Better Gaming Experience by NVIDIA: Ansel, ShadowPlay Highlights and HDR Extensions

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NVIDIA

Agenda

- Ansel
  - Overview
  - Features
  - Core Concepts
  - Common Integration Issues And Solutions
- ShadowPlay Highlights
  - Overview
  - Core Features
  - User Case Analysis

Ansel Overview

- Standardized photo mode for all games running on GeForce
- Built into the display driver where all the heavy lifting is done
- Each game only need to integrate a minimal SDK

Ansel Features

FREE CAMERA

FILTERS

RAW

SUPER RESOLUTION

360

https://www.youtube.com/watch?v=PfFUWeRLuOM


ANSEL
过滤器
调整
Brightness 6%
Contrast 13%
Vibrance 15%
特效
Sketch 22%
Color enhancer 31%
Vignette 0%
Grid of thirds
相机与捕获
视角 82°
旋转 0°
Raw HDR
抓拍类型
屏幕快照
拍摄
完成

Super Resolution

360

Ansel Supported Platforms

UE 4.14+

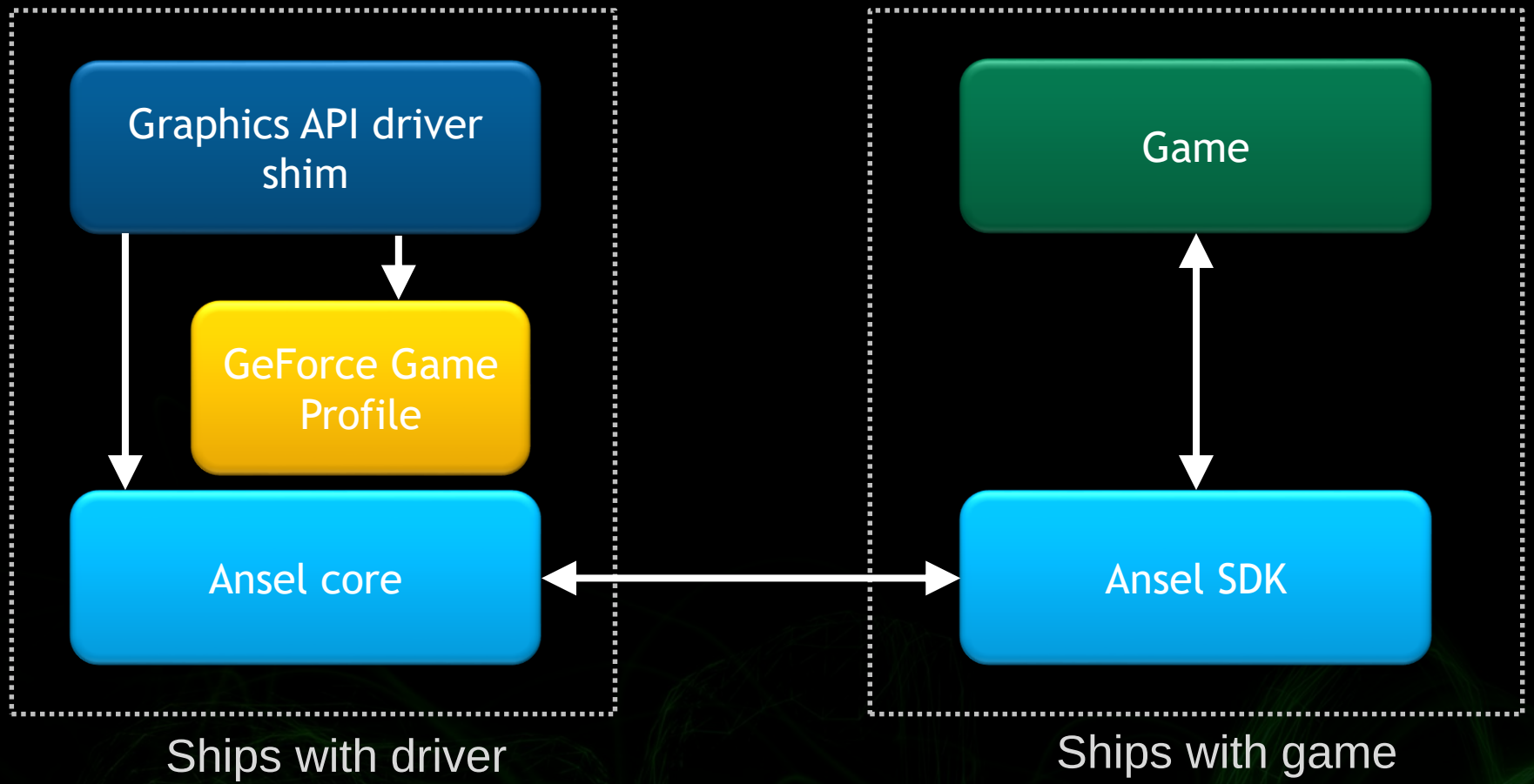
Unity Plugin

Coming soon

NVIDIA
ANSEL SDK

Gameworks Github

Ansel Architecture



Ansel Core Concepts

- Configuration
- Session
- Camera
- Hints (optional)

Configuration

```
struct Configuration
{
    nv::Vec3 right, up, forward;

    float metersInWorldUnit;
    float translationalSpeedInWorldUnitsPerSecond;
    float rotationalSpeedInDegreesPerSecond;

    uint32_t captureLatency;
    uint32_t captureSettleLatency;

    bool isCameraOffcenteredProjectionSupported;
```

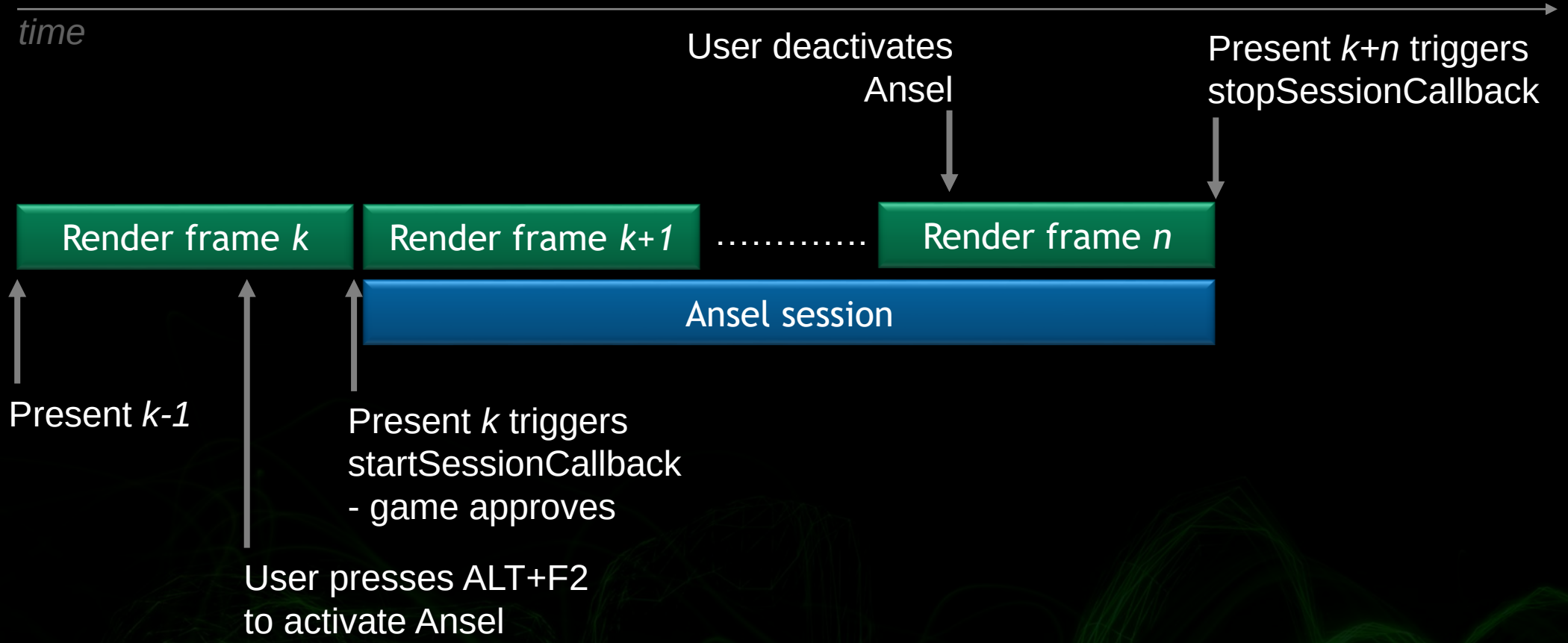
Session

- Session is the period when a player is in Ansel mode
- Session is typically started & stopped by the player

```
struct Configuration
{
    StartSessionCallback startSessionCallback;
    StopSessionCallback stopSessionCallback;

    StartCaptureCallback startCaptureCallback;
    StopCaptureCallback stopCaptureCallback;
```

Event timeline for a Session



Camera

```
struct Camera
{
    nv::Vec3 position;
    nv::Quat rotation;
    float fov;
    float projectionOffsetX, projectionOffsetY;
};

ANSEL_SDK_API void updateCamera(Camera& camera);
```

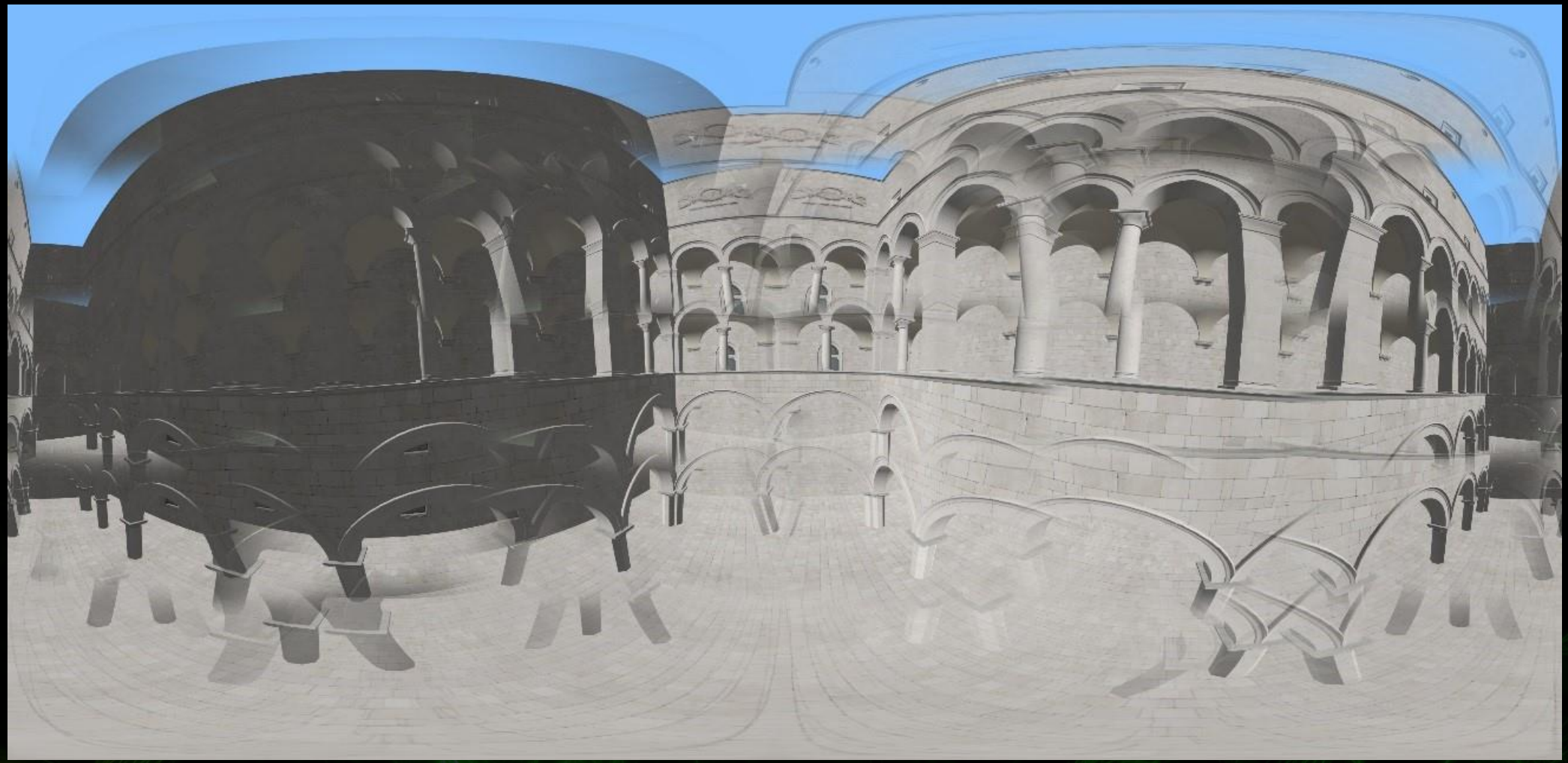
Ansel Common Integration Issues

- Double mouse cursors
- Image tiles suffer from "acne"
- Ghosting everywhere in final picture
- Not compatible with some post-effects


ANSEL
Filter
Adjustments
FX
Camera & Capture
Field of view
91°
Roll
0°
Raw HDR
Capture type
Screenshot
Snap
Done
Double mouse cursor
Game must hide all UI elements
while session is active

“Acne” Caused By TAA

“Ghosting” Caused By Error FOV



“All blurred” Caused By Motion Blur

Handling vignette correctly

Regular shot (vignette active)

Super resolution shot (vignette disabled)
+ vignette applied by user via Ansel filters

THE WITCHER 3: WILD HUNT

200,000 ANSEL WORKS OF ART

WATCH DOGS 2

“ It's a joy to witness what our players can create with Ansel and how easily it allows for high-quality, professional results ”

FLORIN SANDA, UBISOFT PRODUCER

WAR THUNDER

“When you see that Nvidia Ansel is added to the game. Life is complete.”

MOTOR_STORM, WAR THUNDER GAMER

Photo by Vachtar

SHADOWPLAY

CAPTURE YOUR BEST GAMING MOMENTS

200M
videos per year

2x
year over year growth

ShadowPlay Highlights

Desired functionality

Convenience

- I’m busy playing; my fingers and brain aren’t free to hit the record hot-key
- Can you just do it automatically for me?
- Plus, if I’m going to share something, I want it to be dead simple

Auto-curation

- I can’t waste time looking for the good stuff in a two hour recording
- Can you just record the cool moments and show them to me?

Design Methods

Leveraging GeForce Experience's Recording tech

- When something interesting happens, **the** game tells GeForce Experience to save a specific portion of gameplay as video or screenshot

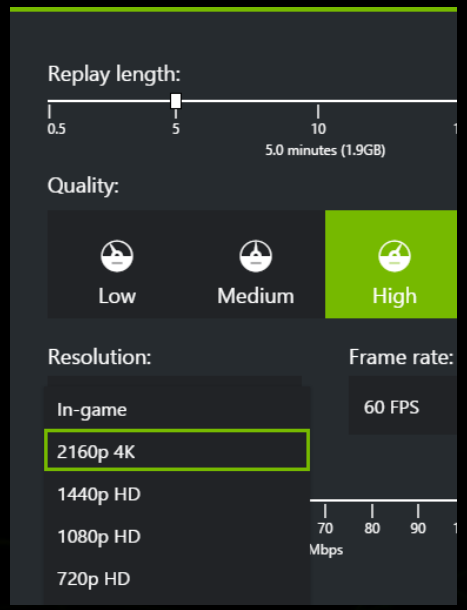
Leveraging GeForce Experience's Overlay

- After a session, game can tell GeForce Experience to display a summary of highlights for that session for the user to review and potentially share

Key Features

- Control the type of highlights recorded per-game
- Review highlights after the game session or from the Gallery
- Elect to enter or skip summary via game UI
- Specify the amount of disk space devoted to highlights
- No game FPS drops
- Minimal system resource use

CONFIGURATION (USER)



Video settings
Highlights settings
Notifications settings

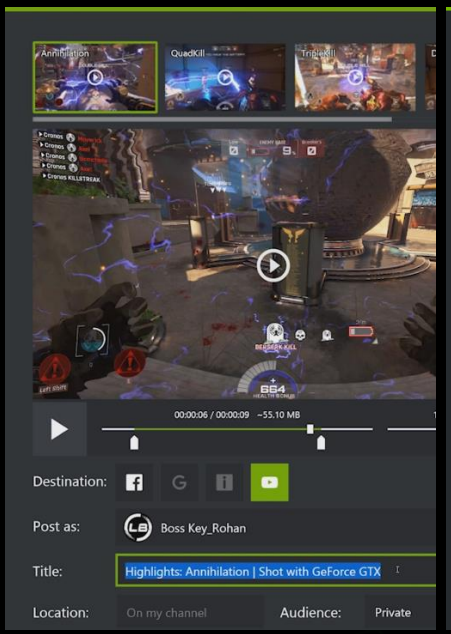
VIDEO (GAME)

4K 60 FPS H.264
no impact to gameplay

SCREENSHOTS (GAME)

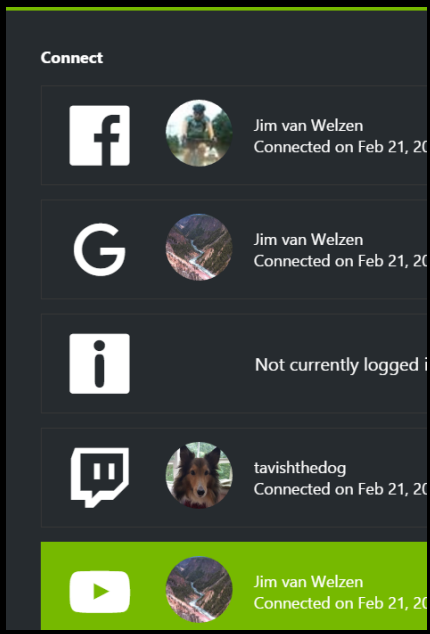
4K PNG images
no impact to gameplay

REVIEW (USER)



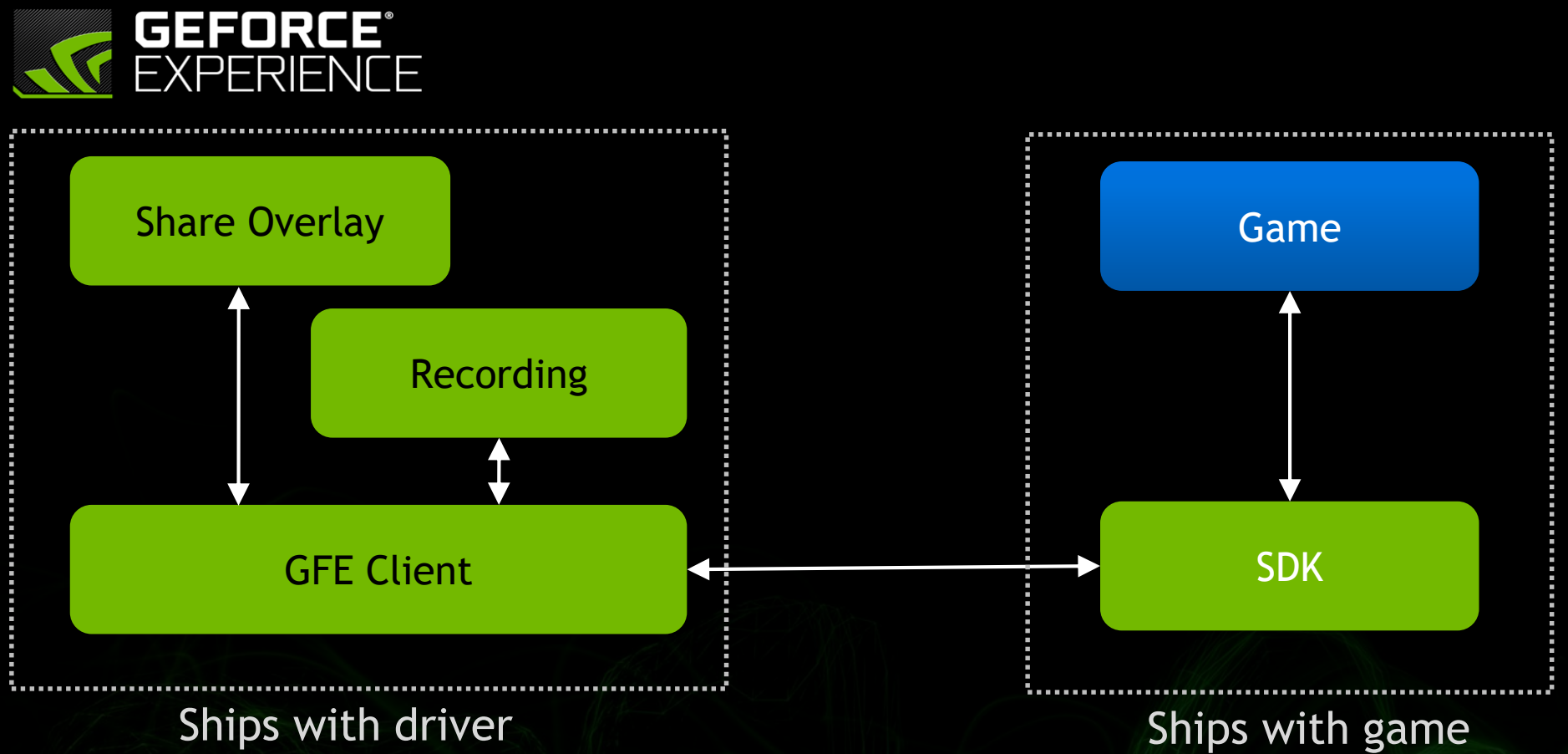
In-game overlay
Review, trim, upload

SHARE (USER)



Facebook
YouTube
Imgur
more coming...

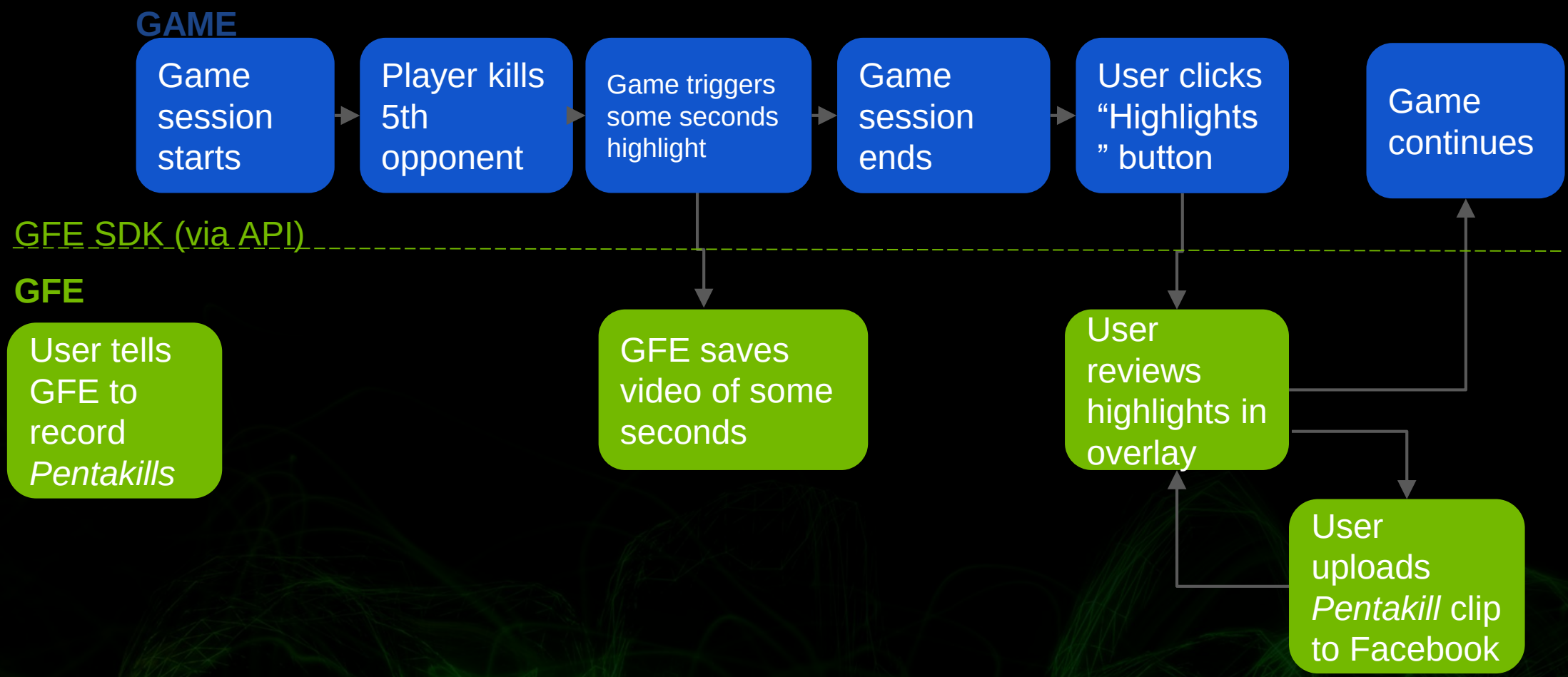
ShadowPlay Highlights Architecture



API

NVGSDK_Create	// Construct the main SDK interface.
NVGSDK_Highlights_Configure	// Provide a list of possible highlight types to GFE
NVGSDK_Highlights_StartSession	// Begin a session which groups several highlights together
NVGSDK_Highlights_SetScreenshotHighlight	// Captures a screenshot highlight of given type for current session
NVGSDK_Highlights_SetVideoHighlight	// Captures a video highlight of given type for current session
NVGSDK_Highlights_StopSession	// Stop a session which groups several moments together
NVGSDK_Highlights_OpenSessionSummary	// Ask GFE to display summary for all highlights in the last session
NVGSDK_Release	// Release the main SDK interface

Example ShadowPlay Highlights Flow



Setting a Highlight

```
NVGSDK_Highlights_SetVideoHighlight

    ( hSDK, “5v5Fight”, {“kill”, startDelta = -4000, endDelta = -1000} );
```

User Case Analysis


Cronos Maverick
Cronos Axel
Cronos Bomchelle
Cronos Axel
Cronos KILLSTREAK
Low
ENEMY BASE
8%
Breakers
BETA v 128110
ANNIHILATION
QUAD KILL
Q
E
Left Shift
664
HEALTH BONUS
BETA FOOTAGE


Cronos Maverick
Cronos Axel
Cronos Bomchelle
Cronos Axel
Cronos KILLSTREAK
Low
ENEMY BASE
9 %
Breakers
Highlight saved to Gallery!
34m
BERSERK KILL
Q
E
Left Shift
+
664
BETA FOOTAGE


Highlight saved to Gallery!
VICTORY
BETA
FOOTAGE

PERSONAL RESULTS

ALL ROLES

Cronos

SCORE	525
KILLS	4
DEATHS	0
ASSISTS	0
OBJECTIVES	0
TOTAL DAMAGE DONE	0
TOTAL PLAYTIME	26M 5S

7 NEW HIGHLIGHTS

CONTINUE TO LOBBY

NEXT MATCH STARTS IN: 00:52

OVERCHARGE / PROMENADE

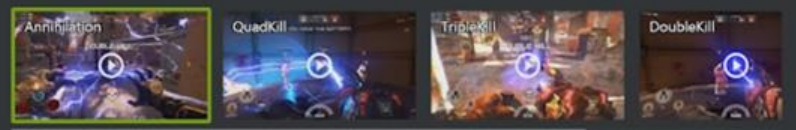
PRESS ESC TO RETURN TO THE LOBBY

BETA FOOTAGE

GeForce Experience

PERSONAL RESULTS

Highlights



00:00:06 / 00:00:09 ~55.10 MB 100%

Destination:

Post as: Boss Key_Rohan

Title: Highlights: Annihilation | Shot with GeForce GTX - YEP! 55/100

Location: On my channel Audience: Private

Upload

Done

BETA FOOTAGE

Why you should integrate ShadowPlay Highlights

- Capture your players' best gaming moments automatically
- Frictionless sharing to social media
- No game modification required
- Optionally add UI element for access to highlights within game
- Technology works equally well with single- and multiplayer games
- Rolling your own solution is a large investment

Sign up for SDK: https://developer.nvidia.com/shadowplay-highlights

HDR

- The Current and Future of HDR
- Tone Mapping
- HDR Display Pipeline
- Best Practices
- QA

HDR

LDR

The Current and Future of HDR

The Current of HDR

- Current LCD monitors: maximum luminance of ~100 nits
- sRGB: 33% of the visual locus, maximum luminance of 80 nits

New Displays

- High-end professional color grading displays
  - Dolby Pulsar (4000 nits), SONY X300 (1000 nit OLED)
- UHD TVs
  - LG, SONY, Samsung… (1000 nits, high contrast, Dolby Vision, etc)
- HDR monitor
  - ACER HDR G-Sync (1000 nits , HDR10)

New HDR Standards

- UHD Alliance Premium Certified
- HDR10,HDR10+
- Dolby Vision
- ……

New HDR Standards

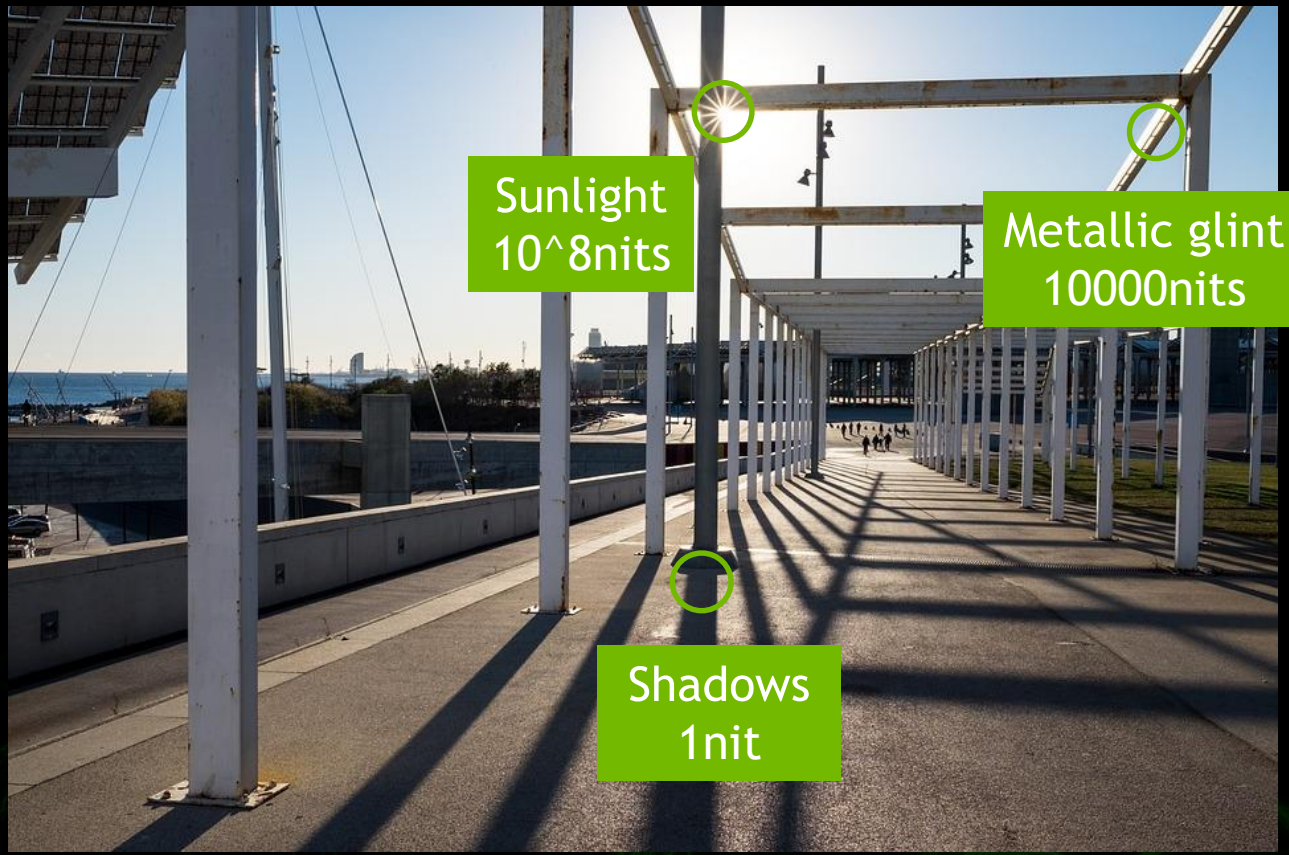
- Much higher luminance range (contrast ratios)
- DCI-P3 or BT. 2020 color space
- 10-bit or more color depth
- SMPTE ST-2084 Dolby Perceptual Quantizer Electro-Optical Transfer Function
- SMPTE ST-2094 Dynamic metadata specification

The Future of HDR

- High Dynamic Range
- Wide Color Gamut
- Better Color Precision
- High Resolution

High Dynamic Range

- Luminance: A measure of light emitted per unit area
- Dynamic range: from the darkest to the brightest
- Human eye: Limited to 10^5 – 10^6

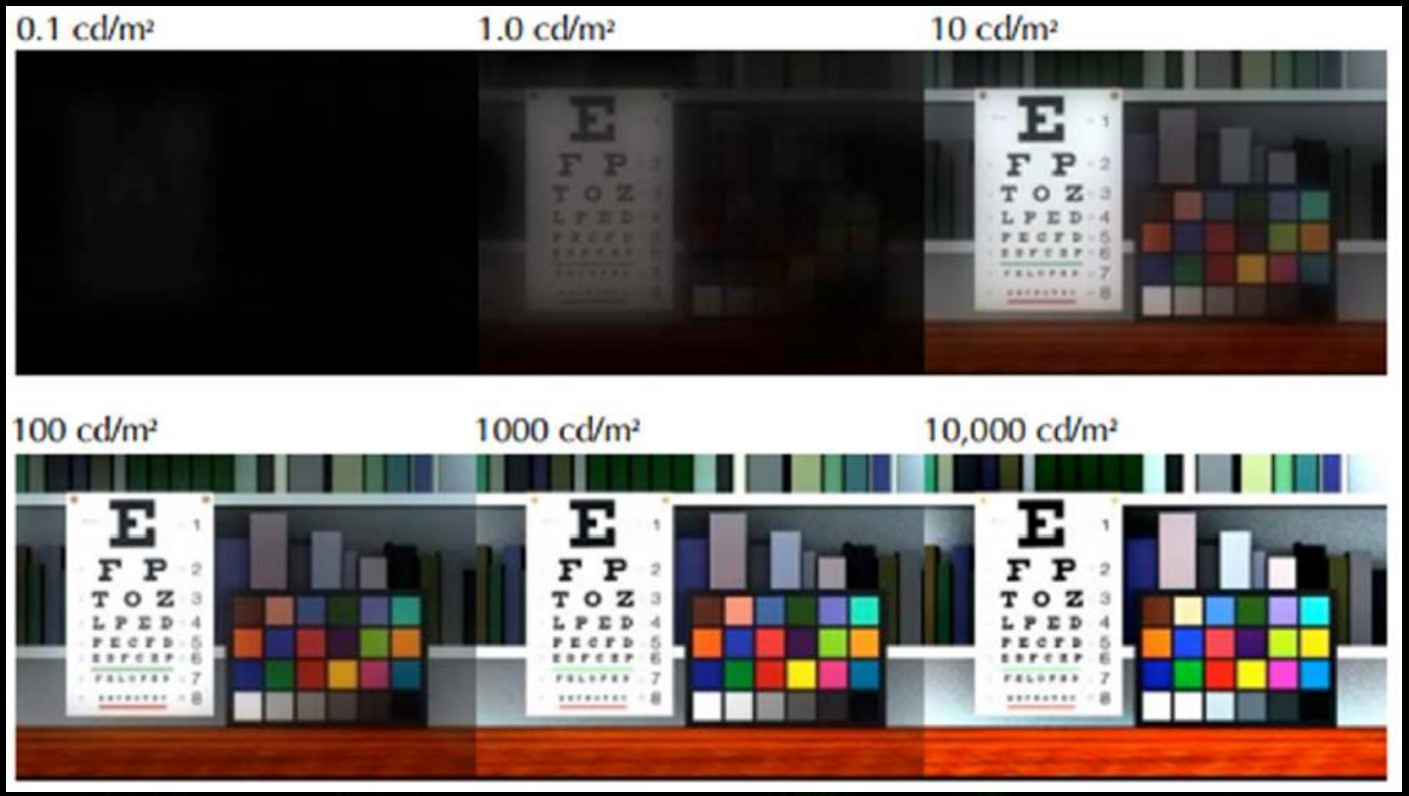


*Pictures from the Internet

Luminance Unit : nit, 1 nit = 1 cd / m2

High Dynamic Range

- More colorful
  - Hunt Effect
- More contrast
  - Stevens Effect
- Brighter brightness
  Darker darkness
- Reduces clipping and compression issues



http://rit-mcsl.org/fairchild/PDFs/AppearanceLec.pdf

Wide Color Gamut

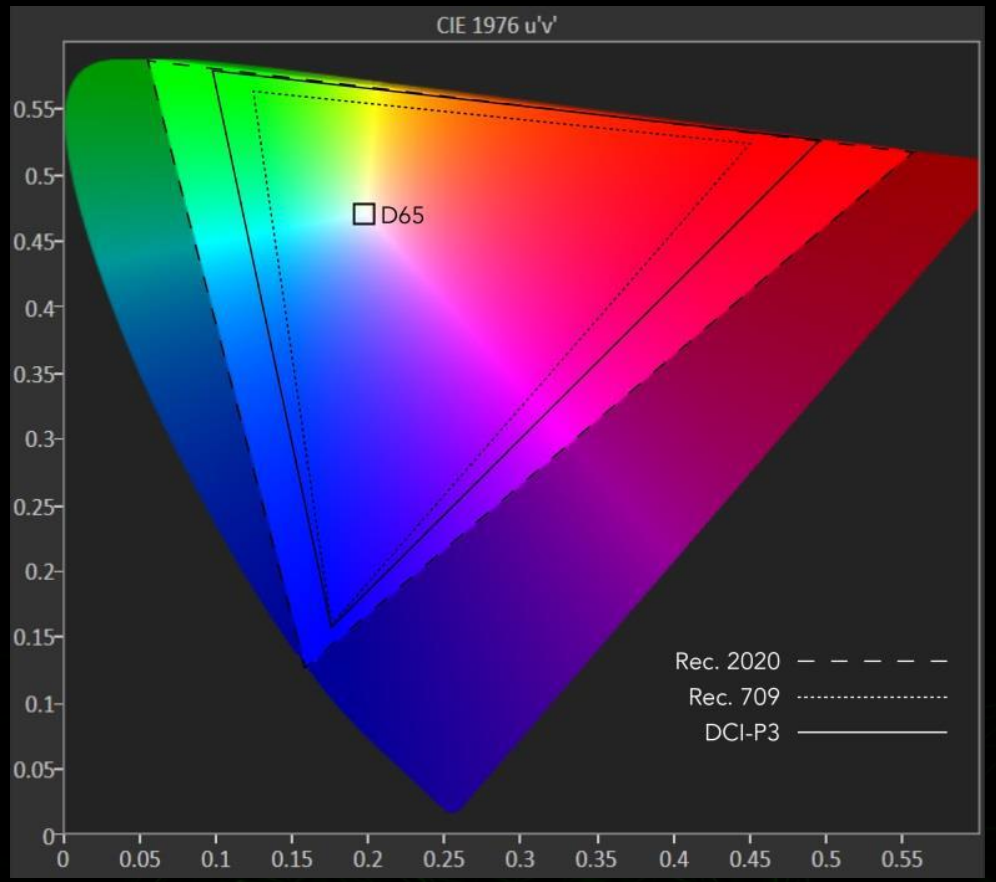


Image credit: W3C

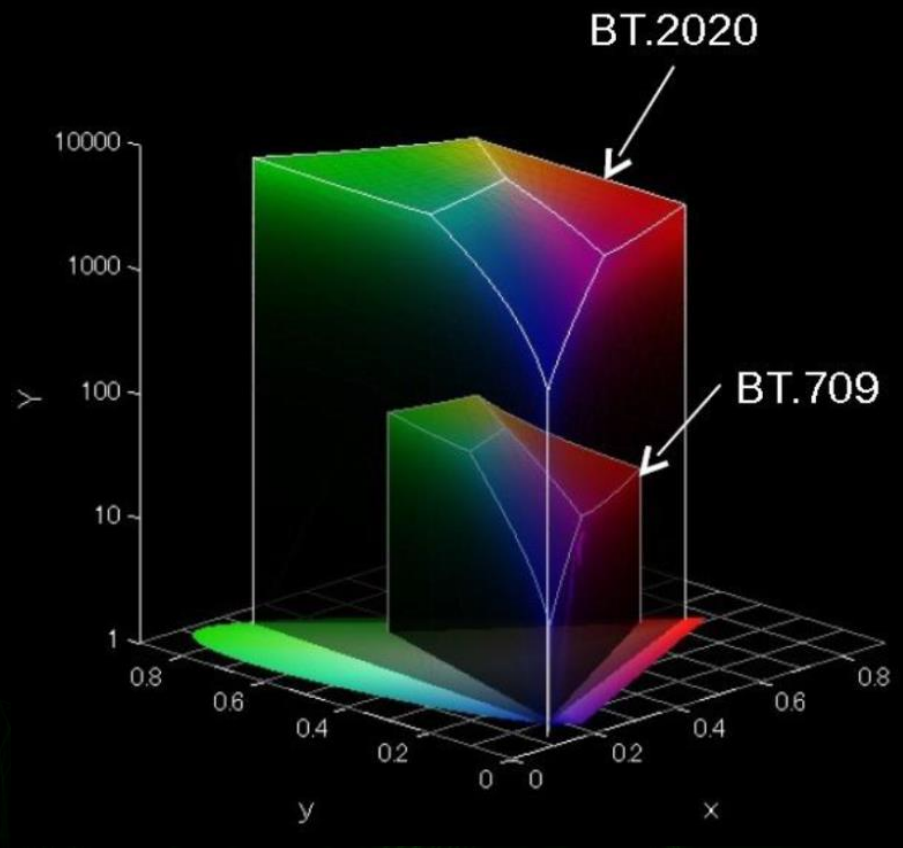
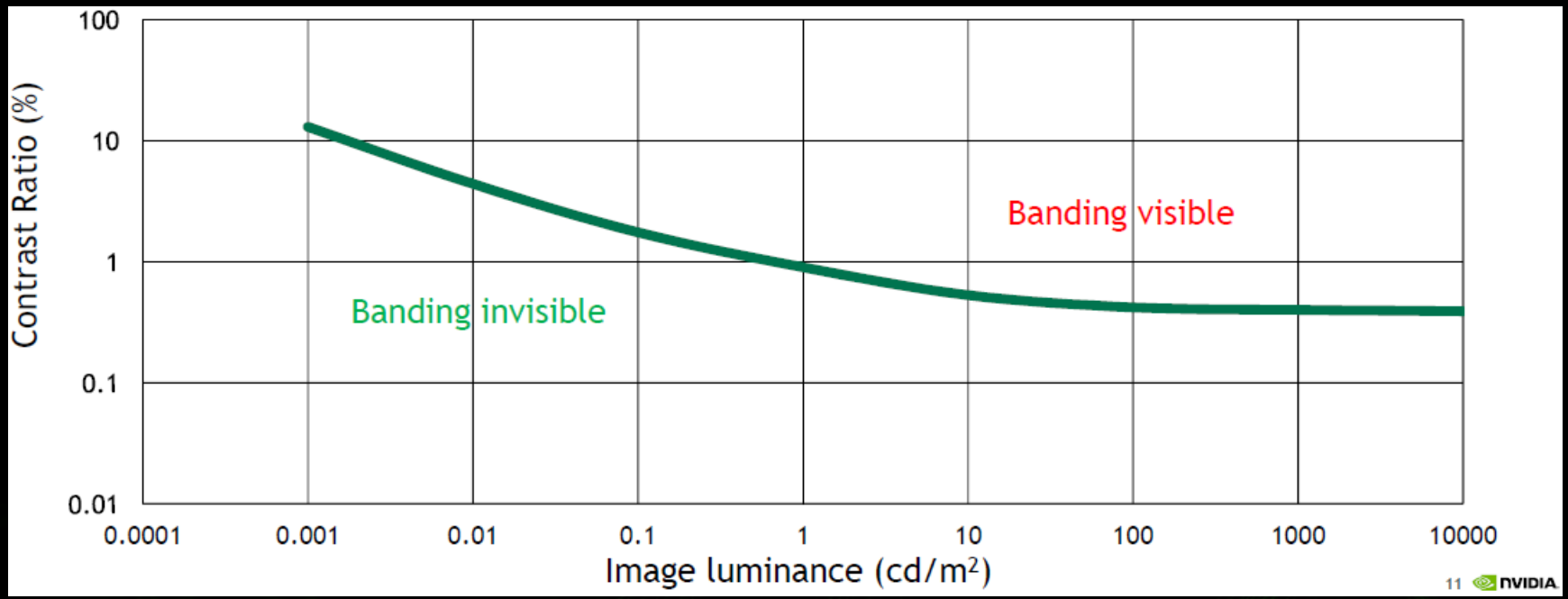


Image credit: Sony

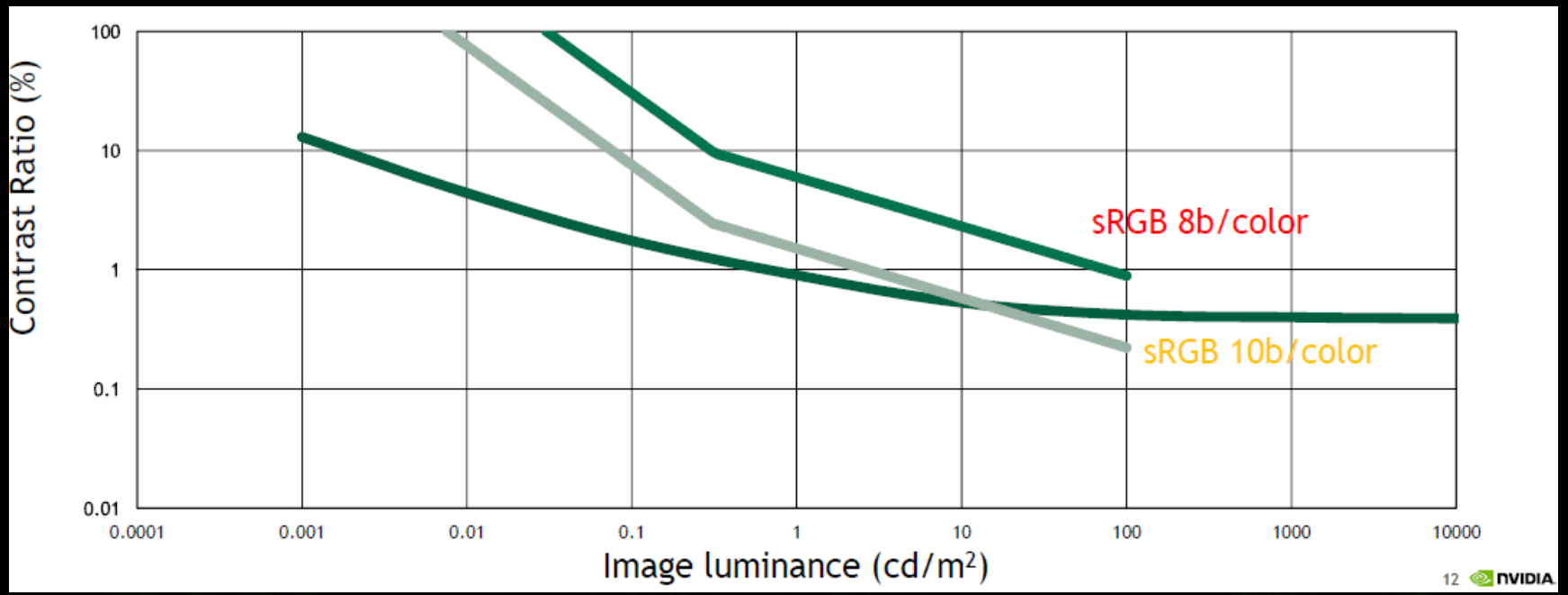
Better Color Precision

Better Color Precision



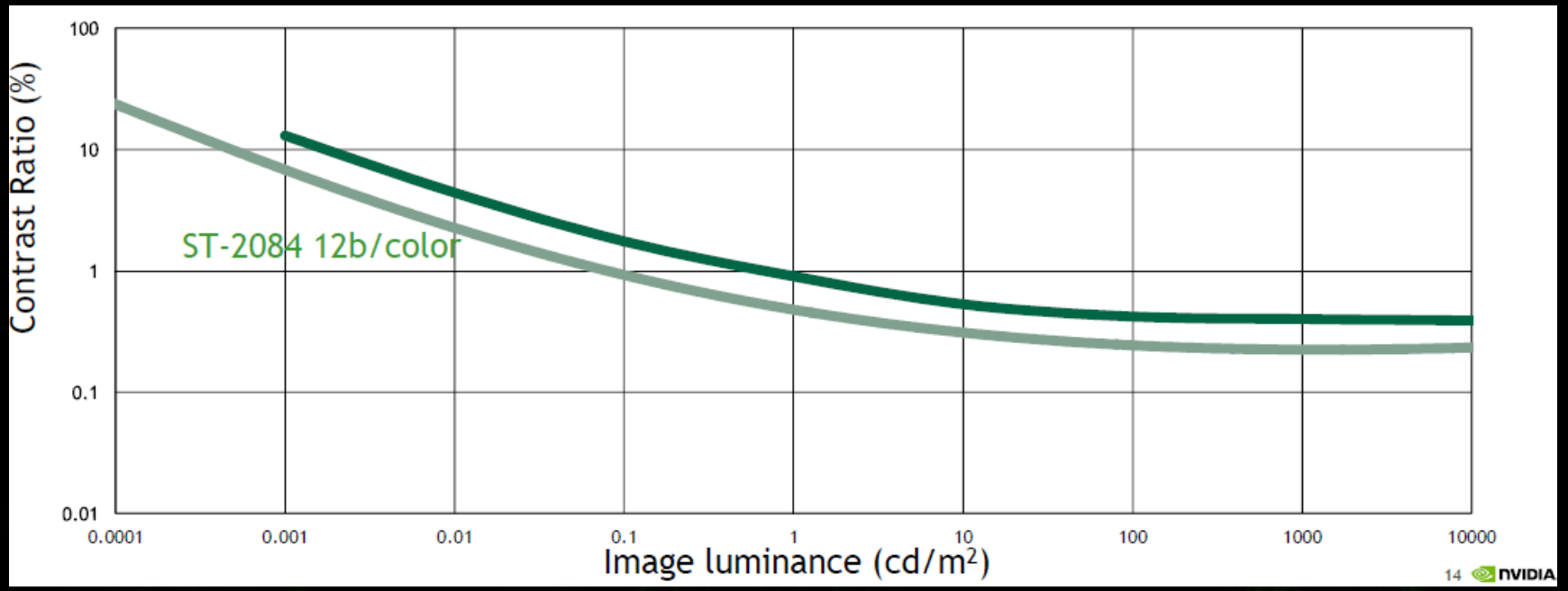
[Barten 1999]

Better Color Precision



sRGB

Better Color Precision



SMPTE ST-2084

Tone Mapping

What is Tone Mapping?

- Compresses or clips the color data into the output range
- Compresses shadows and highlights
- Enhances mid-tone contrast
- Irreversible, data is lost

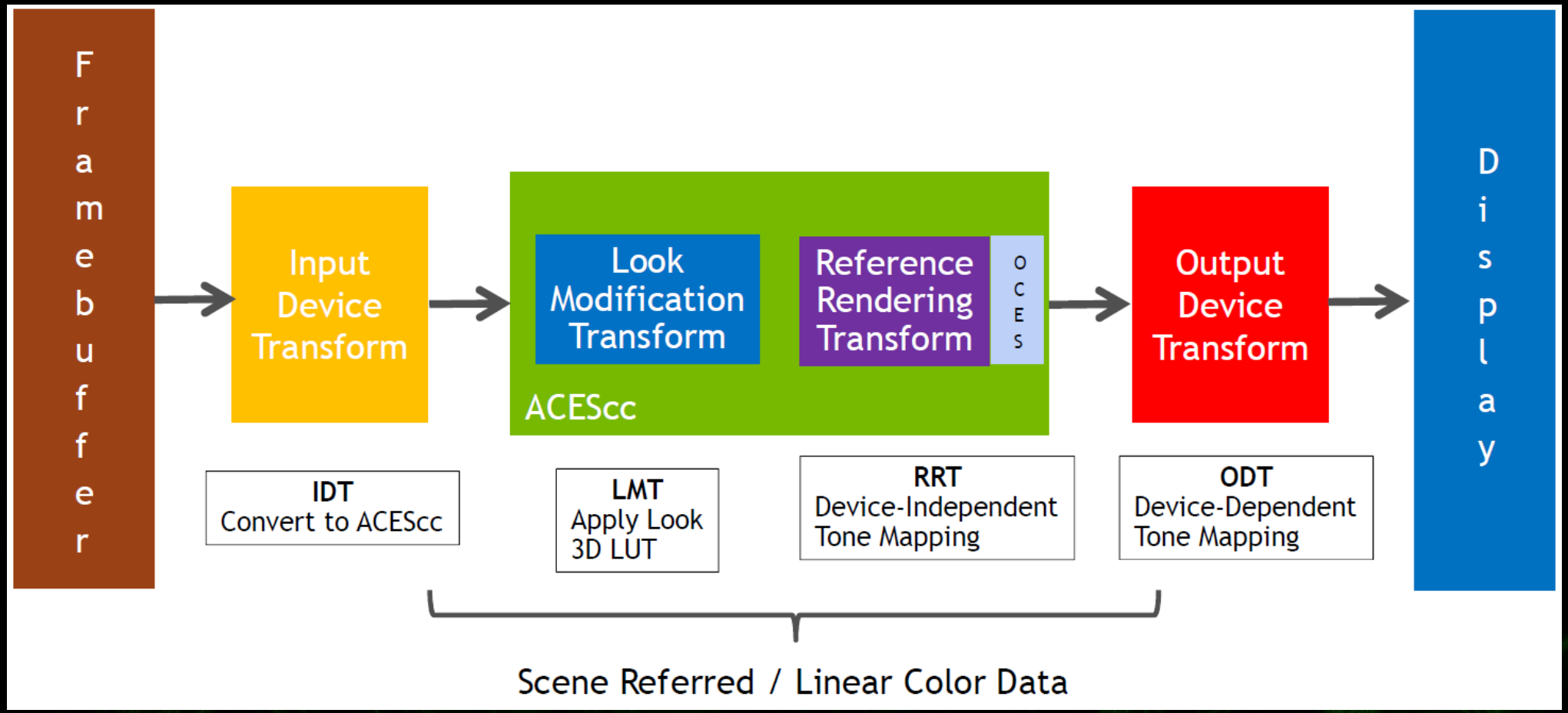
Why Tone Mapping for HDR?

- HDR displays still limited (1000 nit max)
- Permits differentiation of output luminance levels
- HDR adds complexities that could be ignored in LDR

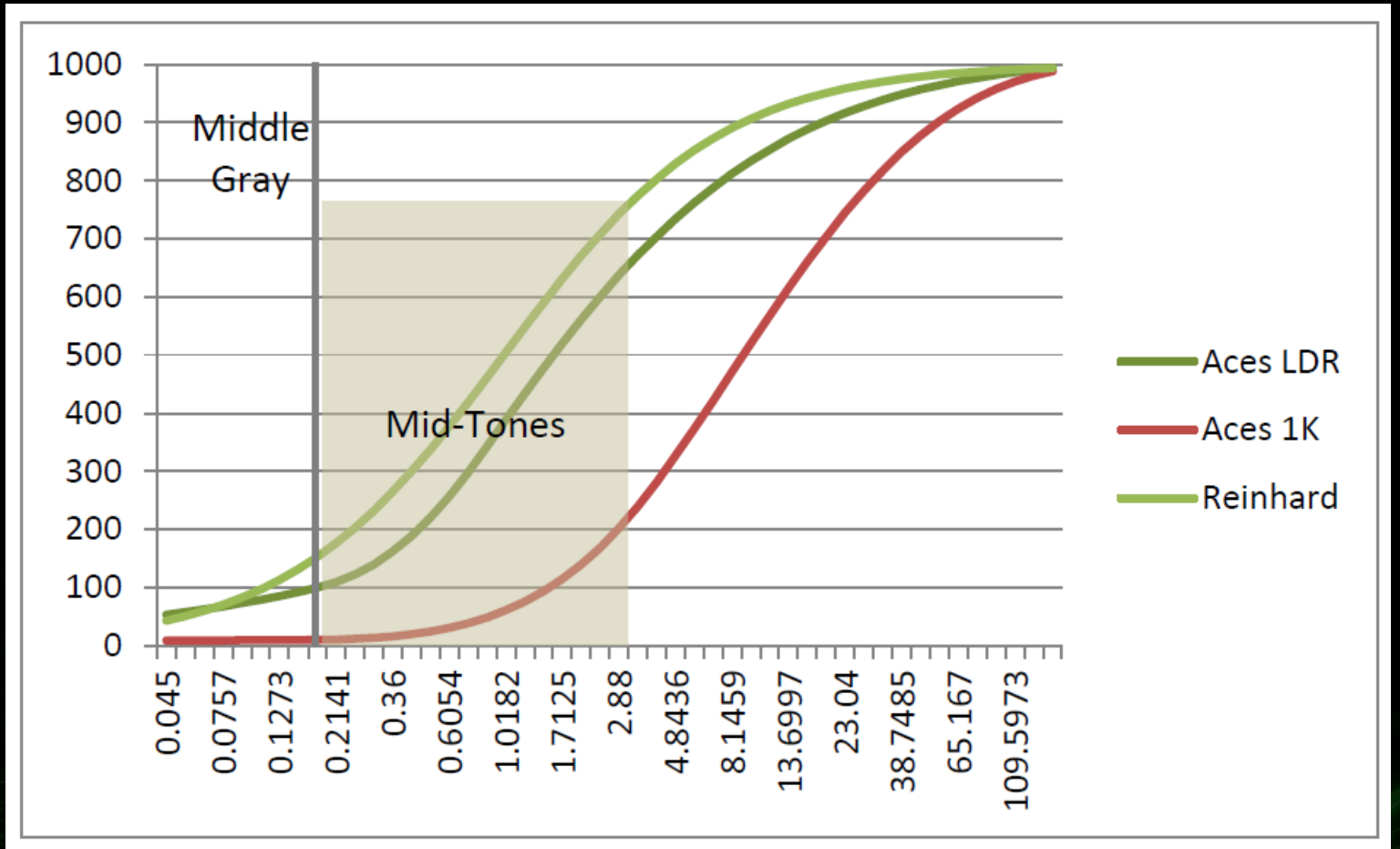
ACES – Academy Color Encoding System

- Standard for digital post-production
- Driven by the Academy of Motion Pictures
- Framework for end-to-end processing and preservation of data
- Tone mapping for different classes of displays
- Reference is written in Color Transform Language
- Open-source and available on GitHub

ACES Pipeline



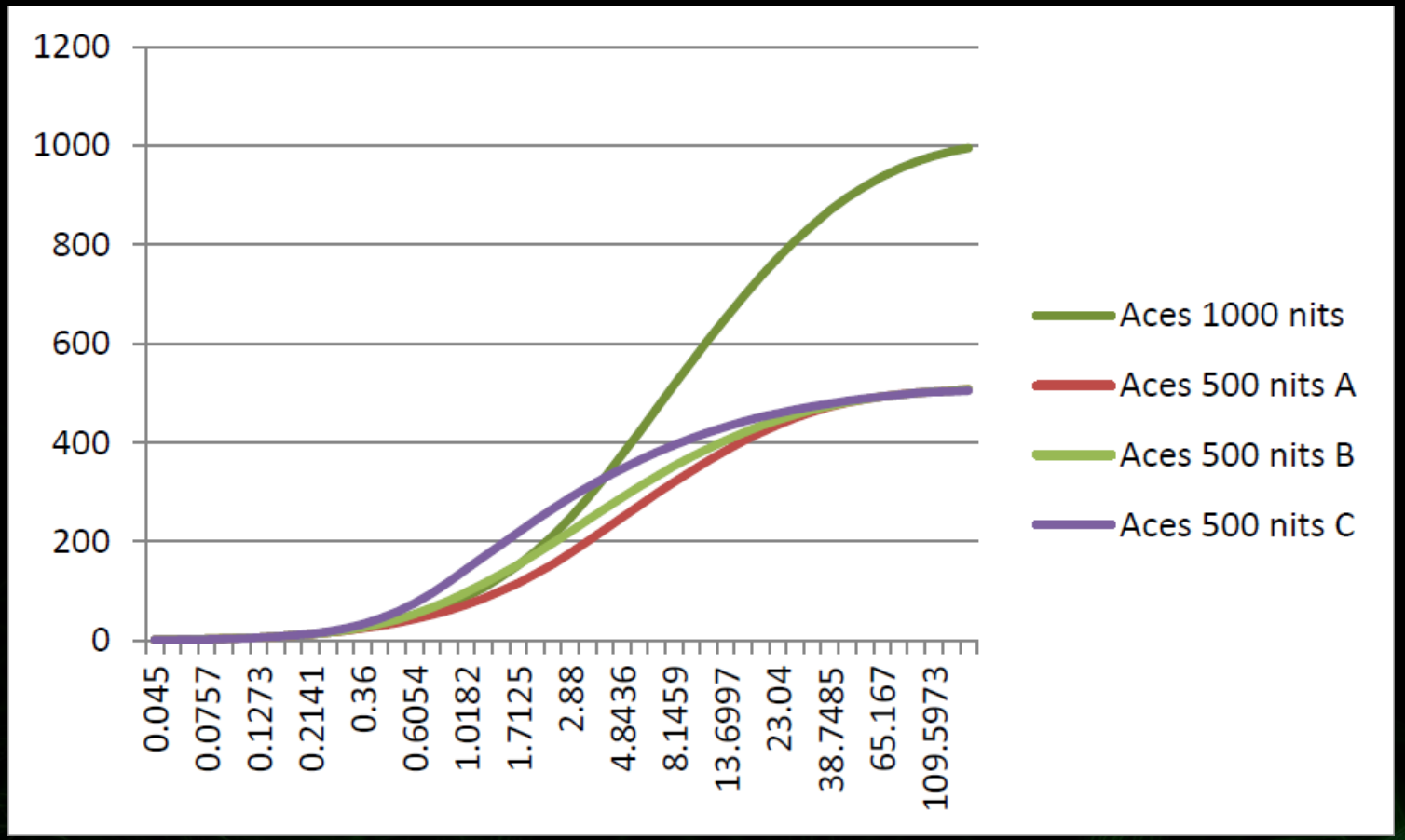
ACES Tone Mapping



Parameterized ACES

- Parameterized ODT developed by NVIDIA
- Allows adaptation of the reference transforms to a wider set of uses
  - Alter output middle gray level
  - Alter input and output range of tone mapper
  - Saturation adjustment
  - Contrast adjustment

Parameterized ACES

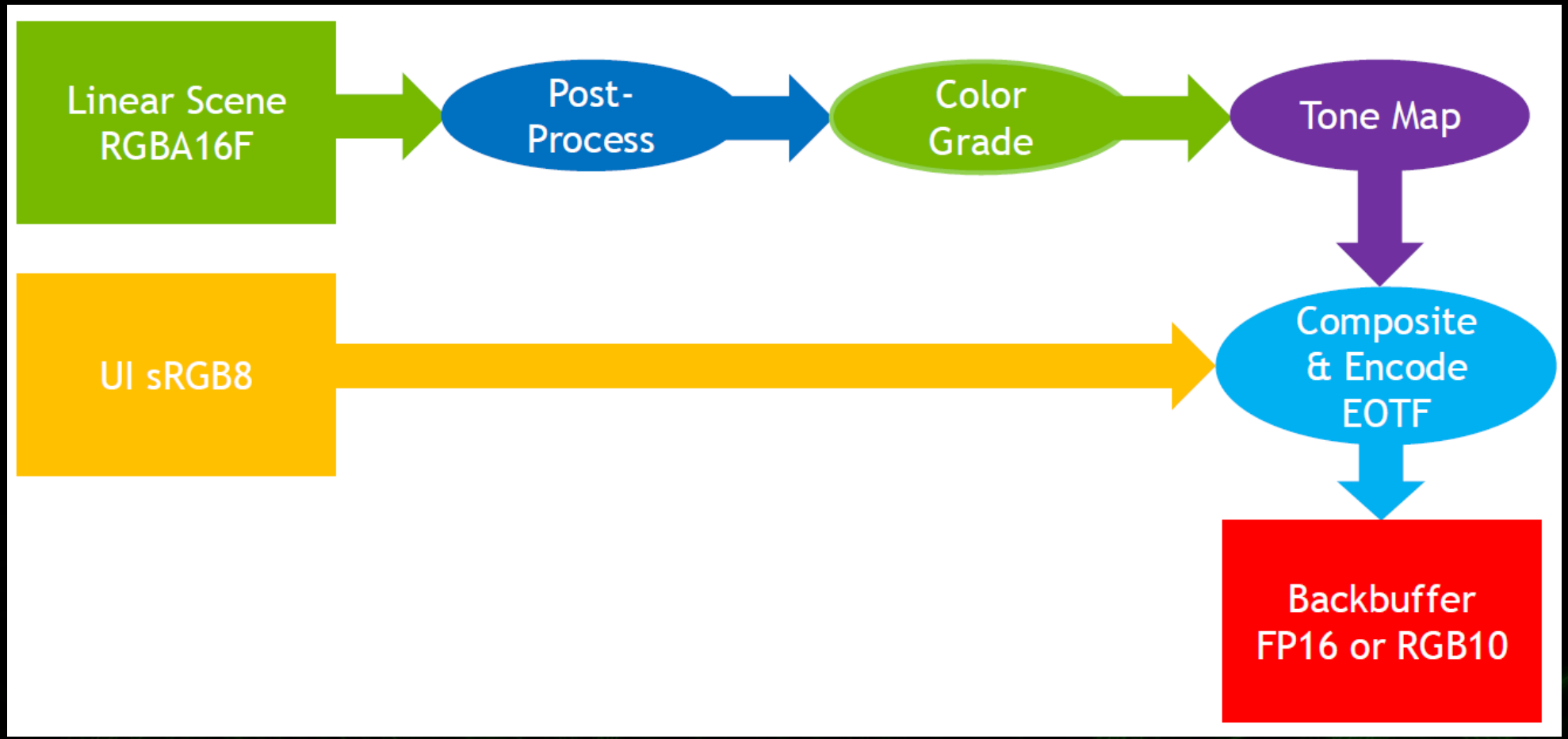


HDR Display Pipeline

Practical Path to Utilizing Current HDR Displays

- Create content with sRGB primaries as done today for LDR
- Render high-quality HDR using physically-based shading
- Apply post process and color grading in the scene referred space
- Tone map with a filmic ACES-derived tonemapper
- Keep backbuffer in FP16 scRGB
- Composite 8-bit sRGB referenced UI as normal

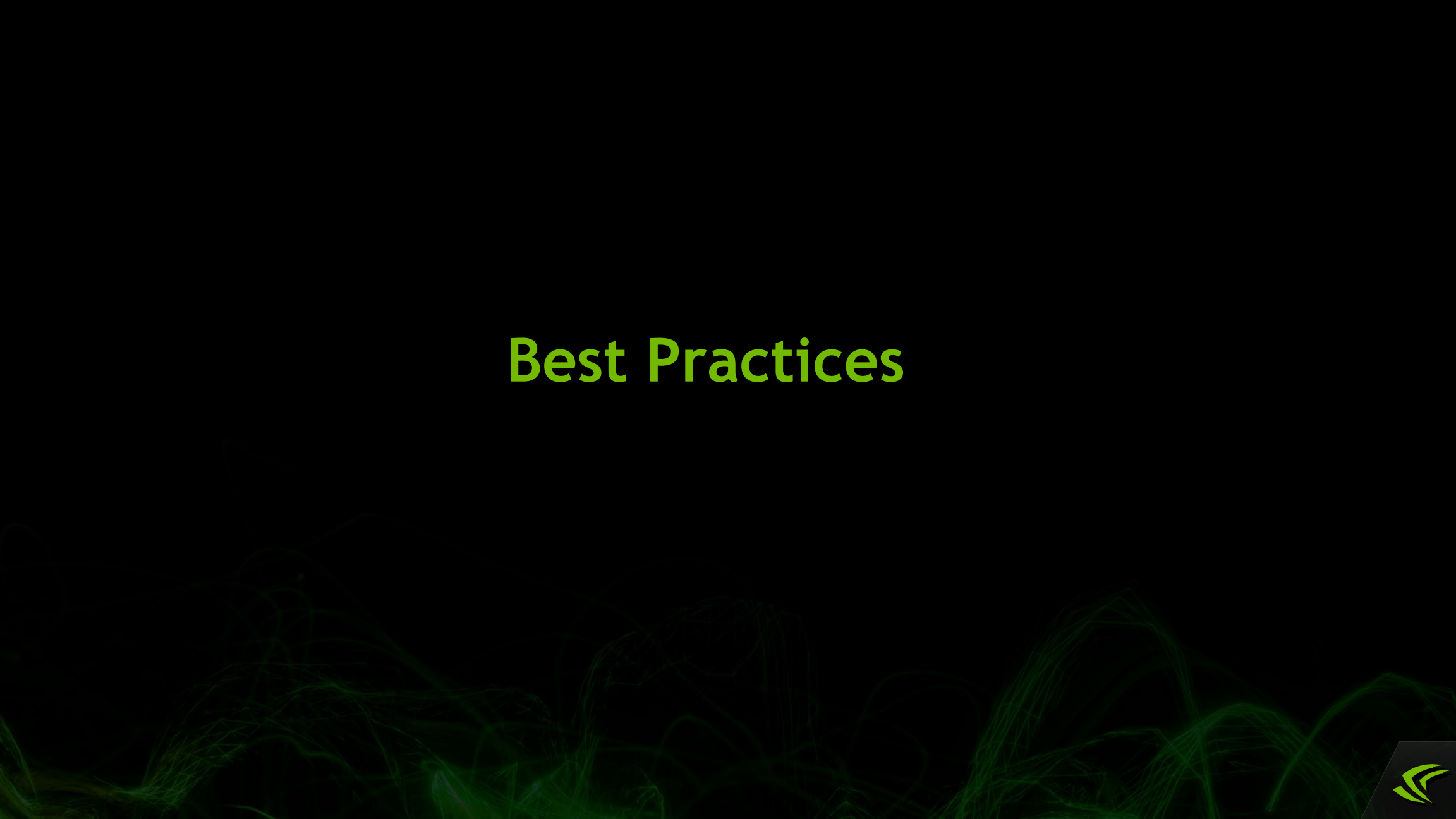
Logical Pipeline for HDR Output



NVAPI for HDR Extension

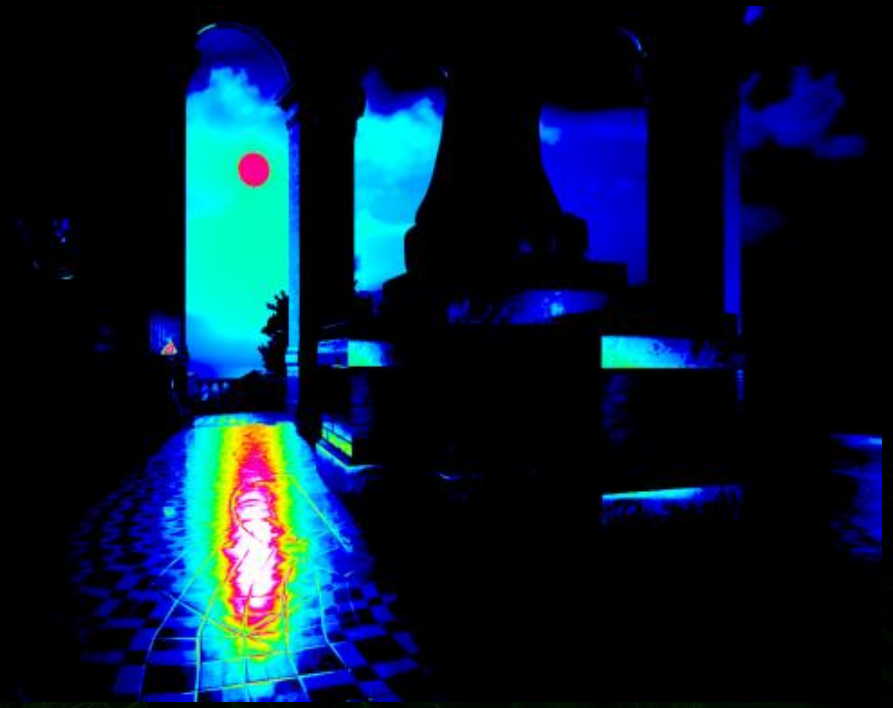
- NvAPI_Disp_HdrColorControl
- Mastering data:
  - Display Primaries
  - White Point
  - Max/Min Master
  - Max CLL
  - Max FALL

Best Practices



Rendering

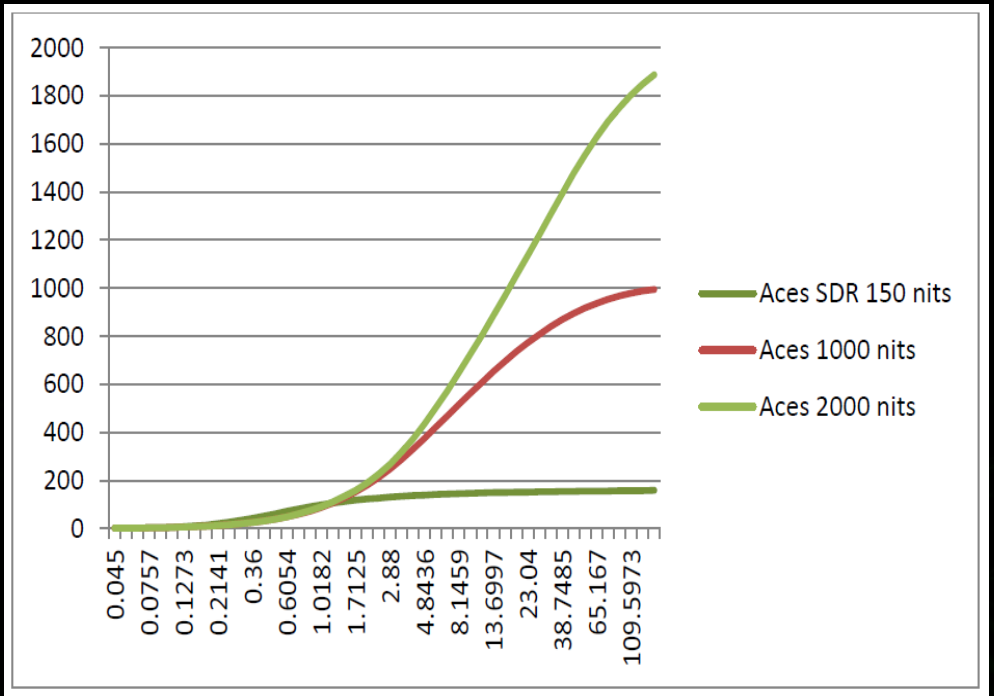
- Use Physically-Based Rendering
- Looks odd when a specular high light outshines a light source

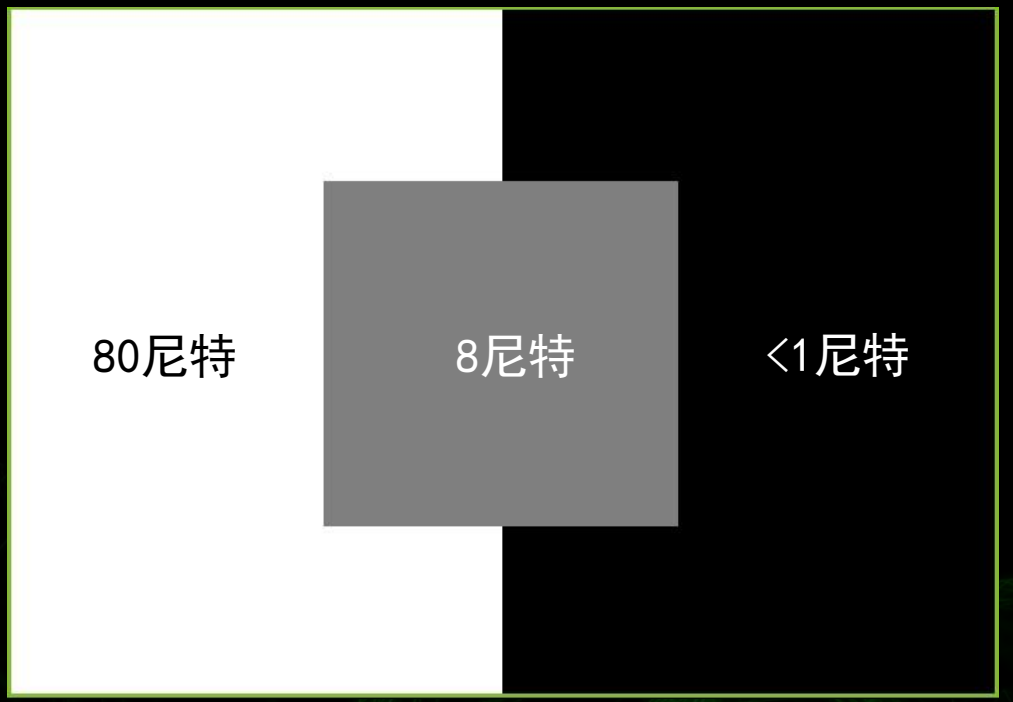


*Pictures from UE4 SunTemple Demo

Tone Mapping

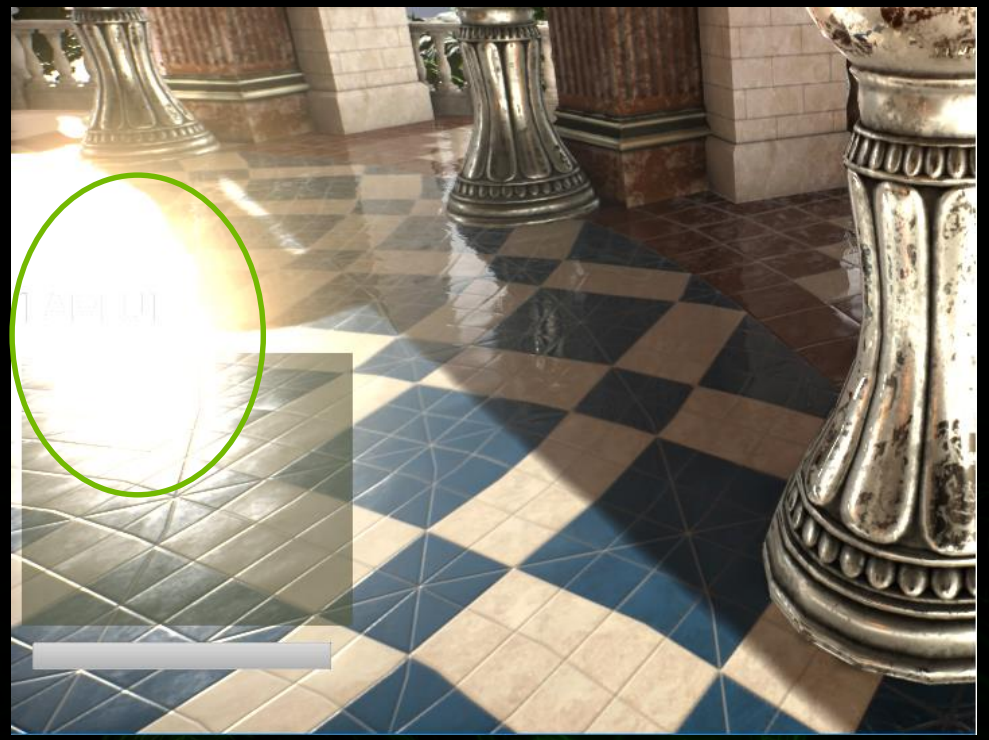
- Tone Mapper should adapt the different output range
- Middle gray should be mapped to a reasonable nits

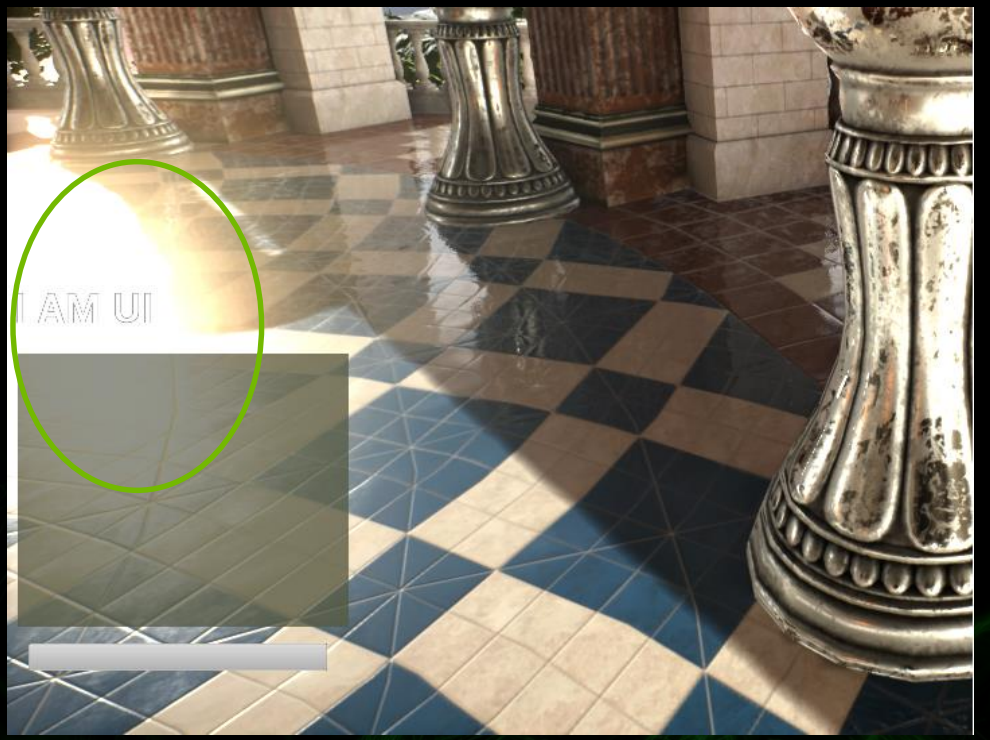




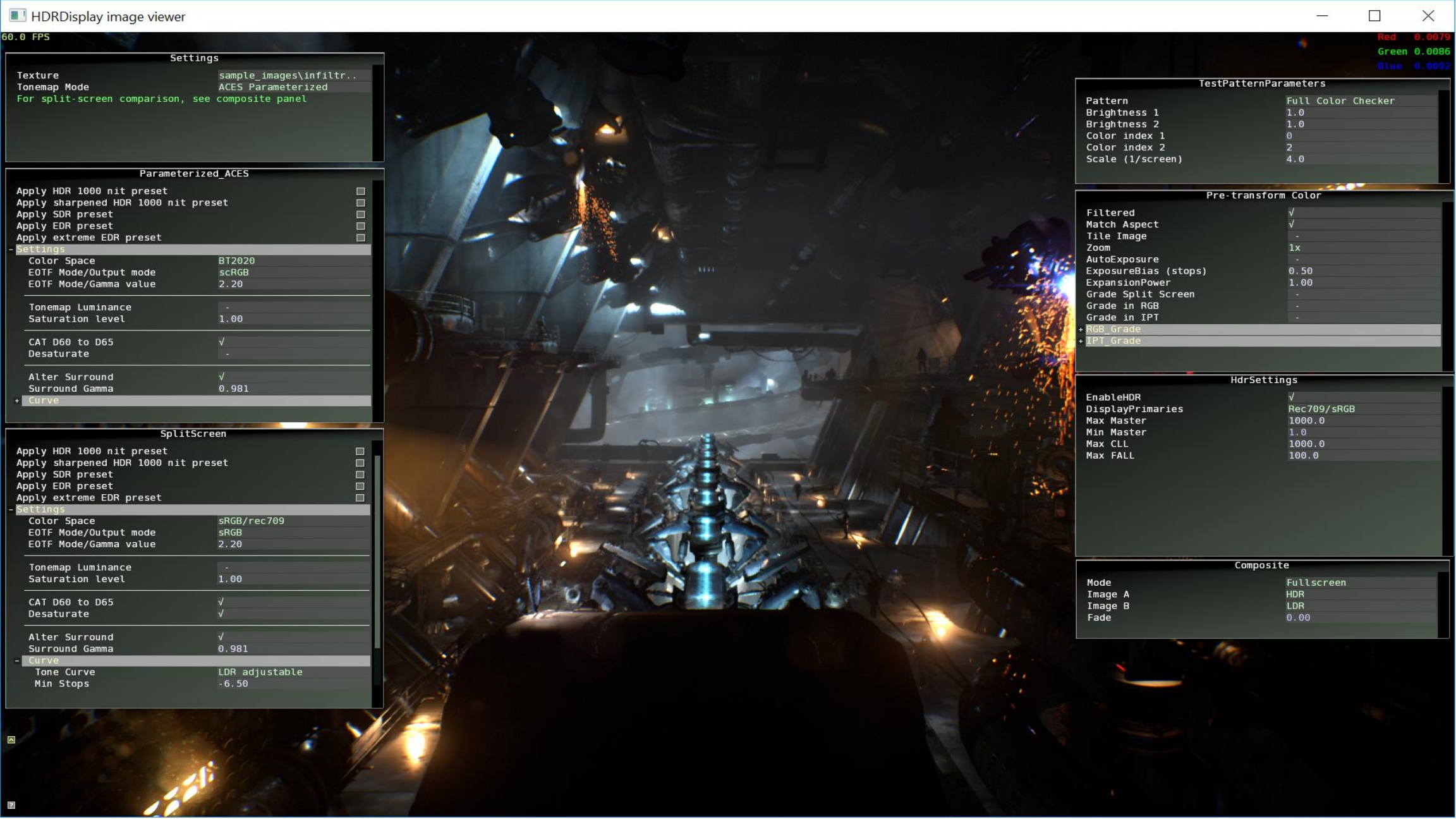
UI

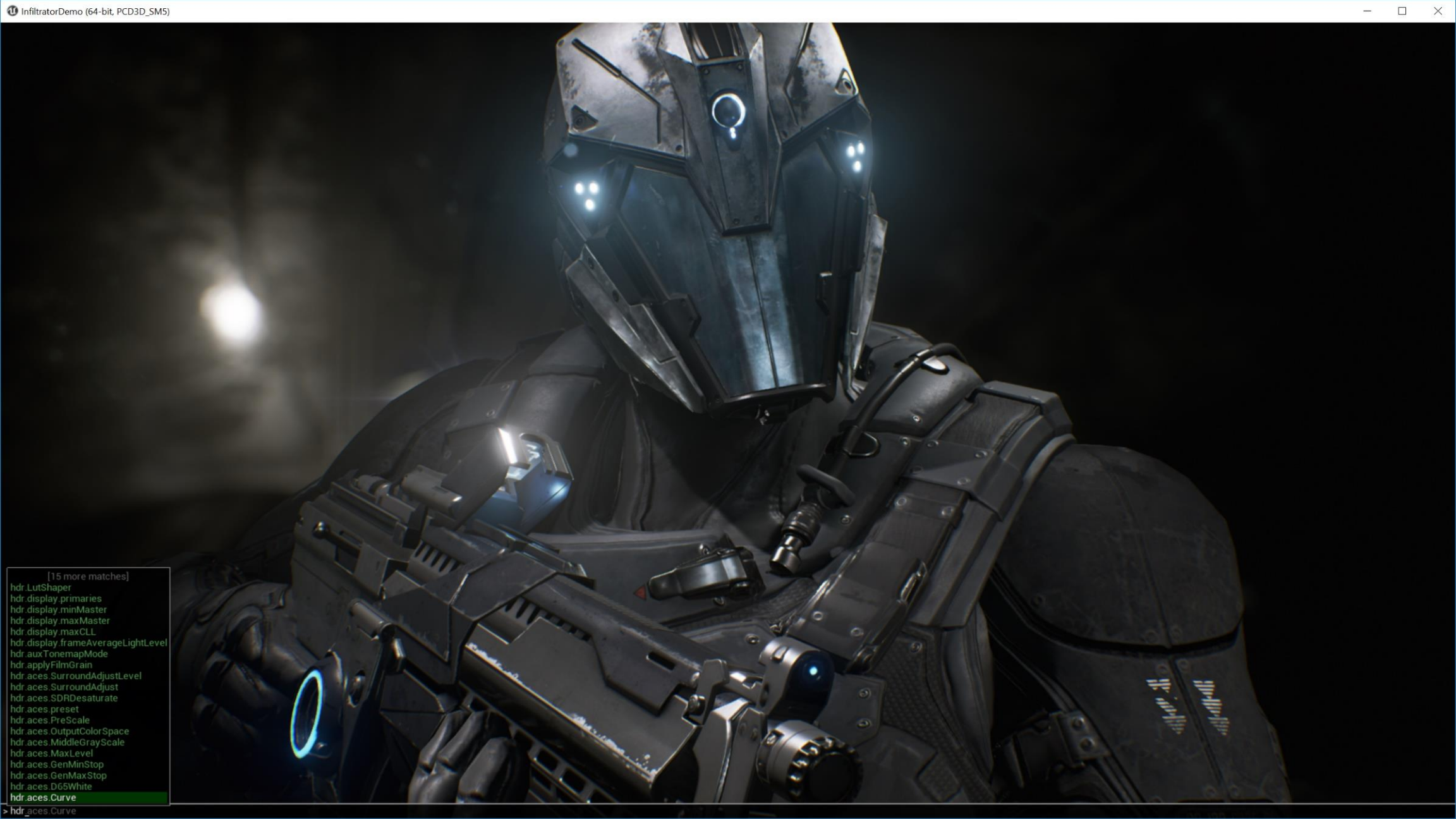
- UI may look dimmer / duller than intended
- Transparent elements may suffer glow through effects





*Pictures from UE4 SunTemple Demo


HDRDisplay image viewer
60.0 FPS
Red 0.0079
Green 0.0086
Blue 0.0092
Settings
Texture sample_images\infiltr..
Tonemap Mode ACES Parameterized
For split-screen comparison, see composite panel
Parameterized_ACES
Apply HDR 1000 nit preset
Apply sharpened HDR 1000 nit preset
Apply SDR preset
Apply EDR preset
Apply extreme EDR preset
- Settings
Color Space BT2020
EOTF Mode/Output mode scRGB
EOTF Mode/Gamma value 2.20
Tonemap Luminance -
Saturation level 1.00
CAT D60 to D65 √
Desaturate -
Alter Surround √
Surround Gamma 0.981
+ Curve
SplitScreen
Apply HDR 1000 nit preset
Apply sharpened HDR 1000 nit preset
Apply SDR preset
Apply EDR preset
Apply extreme EDR preset
- Settings
Color Space sRGB/rec709
EOTF Mode/Output mode sRGB
EOTF Mode/Gamma value 2.20
Tonemap Luminance -
Saturation level 1.00
CAT D60 to D65 √
Desaturate √
Alter Surround √
Surround Gamma 0.981
- Curve
Tone Curve LDR adjustable
Min Stops -6.50
TestPatternParameters
Pattern Full Color Checker
Brightness 1 1.0
Brightness 2 1.0
Color index 1 0
Color index 2 2
Scale (1/screen) 4.0
Pre-transform Color
Filtered √
Match Aspect √
Tile Image -
Zoom 1x
AutoExposure -
ExposureBias (stops) 0.50
ExpansionPower 1.00
Grade Split Screen -
Grade in RGB -
Grade in IPT -
+ RGB_Grade
+ IPT_Grade
HdrSettings
EnableHDR √
DisplayPrimaries Rec709/sRGB
Max Master 1000.0
Min Master 1.0
Max CLL 1000.0
Max FALL 100.0
Composite
Mode Fullscreen
Image A HDR
Image B LDR
Fade 0.00


InfiltratorDemo (64-bit, PCD3D_SM5)
[15 more matches]
hdr.LutShaper
hdr.display.primaries
hdr.display.minMaster
hdr.display.maxMaster
hdr.display.maxCLL
hdr.display.frameAverageLightLevel
hdr.auxTonemapMode
hdr.applyFilmGrain
hdr.aces.SurroundAdjustLevel
hdr.aces.SurroundAdjust
hdr.aces.SDRDesaturate
hdr.aces.preset
hdr.aces.PreScale
hdr.aces.OutputColorSpace
hdr.aces.MiddleGrayScale
hdr.aces.MaxLevel
hdr.aces.GenMinStop
hdr.aces.GenMaxStop
hdr.aces.D65White
hdr.aces.Curve
> hdr_aces.Curve

Learn More

- Nvidia HDR white paper

  https://developer.nvidia.com/sites/default/files/akamai/gameworks/hdr/UHDColorForGames.pdf
- Nvidia HDR Sample SDK

  https://developer.nvidia.com/hdr-display-sample
- Nvidia HDR extension for UE4

  https://github.com/ehartNV/UnrealEngine_HDR