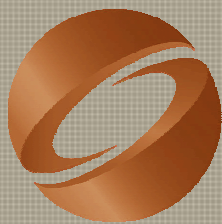


VALVE

HDR in Valve's Source Engine

SIGGRAPH 2006



Gary McTaggart
Valve

SIGGRAPH2006

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VALVE

Overview

- Intro to HDR
- Reflection/Refraction
- Tone Mapping and Auto-exposure
- Road to a shippable HDR implementation

Why HDR?



Paul Debevec's *Rendering with Natural Light*

What is *Lost Coast*?

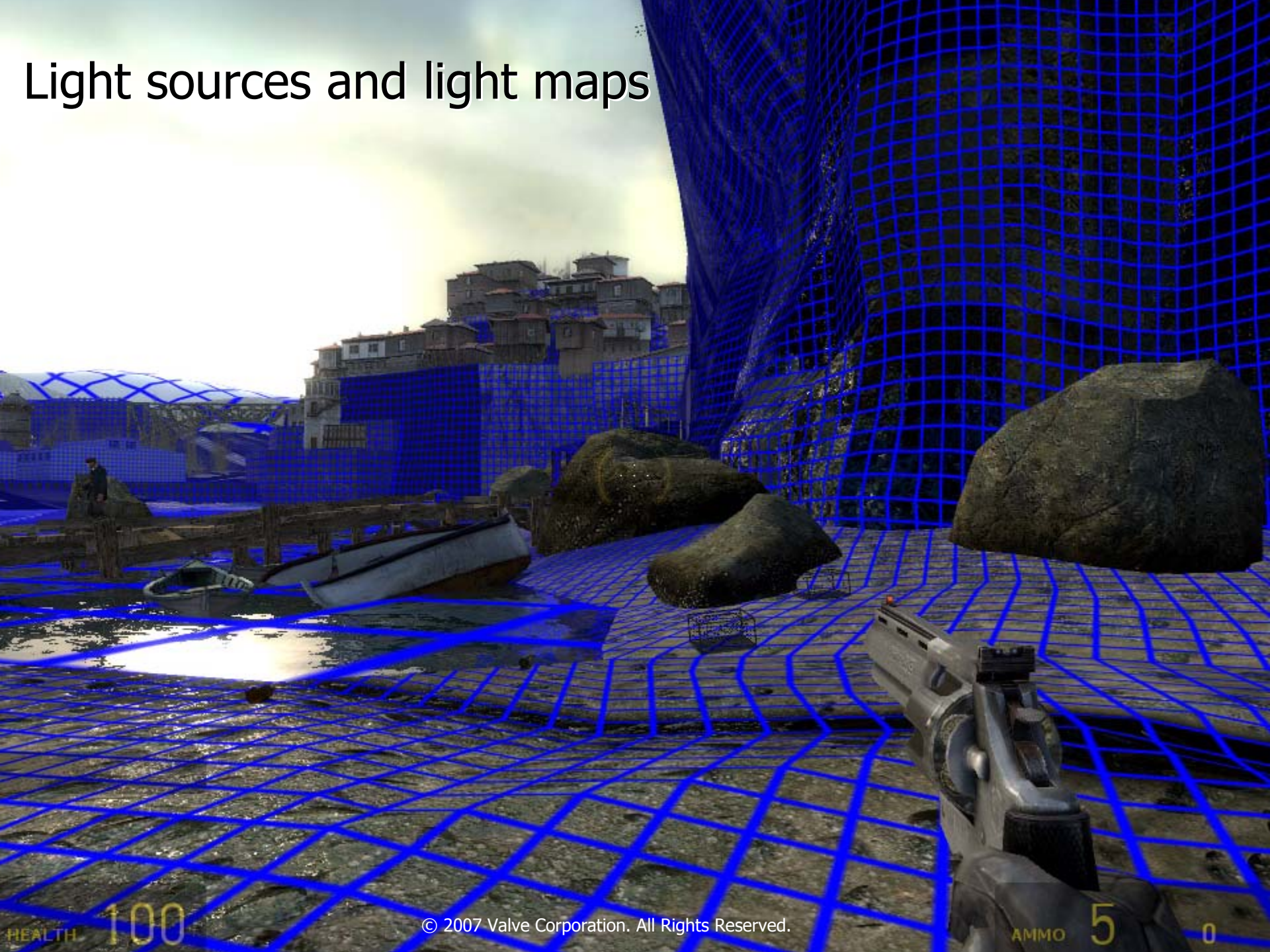
HEALTH 100

AMMO 6 0

Source HDR Radiosity Lighting from the Sun



Light sources and light maps



HEALTH 100

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AMMO 5 0



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Real-World Sky at Multiple Exposures



f22 @ 1/1600th second



f22 @ 1/250th second



f22 @ 1/40th second





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Scene from Source Engine/*Lost Coast*



Tonemap scale = 0.05



Tonemap scale = 1



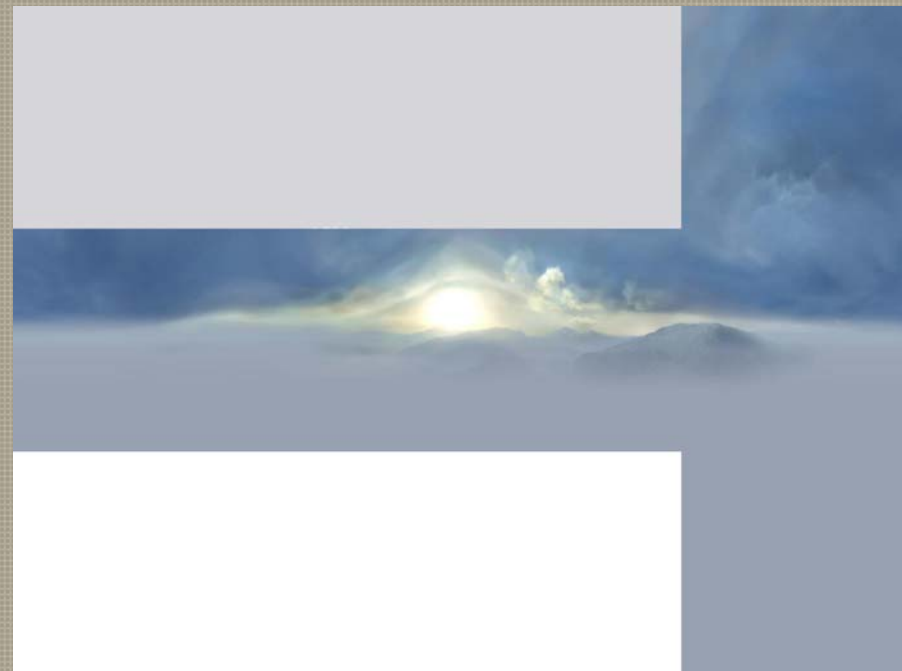
Tonemap scale = 4





VALVE

Authored HDR Skybox





HDR cube maps

Environment probes placed in Level Editor

Textures

Texture group: All Textures

Current texture: brick/brickfloor001a

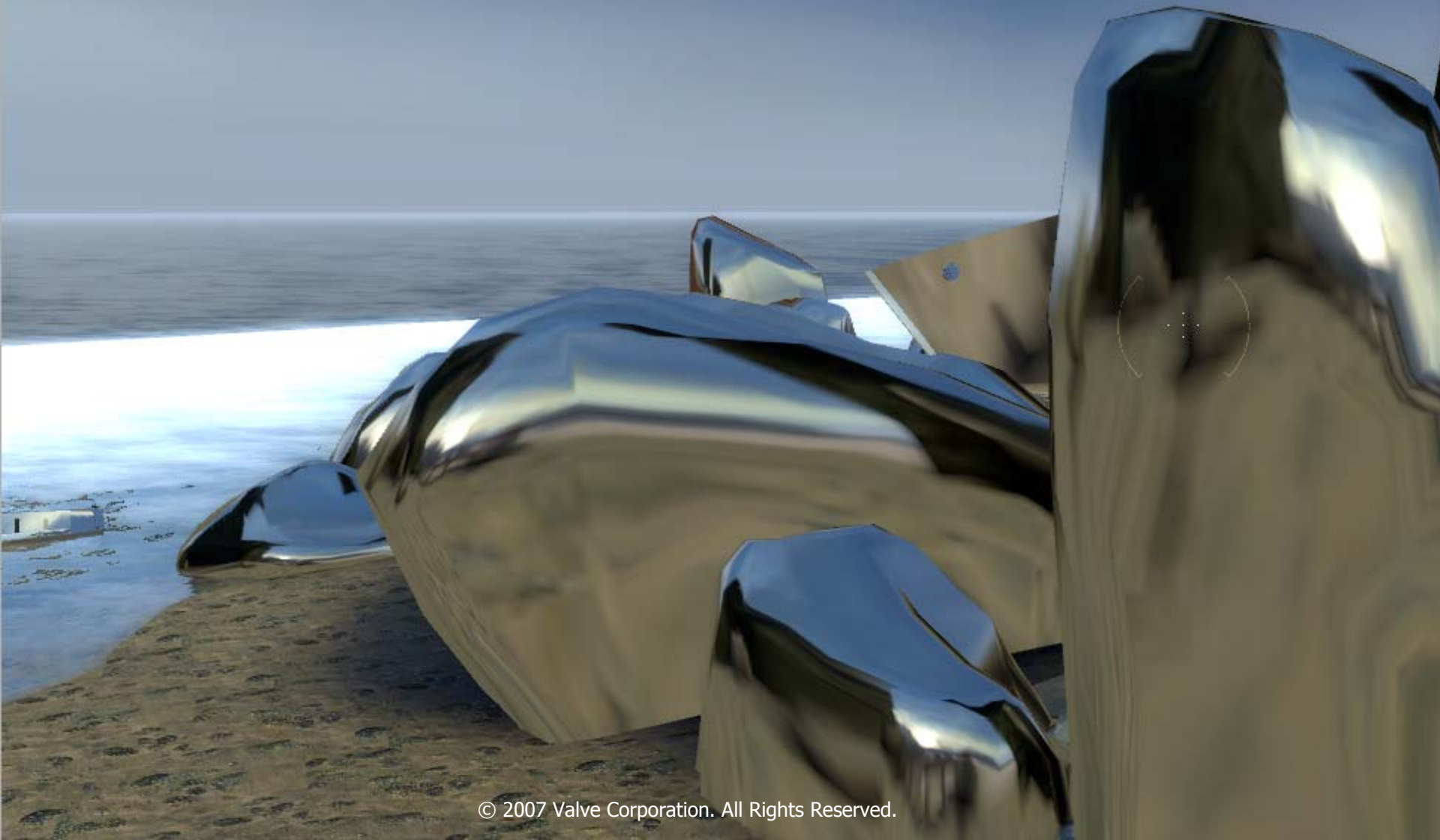
512x512

Browse...

Preview

Close

HDR cube maps



HDR cube map reflection



LDR



HDR

HDR water reflection and refraction

Reflection Render
Target



Refraction Render
Target



Water: Exposure 1



Water: Exposure 2



Water: Exposure 3

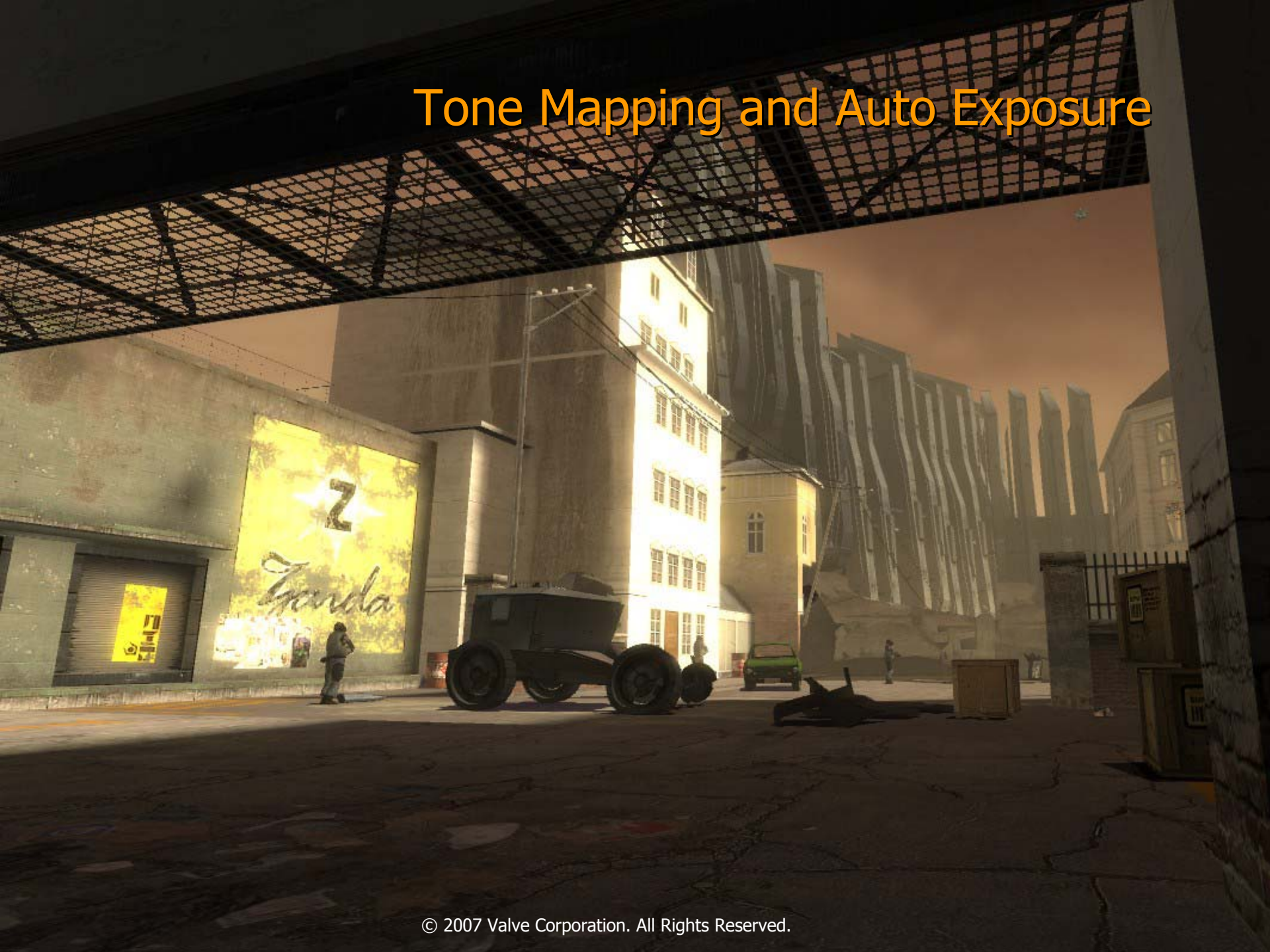


General Refraction

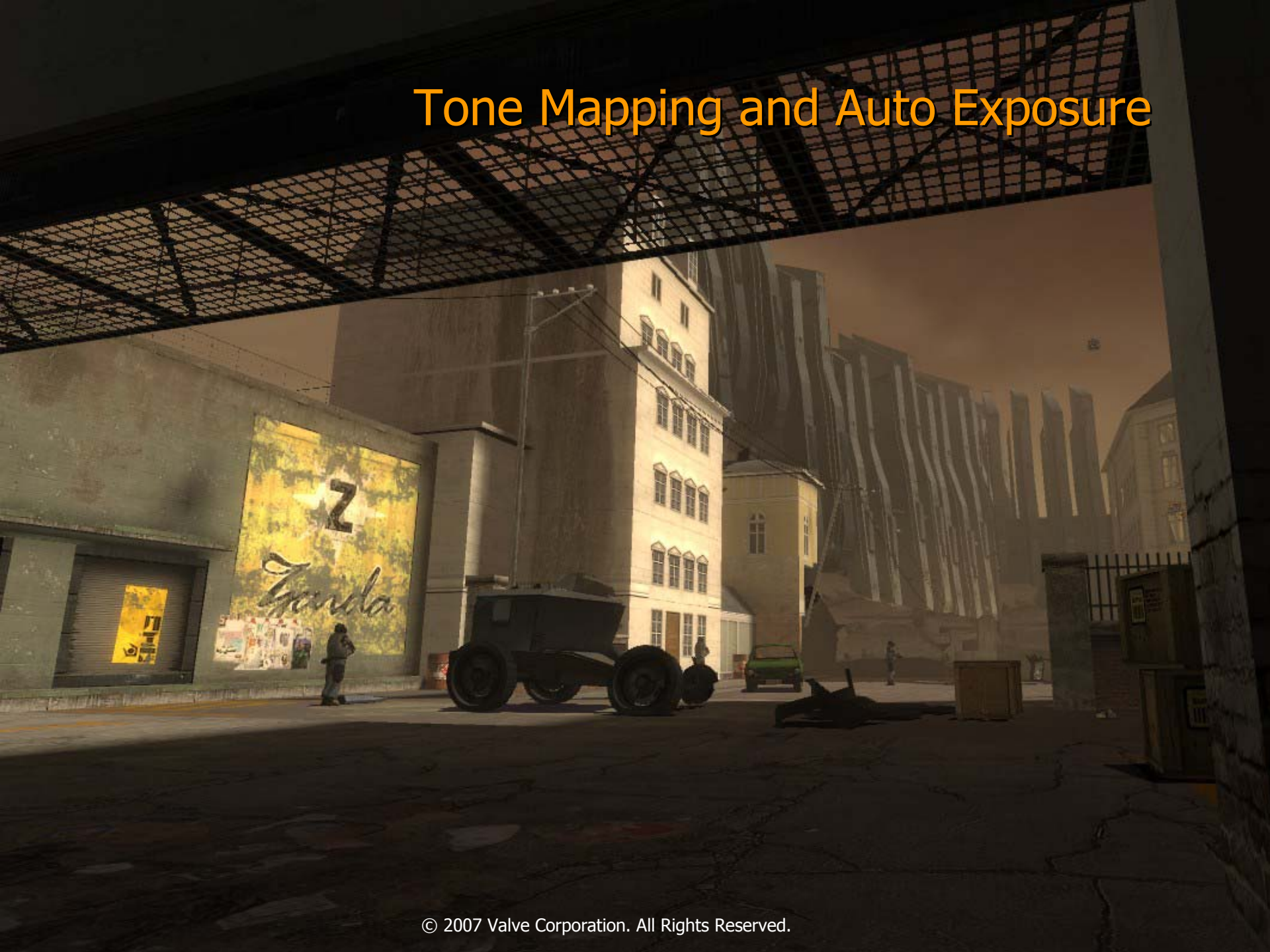


HEALTH 95

Tone Mapping and Auto Exposure



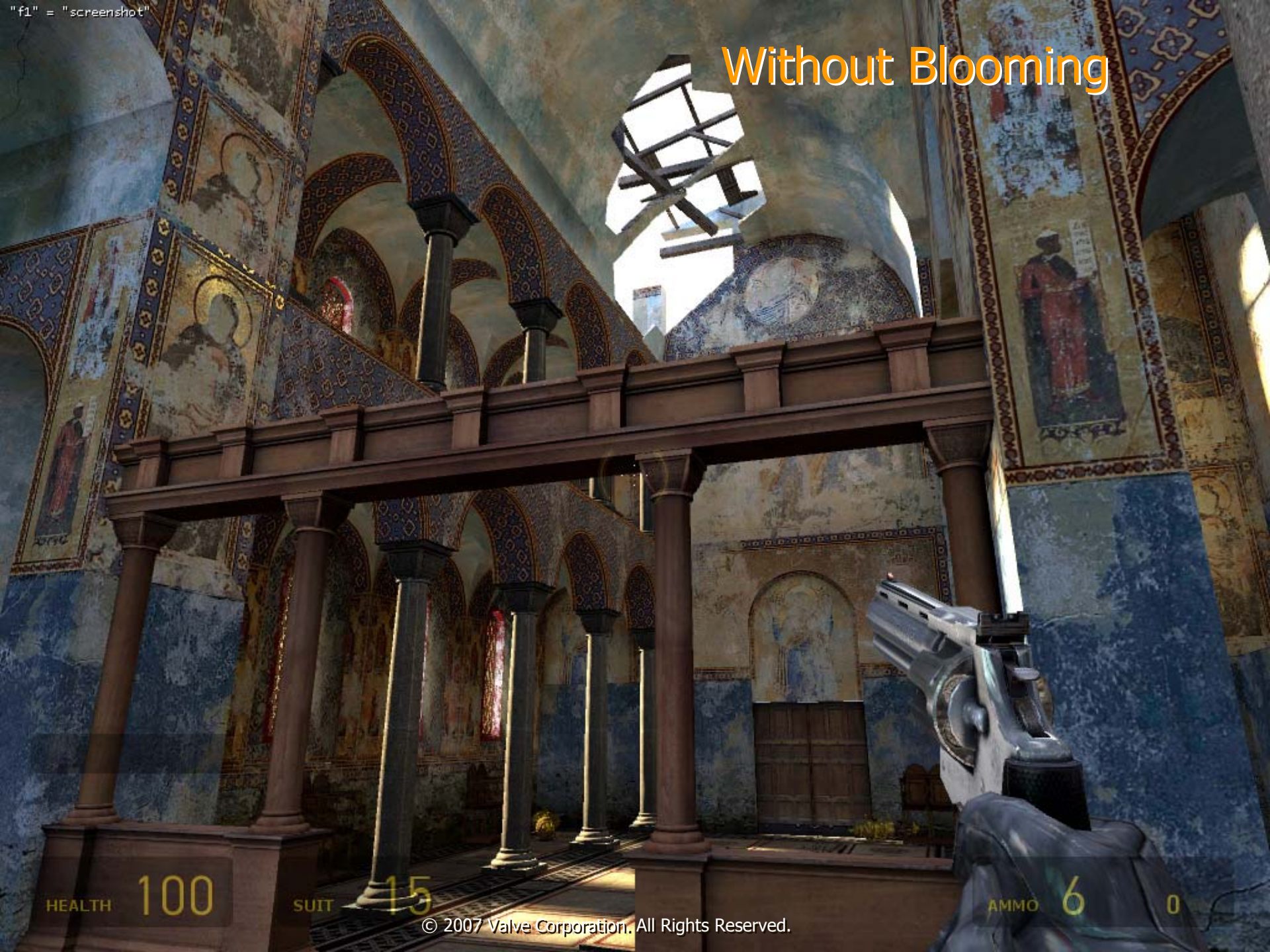
Tone Mapping and Auto Exposure



Tone Mapping and Auto Exposure



Without Blooming



HEALTH 100

SUIT 15

AMMO 6 0

Only Blooming

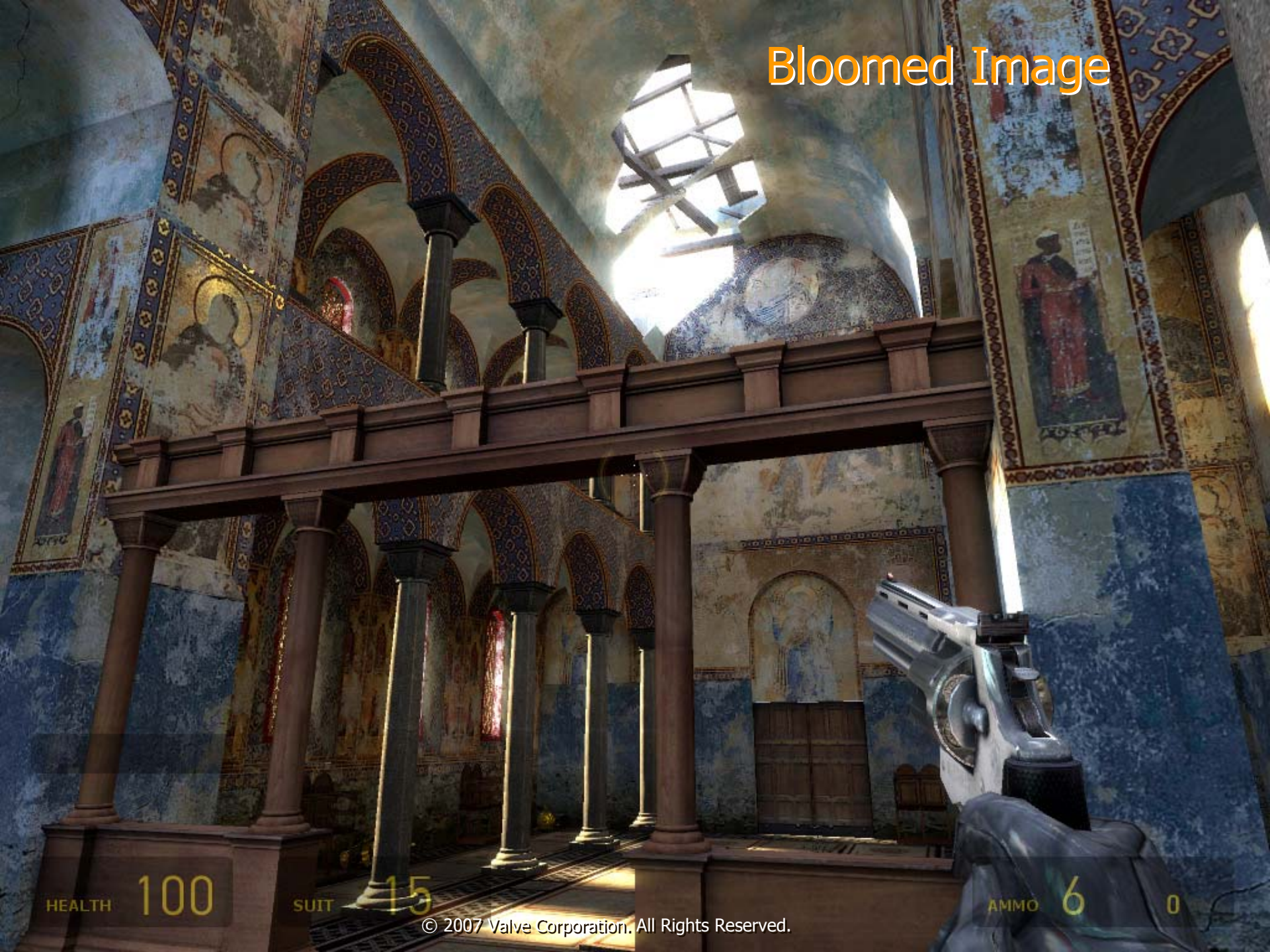


HEALTH 100

SUIT 15

AMMO 6 0

Bloomed Image



HEALTH 100

SUIT 15

AMMO 6 0



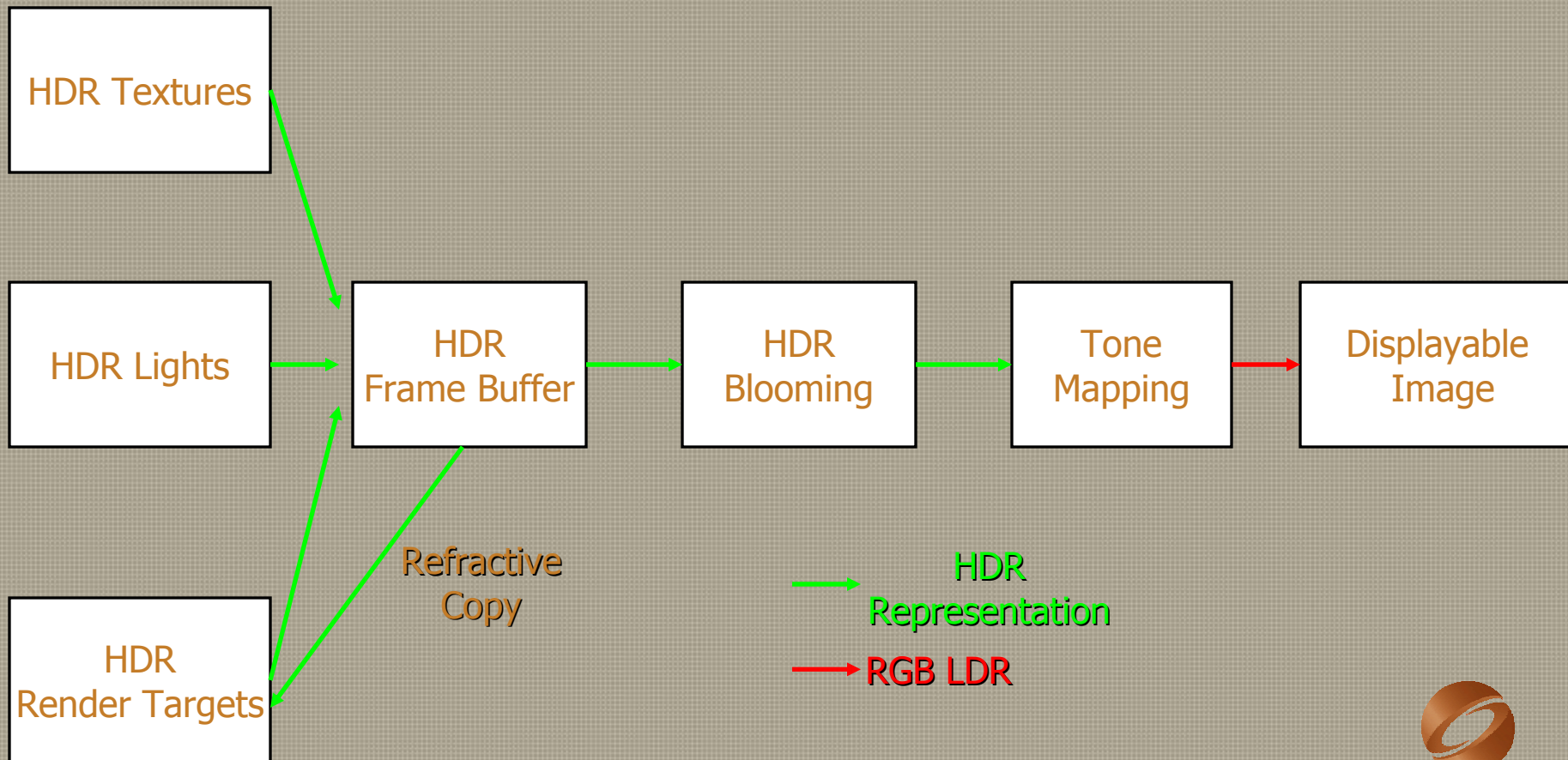
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Criteria for evaluating HDR methods

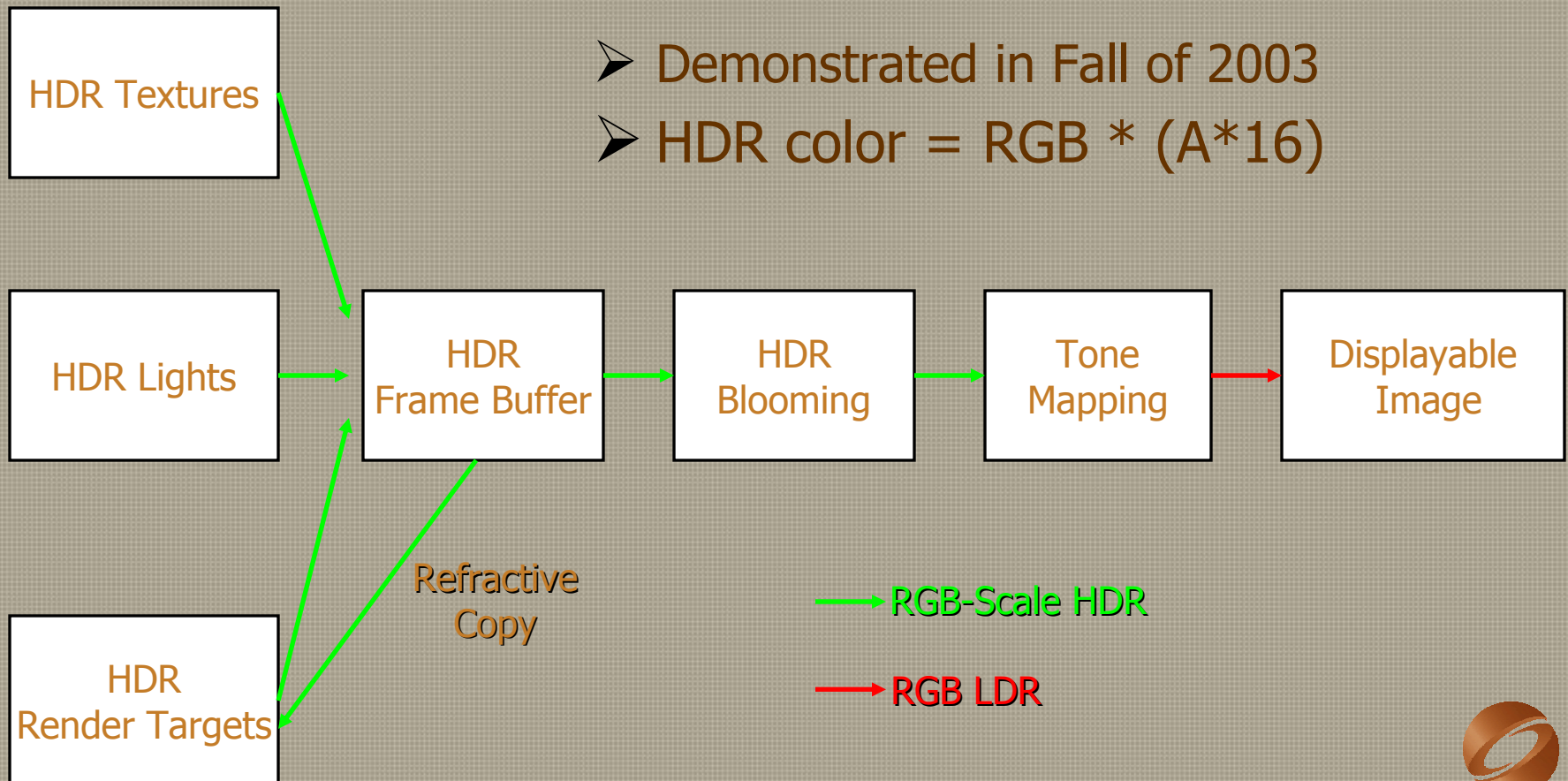
- MSAA Compatibility
- Alpha-blending Compatibility
- HDR blooming
- HDR reflection/refraction
- Bilinear filtering
- Customer hardware support
- Memory requirements
- Performance



Ideal Implementation



RGB-Scale HDR Implementation





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RGB-Scale HDR Tradeoffs

➤ Pros:

- MSAA works
- works on all DirectX 9 hardware
- HDR Blooming

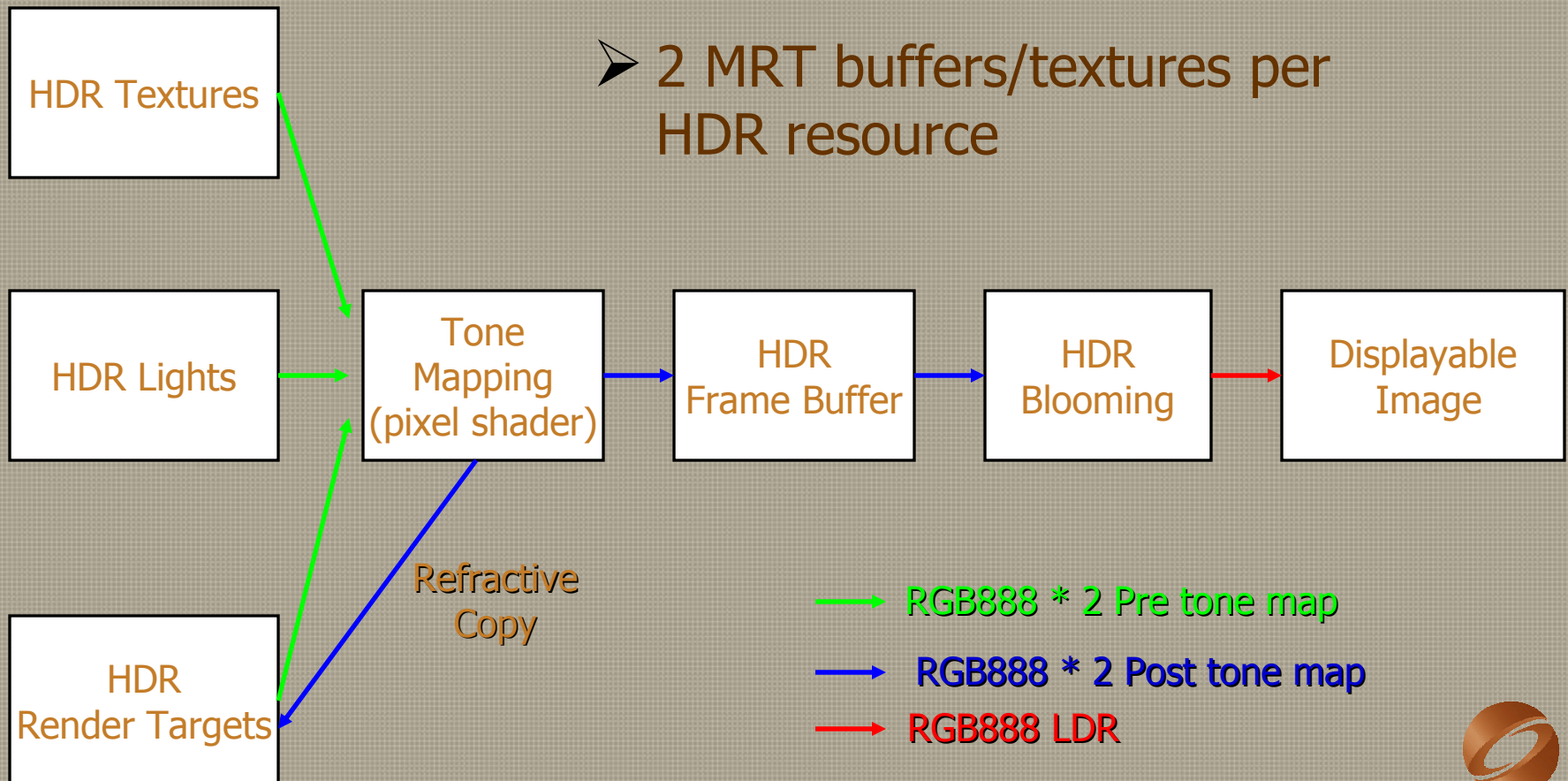
➤ Cons:

- alpha blending very difficult
- bilinear filtering doesn't work
- extra conversion of frame buffer





MRT HDR Implementation





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MRT HDR Tradeoffs

➤ Pros:

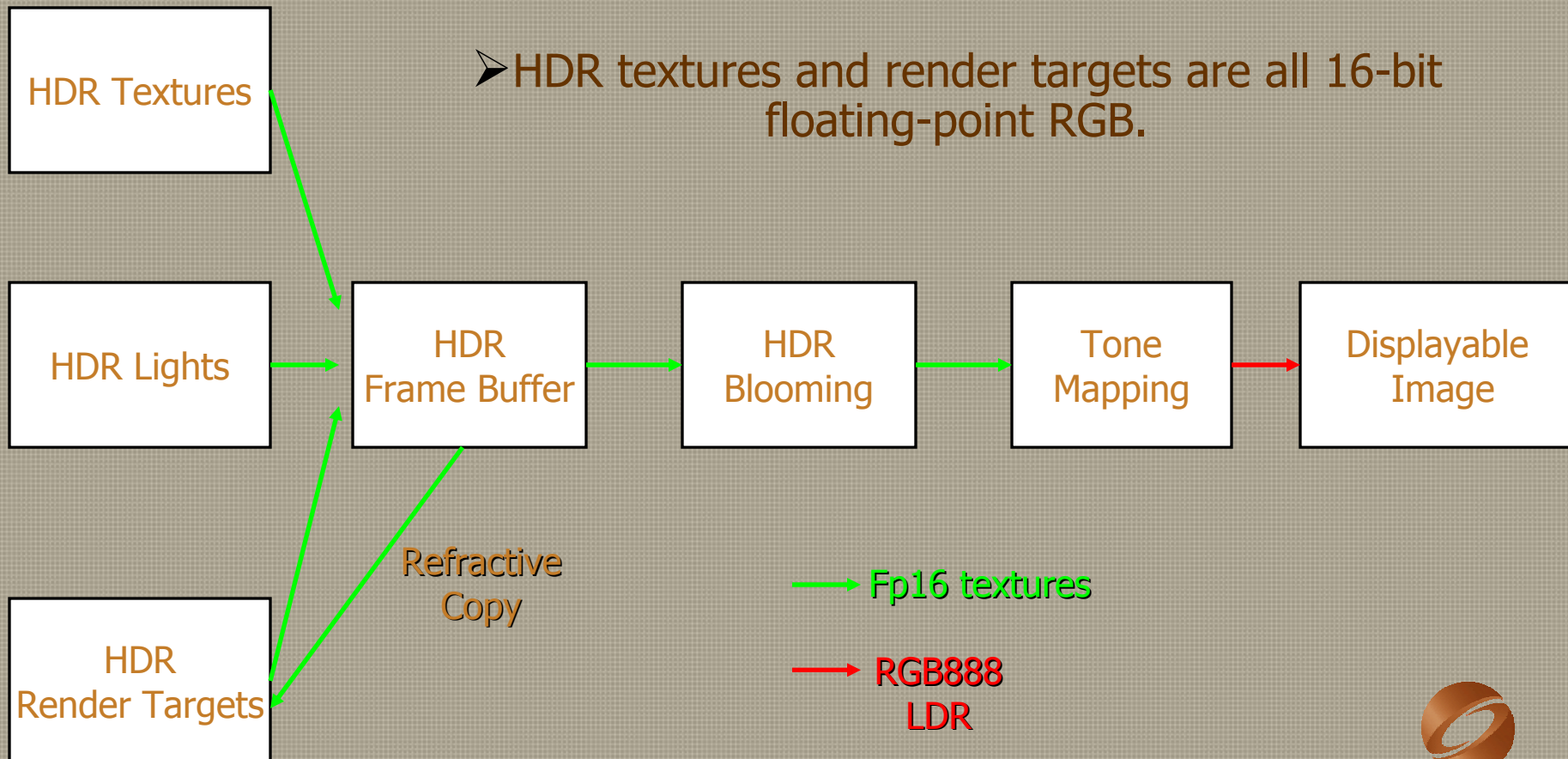
- Main motivation: alpha blending works.
- bilinear interpolation works
- works on all DirectX 9 hardware

➤ Cons:

- MSAA doesn't work
- HDR textures, render targets, etc take twice as much space.

Floating Point HDR

- HDR textures and render targets are all 16-bit floating-point RGB.





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Floating Point HDR Tradeoffs

➤ Pros:

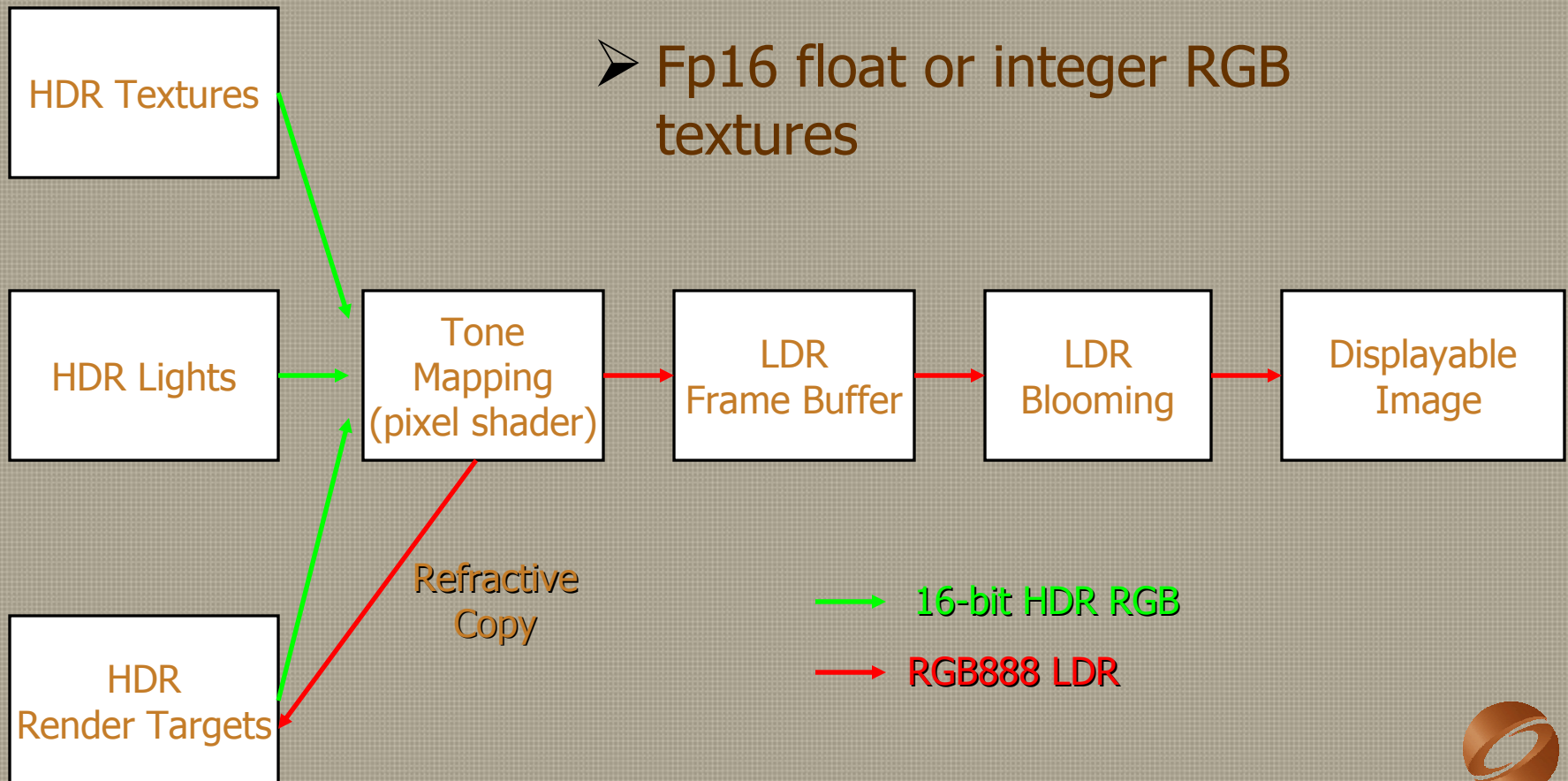
- HDR Blooming
- HDR refraction
- Improved tone mapping

➤ Cons:

- Requires fp16 alpha blending
- Bad performance
- Tons of memory
- MSAA doesn't work
- **GOTCHA! Floating point SPECIALS!!!**



Valve Integer HDR Implementation





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Valve Integer HDR Tradeoffs

➤ Pros

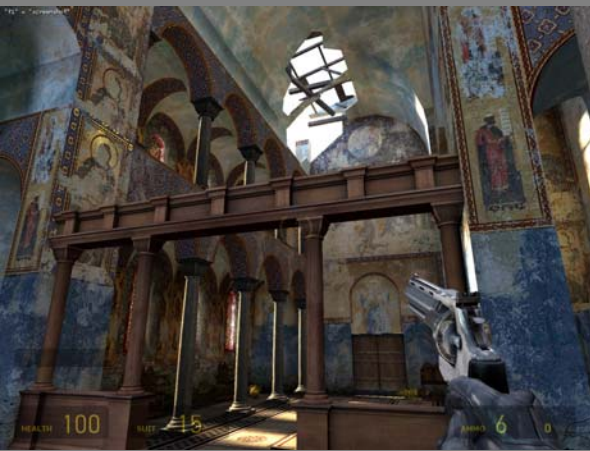
- Works on all DX9 hardware
- Lower memory requirements
- Very fast!
- Supports MSAA on all hardware
- No specials to deal with!

➤ Cons

- LDR Blooming
- LDR Refraction

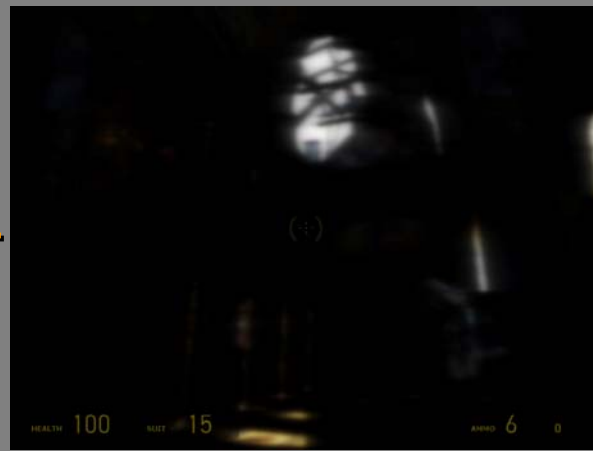


Valve Integer HDR blooming



color

+



Luminance(color) * color

=



Valve Integer HDR blooming



HEALTH 100

SUIT 15

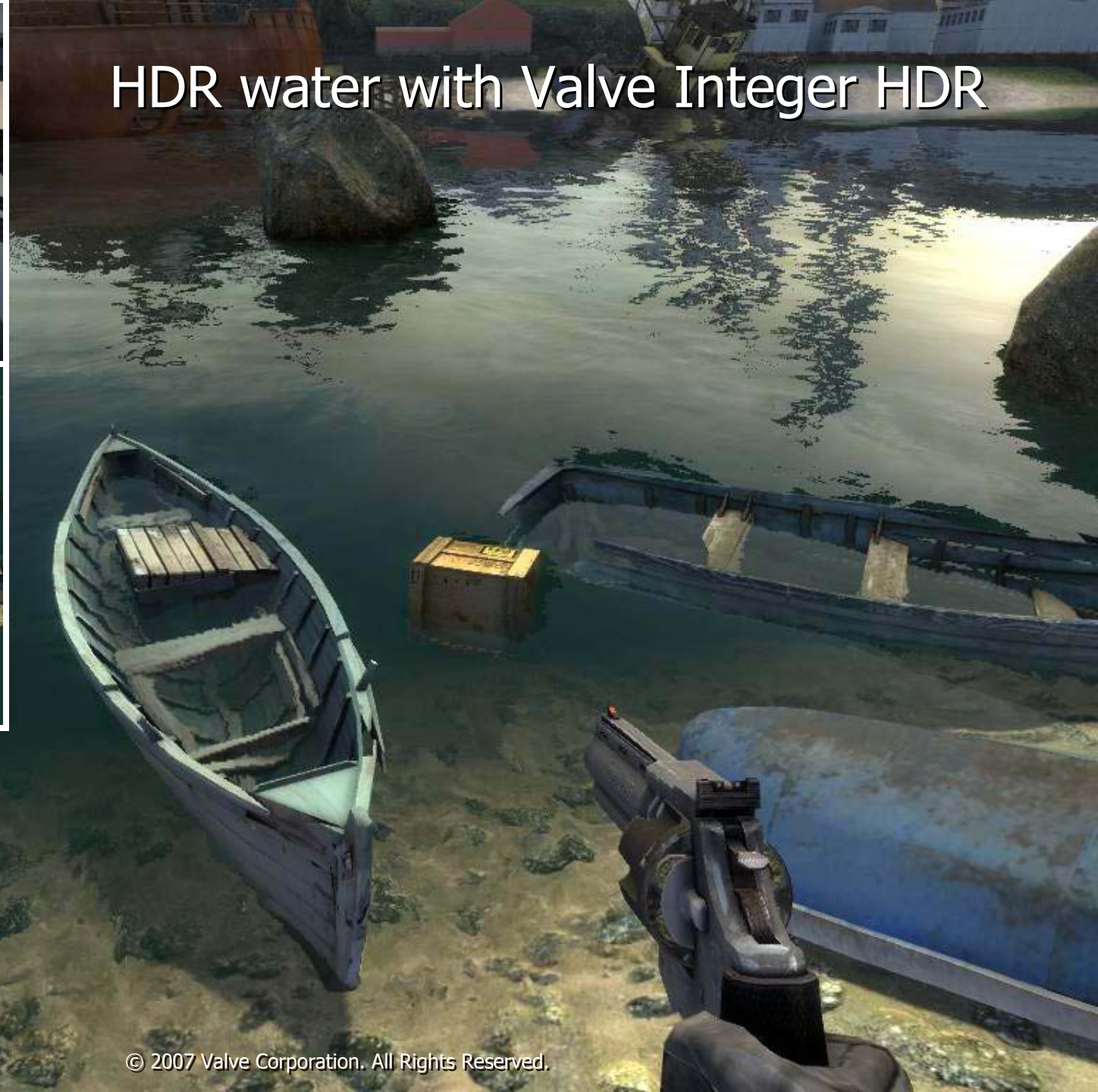
AMMO 6 0

HDR water with Valve Integer HDR

Reflection Render
Target



Refraction Render
Target



General Refraction/Valve Integer HDR



HEALTH 95

Auto Exposure



Auto Exposure





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Tone Mapping with Valve Integer HDR



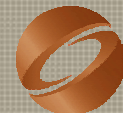
Tonemap scale = 0.5



Tonemap scale = 1



Tonemap scale = 8





VALVE

Beyond Linear Scale Tone Mapping

- Dark scenes with high exposure: desaturate
- Use Color Correction
- For more info, check out Jason Mitchell's talk in the **"Advanced Real-Time Rendering in 3D Graphics and Games"** course on Tuesday in room 156.



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Desaturation via Color Correction





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HDR and Authoring

- Bloom amount and exposure range
- Asymmetric autoexposure

Team Fortress 2: NPR + HDR!



Team Fortress 2: NPR + HDR!



Team Fortress 2: NPR + HDR!





VALVE

Conclusion

- Intro to HDR
- Reflection/Refraction
- Tone Mapping and Auto-exposure
- Road to a shippable HDR implementation



VALVE

SDK & Academic Licensing

- Publicly available SDK
- Academic licenses provide
 - Access to Valve games
 - Source code
 - HLSL shaders, Radiosity and visibility calculations
 - AI system, path finding
 - Animation system, acting system, inverse kinematics
 - Production quality art and sound assets
 - Useful level and modeling tools
 - Hammer level editor, Faceposer, Model viewing utilities

academiclicensing@valvesoftware.com

