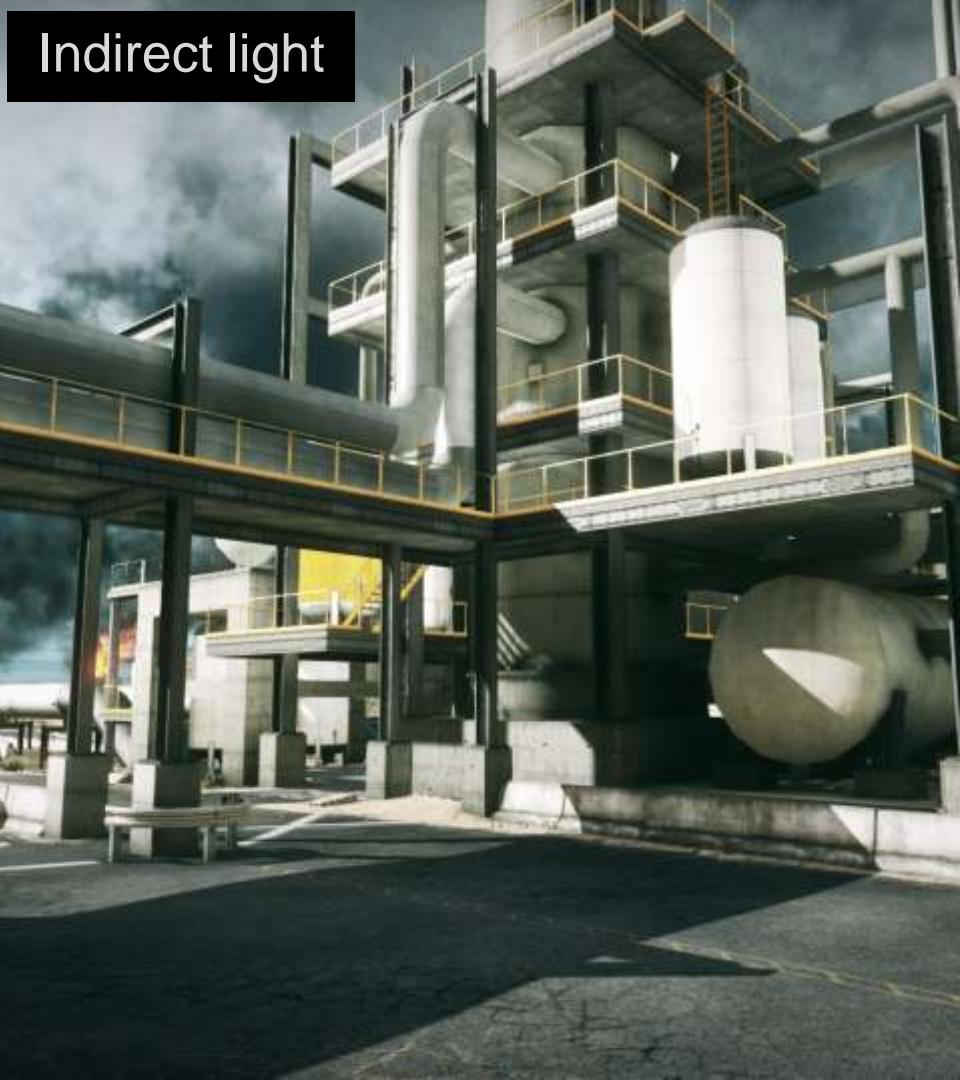
Indirect light



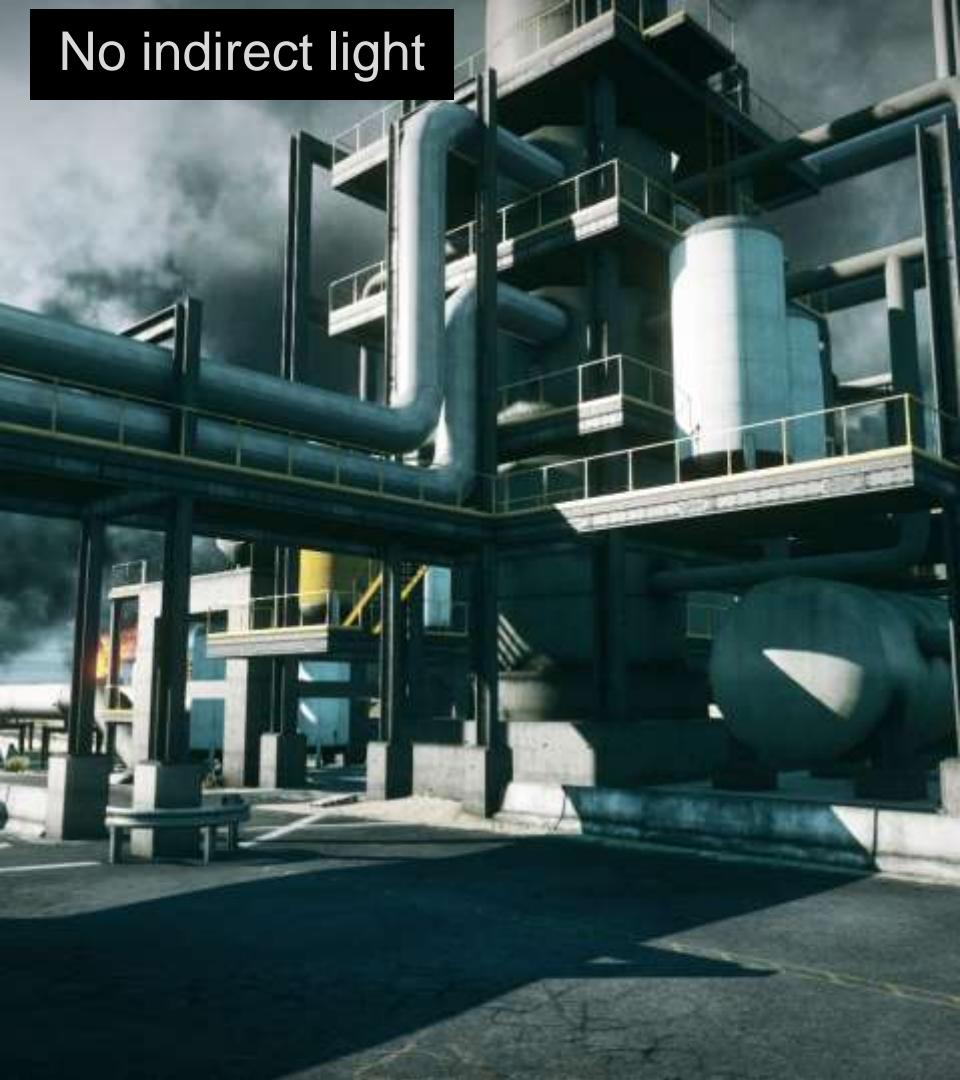
No indirect light



Indirect light



No indirect light



## Spotlight shadows



# EFFECTS

1000s of small and big particles

- › Sprite particles
- › Mesh particles

Essential that particles fit in & interact with the environment

- › It is all about the lighting (again!)

## Particle shadows!

- › On ground & opaque objects
- › Disabled when  
ShadowQuality = Low



## Alpha-tested debris

- › Gives sharp details



## Soft particles

- › Soft fade instead of hard z-test



Particle shadows = on



Particle shadows = off







## Volumetric particle lighting

- › Each particle is lit by all lights
- › Fit into all light environments
- › Automatic!



## Particle lights

- Light up both themselves and surrounding surfaces

Particle lighting





Shadows on particles = on



Shadows on particles = off



180

225

270

315

00

91 °

SMOKE  
READY

0 KPH

3X  
60Hz

- [2] 7,62 MM COAXIAL MACHINEGUN
- [1] 120 MM CANNON

CANNON AP - RDY

62

# TERRAIN

## Vast view distances

- › High-res streamed heightfields
- › Per-pixel normalmaps
- › DX11 tessellation & displacement mapping





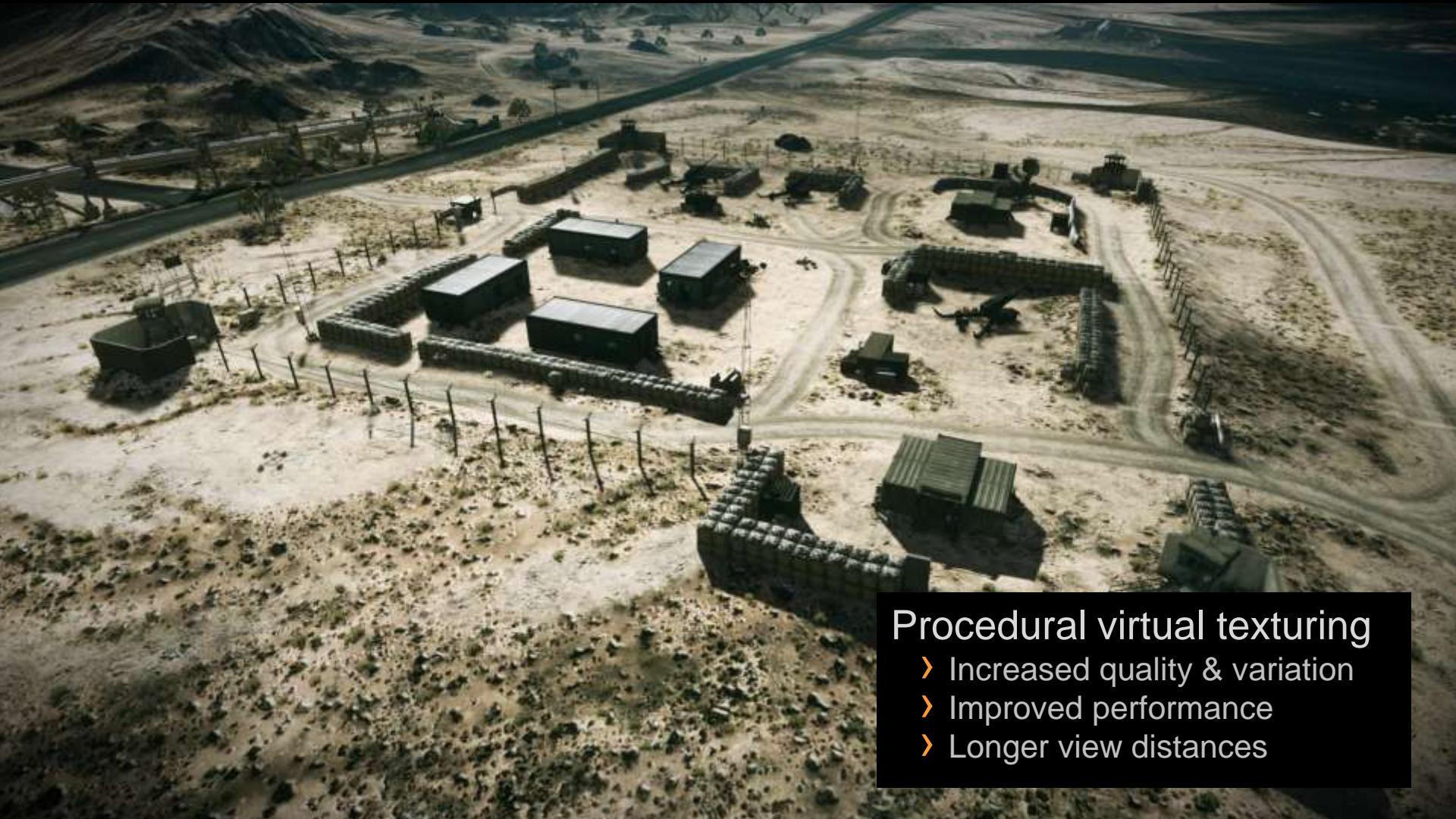
A landscape scene featuring a large, rugged mountain peak on the left with dark, rocky slopes and patches of snow or ice. In the middle ground, a wide valley opens up, leading towards smaller, rounded hills. The sky is filled with soft, white clouds. The overall lighting suggests a bright day with some shadows cast by the mountains.

Normal mapped terrain



Displacement mapped terrain

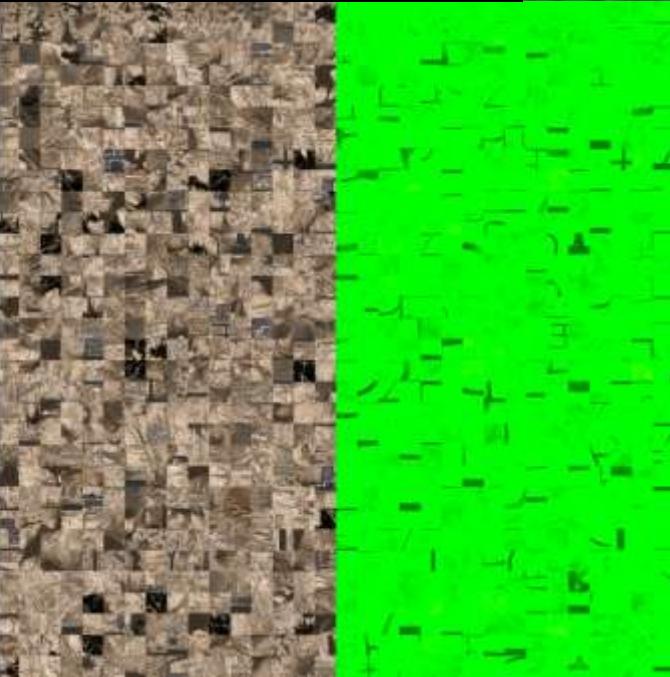
Requires DX11 GPU  
› Terrain Quality set to HIGH or ULTRA



Procedural virtual texturing

- Increased quality & variation
- Improved performance
- Longer view distances

# Terrain virtual texture atlases



## Virtual texture tiles

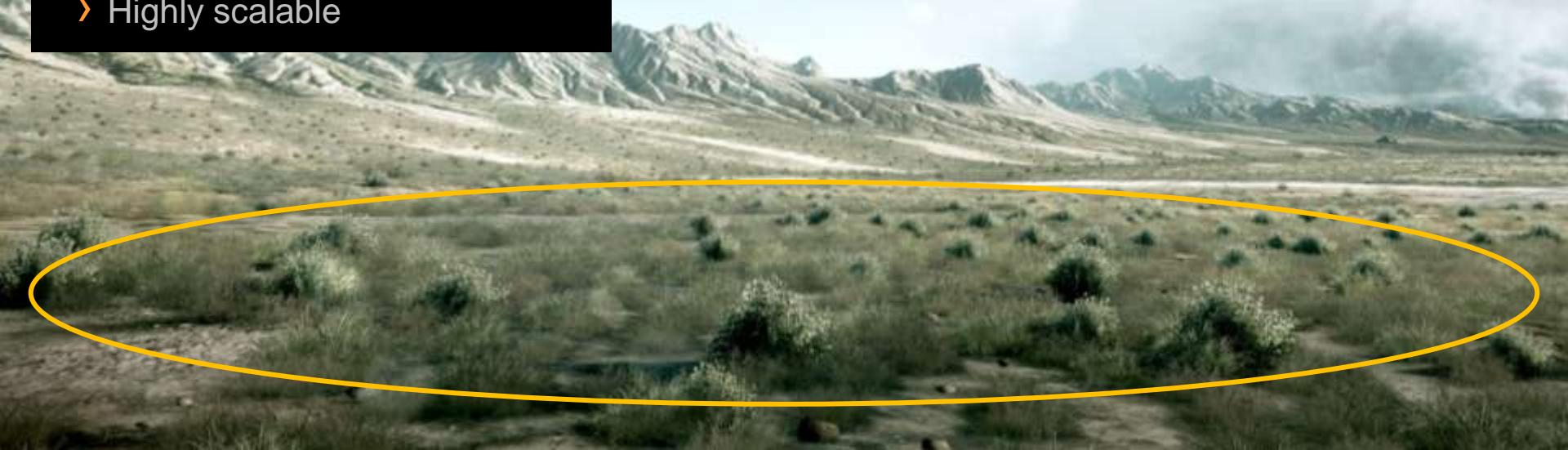
- › Regenerated when moving
- › 256x256 resolution
- › Compressed to DXT5 in real-time on the GPU

## Terrain Decoration

- › Grass
- › Rocks
- › Debris
- › Small bushes

## Procedurally instanced

- › Based on the terrain materials
- › Highly scalable



A photograph of a forest scene with tall evergreen trees and some deciduous trees in the foreground. The ground is covered in green grass and brown dirt patches. In the background, there are rocky outcrops and distant hills under a clear blue sky.

Terrain Decoration = Off

A landscape scene featuring a dense forest of tall, thin trees with light-colored trunks. The ground is covered in green grass and small yellow flowers. In the background, there's a rocky hillside and a distant building on stilts near a body of water.

Terrain Decoration = Low



Terrain Decoration = Medium





Terrain Decoration = High



Terrain Decoration = Ultra



Terrain Decoration = Low

# POST-PROCESSING



## Post effects:

- › Bloom
- › Filmic Tonemapping
- › Motion blur
- › Depth of field
- › Vignetting
- › Screen glare
- › Blur
- › SSAO/HBAO
- › Color grading
- › Film grain
- › Antialiasing

## Ambient Occlusion

- › Key visual cue to ground objects

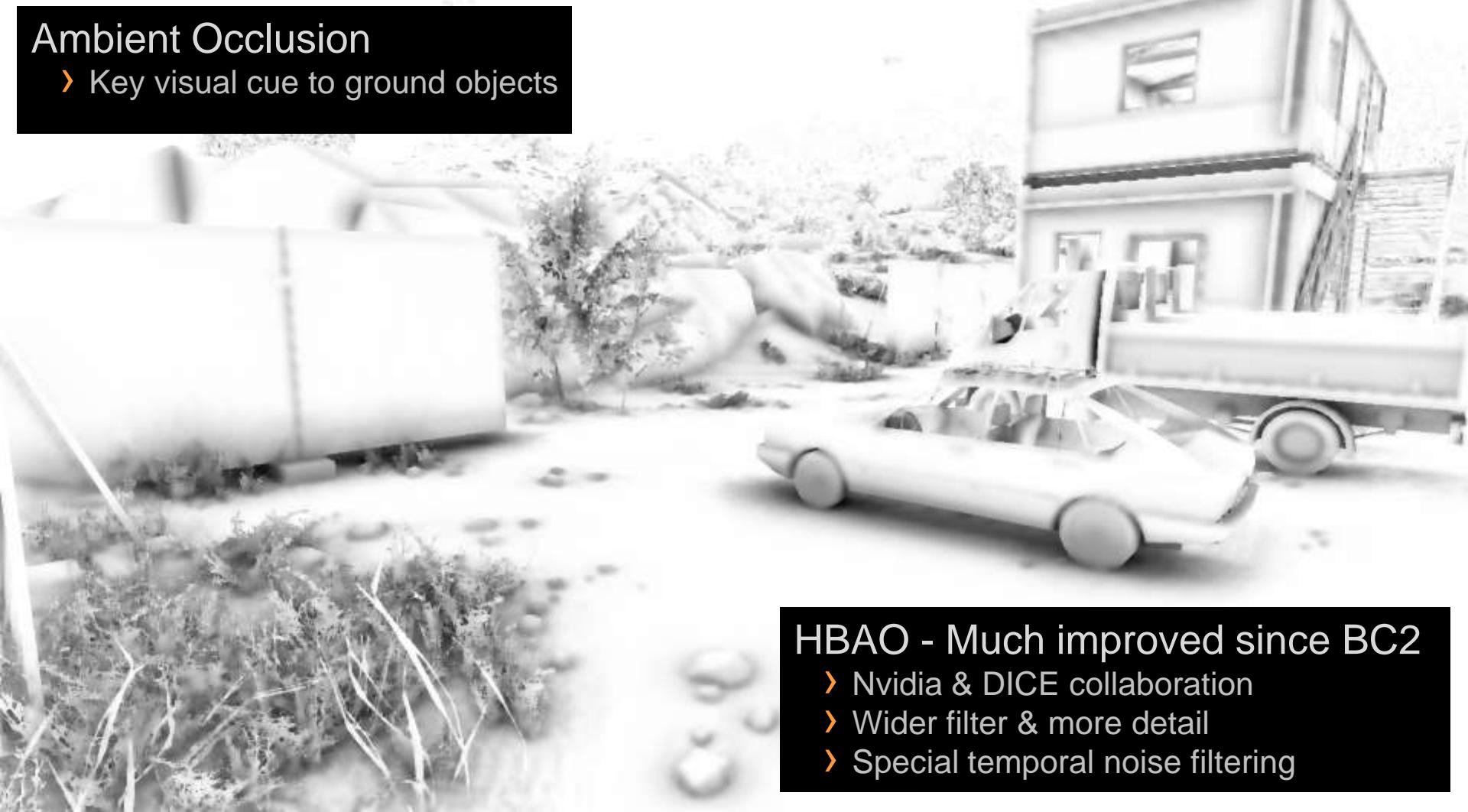


## SSAO - Super cheap effect

- › No extra memory cost
- › Used on the consoles and MEDIUM

## Ambient Occlusion

- › Key visual cue to ground objects



## HBAO - Much improved since BC2

- › Nvidia & DICE collaboration
- › Wider filter & more detail
- › Special temporal noise filtering

No AO



SSAO



HBAO





31 / 124  
Gx1

Motion blur



Color grading



31  
124  
Ex1

Blur + Vignette + Desaturation + Blood

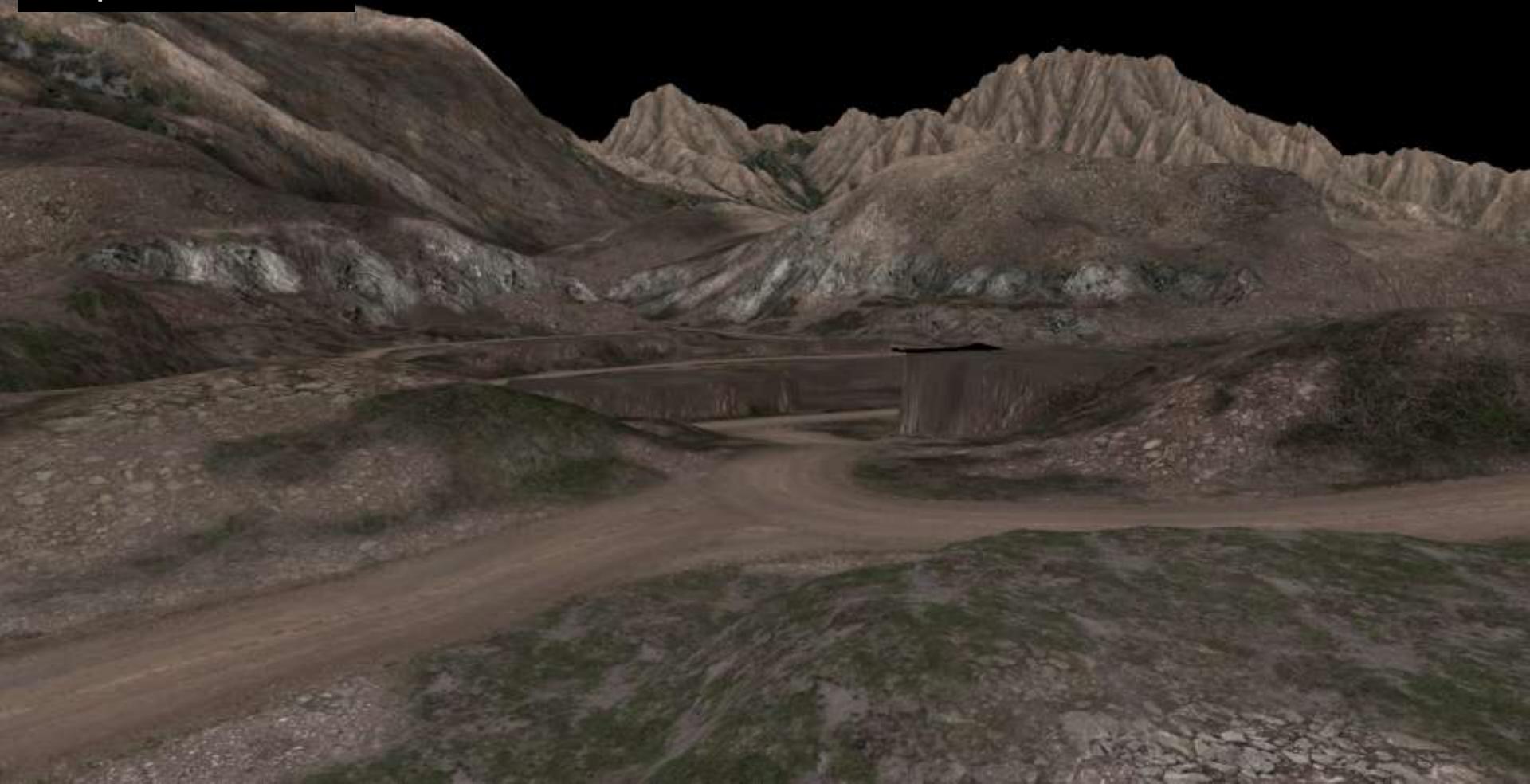


31 / 124  
8x1

# SCENE BREAKDOWN



# Step 1 - Terrain



## Step 2 – Composite Meshes



## Step 3 – Rigid Meshes



## Step 4 – Foliage



## Step 5 - Decals



## Step 6 – GBuffer Normals



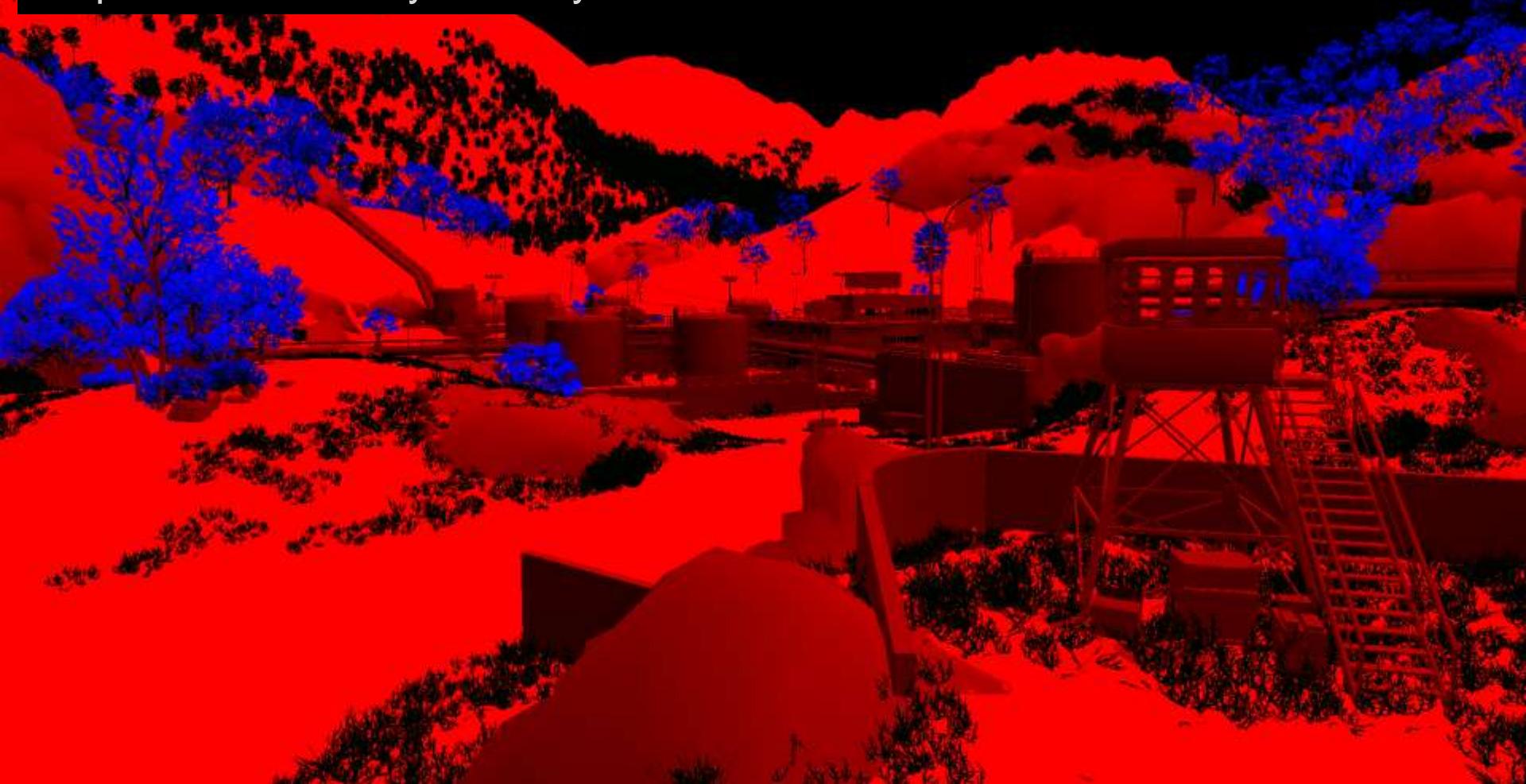
## Step 7 – GBuffer Specular



## Step 8 – GBuffer Smoothness



## Step 9 – GBuffer Sky Visibility



## Step 10 – Sky & Indirect light



## Step 11 – Sun Light



## Step 12 – Local Lights



## Step 13 – Combined lighting & albedos



## Step 14 - Sky



## Step 15 – Atmospheric Scattering



## Step 16 – Lensflares & Glare



## Step 17 – Bloom (tinted)



## Step 18 – Final color grading



# Graphics options

MAIN / OPTIONS /

## VIDEO

### CONTROLS

### GAMEPLAY

### AUDIO

### VIDEO

### KEY BINDINGS

FULLSCREEN MONITOR

< 1 >

FULLSCREEN RESOLUTION

< 1920x1200 59.95Hz >

FULLSCREEN

< OFF >

BRIGHTNESS

[progress bar]

VERTICAL SYNC

< OFF >

FIELD OF VIEW

< 70 >

MOTION BLUR AMOUNT

[progress bar]

OPEN SCREEN ADJUST

GRAPHICS QUALITY

< CUSTOM >

TEXTURE QUALITY

< ULTRA >

SHADOW QUALITY

< ULTRA >

EFFECTS QUALITY

< ULTRA >

MESH QUALITY

< ULTRA >

TERRAIN QUALITY

< ULTRA >

TERRAIN DECORATION

< ULTRA >

ANTIALIASING DEFERRED

< 4x MSAA >

ANTIALIASING POST

< HIGH >

MOTION BLUR

< ON >

ANISOTROPIC FILTER

< 16X >

AMBIENT OCCLUSION

< HBAO >

# Graphics options

LOW = lowest possible

- › Similar visuals to consoles, some components disabled
- › Still contains the essential visuals to not be unfair in MP
- › Minimum: Geforce 8800 GT 512 MB RAM

MEDIUM = good perf

- › Most important visual features enabled

HIGH = what the game is designed for

- › All major features on except for MSAA (if you have DX11 card)
- › Recommended: Geforce 560 TI or better

ULTRA = highest possible

- › Intended primarily for multi-GPU machines for 60+ fps

## Antialiasing

- › Because everybody hates aliasing

## Multiple options:

- › Deferred: MSAA 2x, 4x
- › Post: FXAA low, medium, high
- › Or both!



## Selective supersampling for MSAA

- › Detect edges with the most aliasing
- › Major GPU performance improvement





```
> Render.DrawFps  
Render.DrawFps Boolean  
Render.DrawFpsMethod UInt32  
Render.DrawFpsHistogram Boolean  
Render.DrawFps Boolean  
Render.DrawFpsMethod UInt32  
Render.DrawFpsHistogram Boolean
```

## In-game Console

- › Toggle with key above TAB
- › Just a few commands (prevent cheating)



## Built-in FPS meter

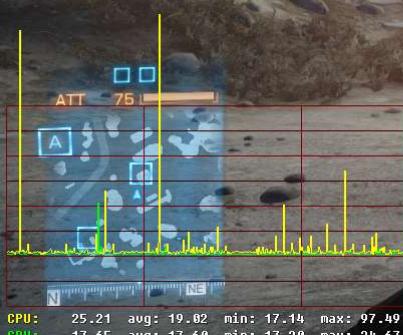
- › `Render.DrawFps 1`
- › Average FPS over last second
- › FRAPS-style

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## Performance overlay

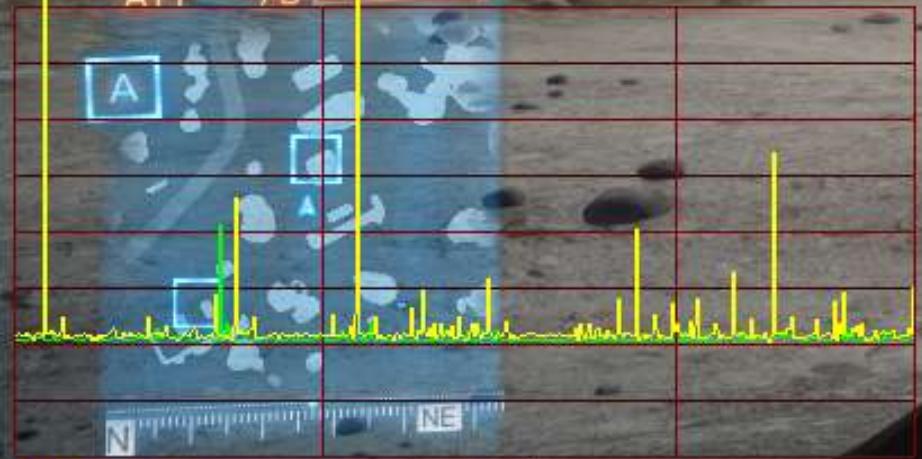
- › `Render.PerfOverlayVisible 1`
- › Shows CPU & GPU time graph in ms/f
- › See spikes / unstable performance
- › See if CPU bound (green below yellow)



3 sec

ATT 75

A



# Stereo

## Real 3D stereo rendering in BF3

- › Built-in full support in Frostbite 2
- › Render complete frame for each eye (in parallel!)
- › Works correctly with transparent surfaces and effects
- › Looks great! Requires a good PC

Been working closely with Nvidia to add the support

Play it here at GeforceLAN!

- › Available in game soon after Retail release

# Summary

BF3 looks sweet! ☺

- › Marriage of massive Battlefield gameplay with great visuals & style
- › Made for *your* PC

The future for PC games is bright!

- › We have many more Frostbite 2 games in development ☺
- › You'll start seeing more devs do proper PC games again

# Thanks to



And you for listening!

DICE

# Questions?



Email: repi@dice.se  
Blog: <http://repi.se>  
Twitter: @repi  
Battlelog: repii



For more DICE talks: <http://publications.dice.se>

DICE

# BATTLEFIELD

# 3

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