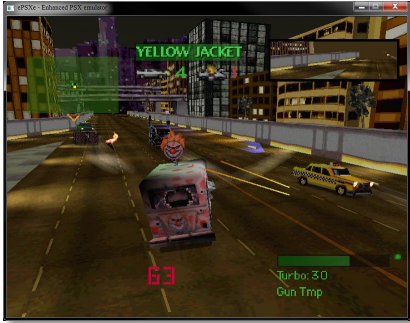




From Pixels to Reality – Thoughts on Next Game Engine

Hao Chen
Sr. Principal Engineer, Amazon
chenha@amazon.com





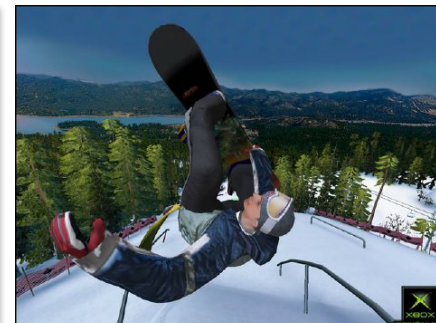
Twisted Metal- PSX
1995



Outwars - PC
1998



Links 2001 -PC
2000



AMPED-XBOX
2001



AMPED 2 – XBOX
2003

20 Years?....Why am I still here?.....☺



Halo 2– XBOX
2004



Halo 3– XBOX 360
2007



Halo Reach– XBOX 360
2010



Destiny– Xbox One PS4, PS3, 360
2014

Same Growth Story - GPU, API, Console, Fidelity



- It's Moore's law, stupid!

Game Engine 2016



Multi-threaded



Multi-Platform



Modern API



Deferred Rendering



PBR



Global Illumination



Dynamic Environment



60 FPS@1080P



lumberyard
BY amazon

Game Engine 2018?

What is NOT good enough?



Aliasing



Shadow



Transparency



Content Production



Load Time



Animation



Performance

What is new?



Community Based Gaming



E-Sports



User Created Content



Broadcast

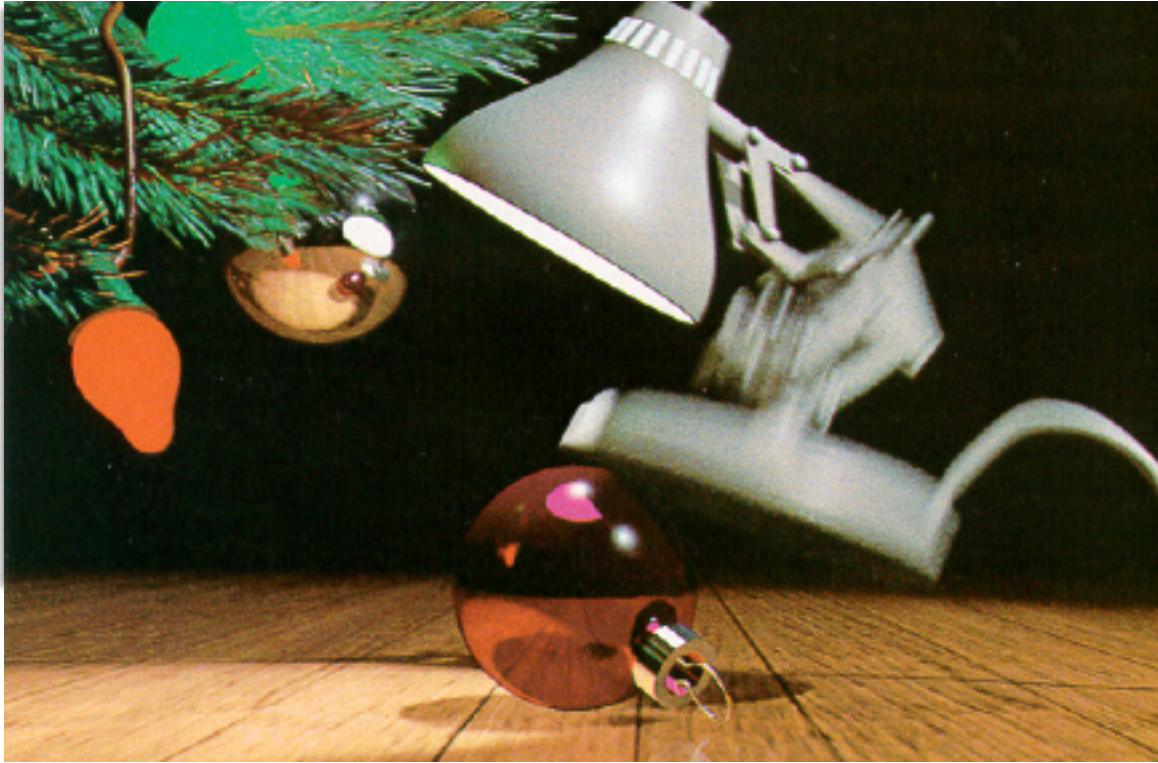


Mobile



VR/AR

Aliasing is by Design



“Image Quality. We eschew aliasing and faceting artifacts, such as jagged edges, Moire patterns in textures, temporal strobing, and highlight aliasing.”

[\[CookCarpenterCatmull87\]](#)

1986 Pixar Christmas Card by John Lasseter and Eben Ostby.

Film vs. Game



Reyes/Ray Tracing

Object Space Shading

Lots of Visibility Samples

Image Quality



Direct 3D / OpenGL

Screen Space Shading

Few Visibility Samples

Throughput

REYES/Ray Tracing for Games? -- Not Ready Yet



Make REYES work with GPU [[Fatahalian10](#)][[BurnsFatahalianMark10](#)]
[[Kunzhou09](#)]

- Small Triangle Problem
- Scene Complexity
- Not fast enough



Real-time Ray-Tracing [[Nvidia IRay](#)]

- 4K now, 8K soon.
- Multiple-monitors/Stereo
- Not fast enough

Better Way: Borrow and Combine Ideas



Shade in Object Space = Inherently Stable
[\[CookCarpenterCatmull87\]](#) [\[Fatahalian10\]](#)

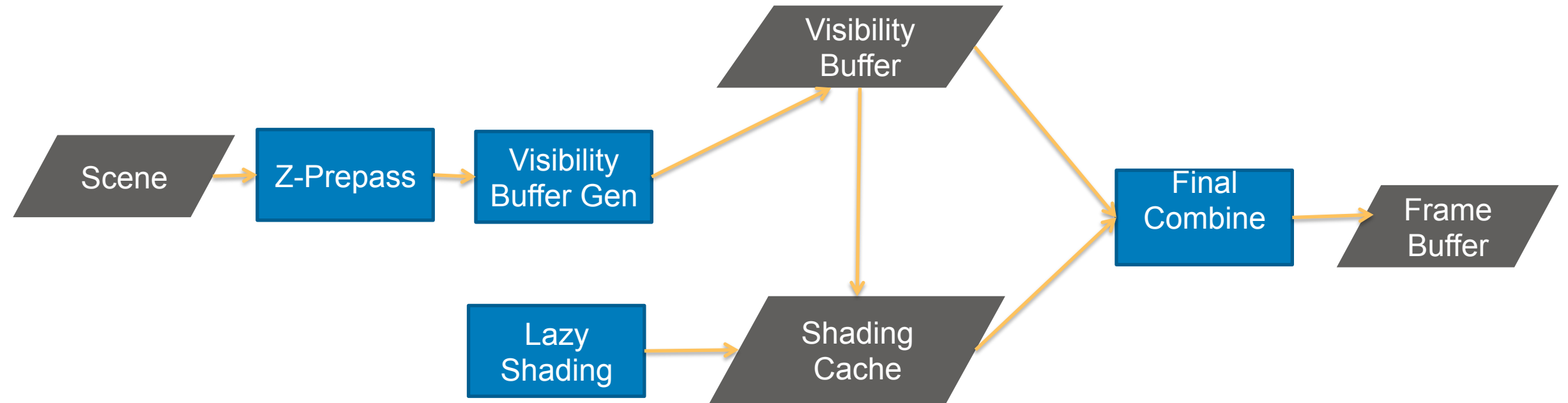


Decouple Visibility Sampling from Shading = Multi-Rate
[\[BurnsFatahalianMark10\]](#)



Visibility Buffer = Reduce Memory & Bandwidth
[\[BurnsHunt2013\]](#) [\[\[SchiedDachsbacher15\]](#)

Possible Rendering Pipeline



Go Further with Multi-Rate



Visibility Samples



Shading Samples



Lighting Samples



Light Transport Update



AI



Physics



Input

What about Other “Aliasing”?



Specular Aliasing

- Lean Mapping [\[OlanoBaker 2010\]](#)



Shadows

- Frustum Traced Raster Shadows
[\[WymanHoeltzleinLefohn15\]](#)



Transparency

- Order Independent Transparency

Load Time



Compression – 2X Better Than Z-LIB



Procedural Synthesis – Substance
<https://www.allegorithmic.com>



Wang Tiles [Wang61][Stam97][Liyi04]
<https://artomatix.com>

Cloud



Huge Worlds



Thousands of Inhabitants



Thin Clients



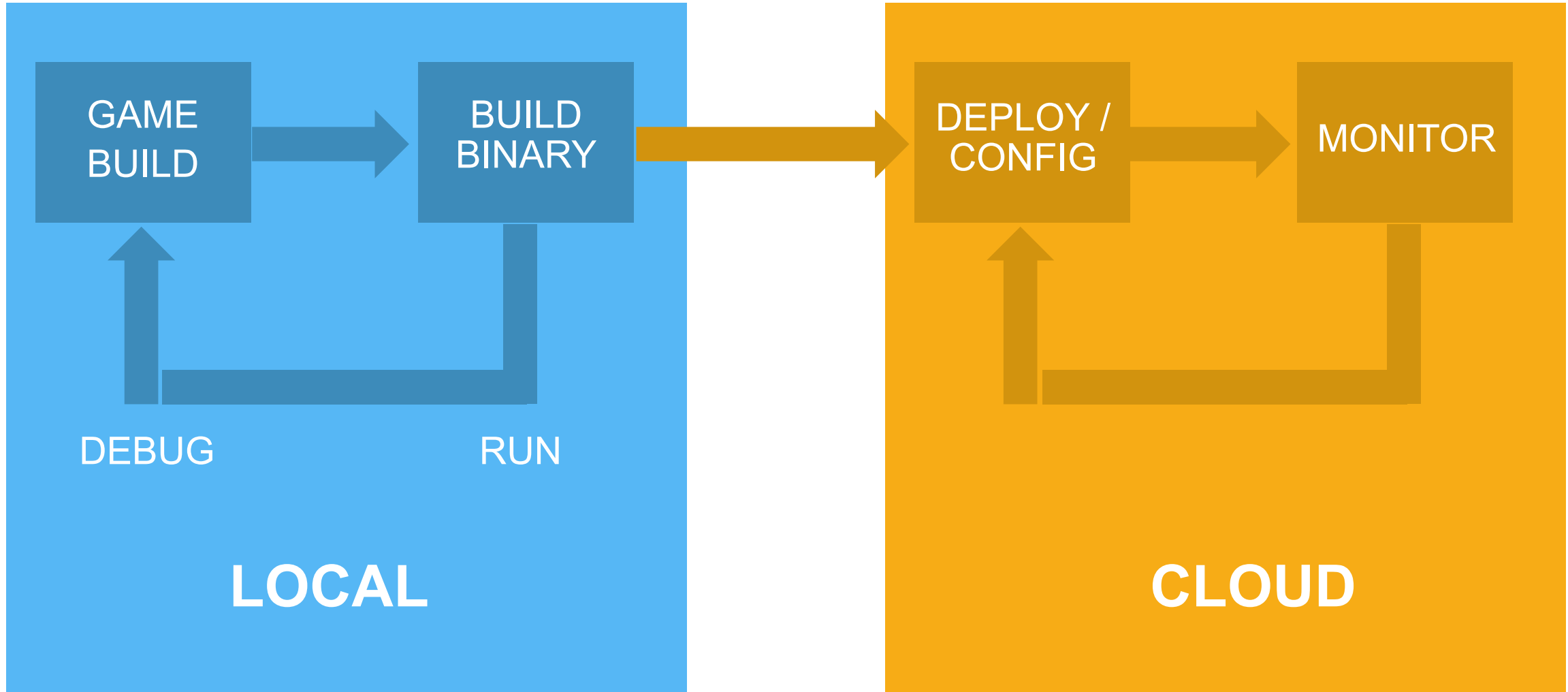
Studio In A Box



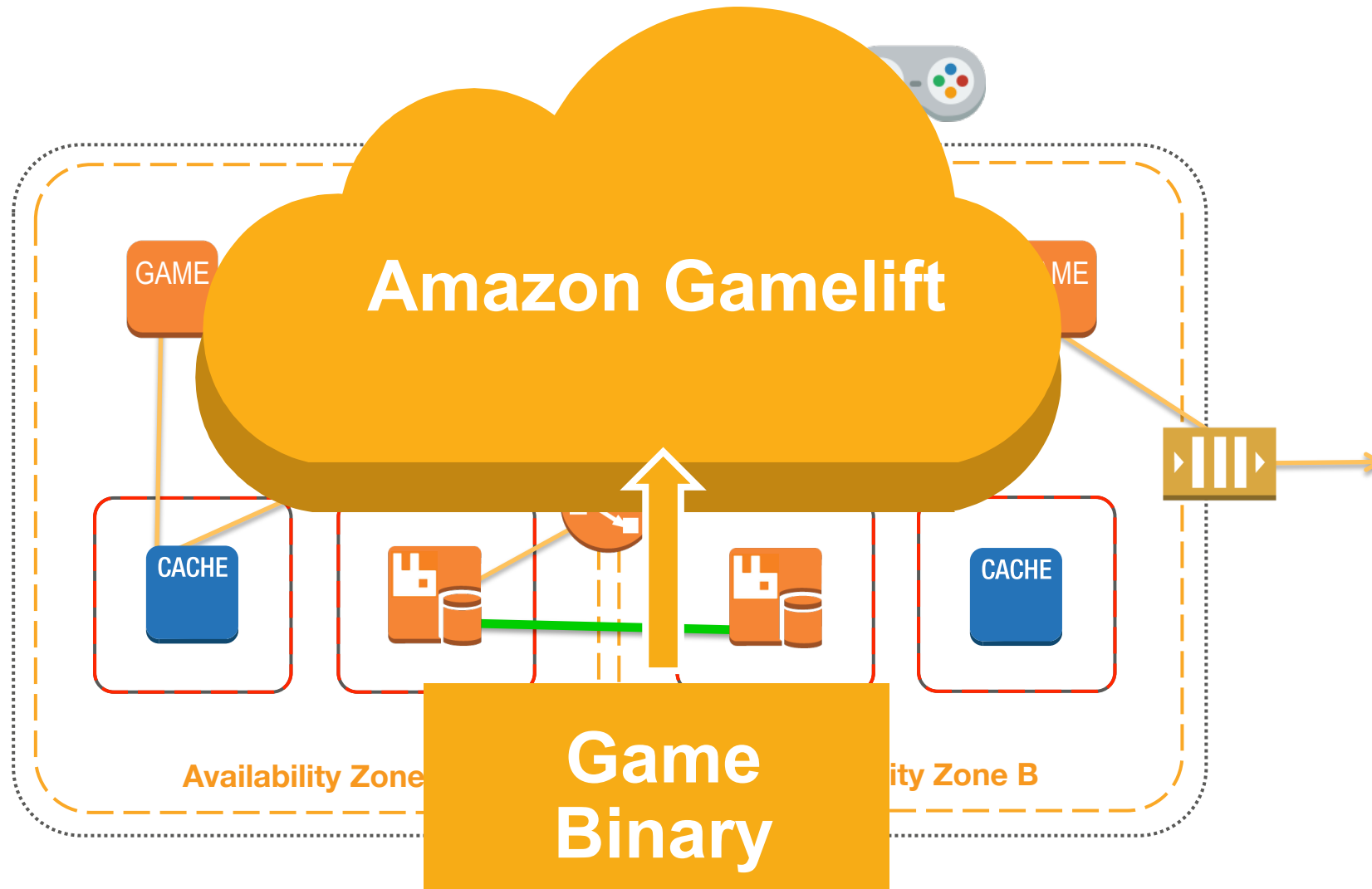
Content Production

Amazon Lumberyard - GameLift

Problem we are solving?

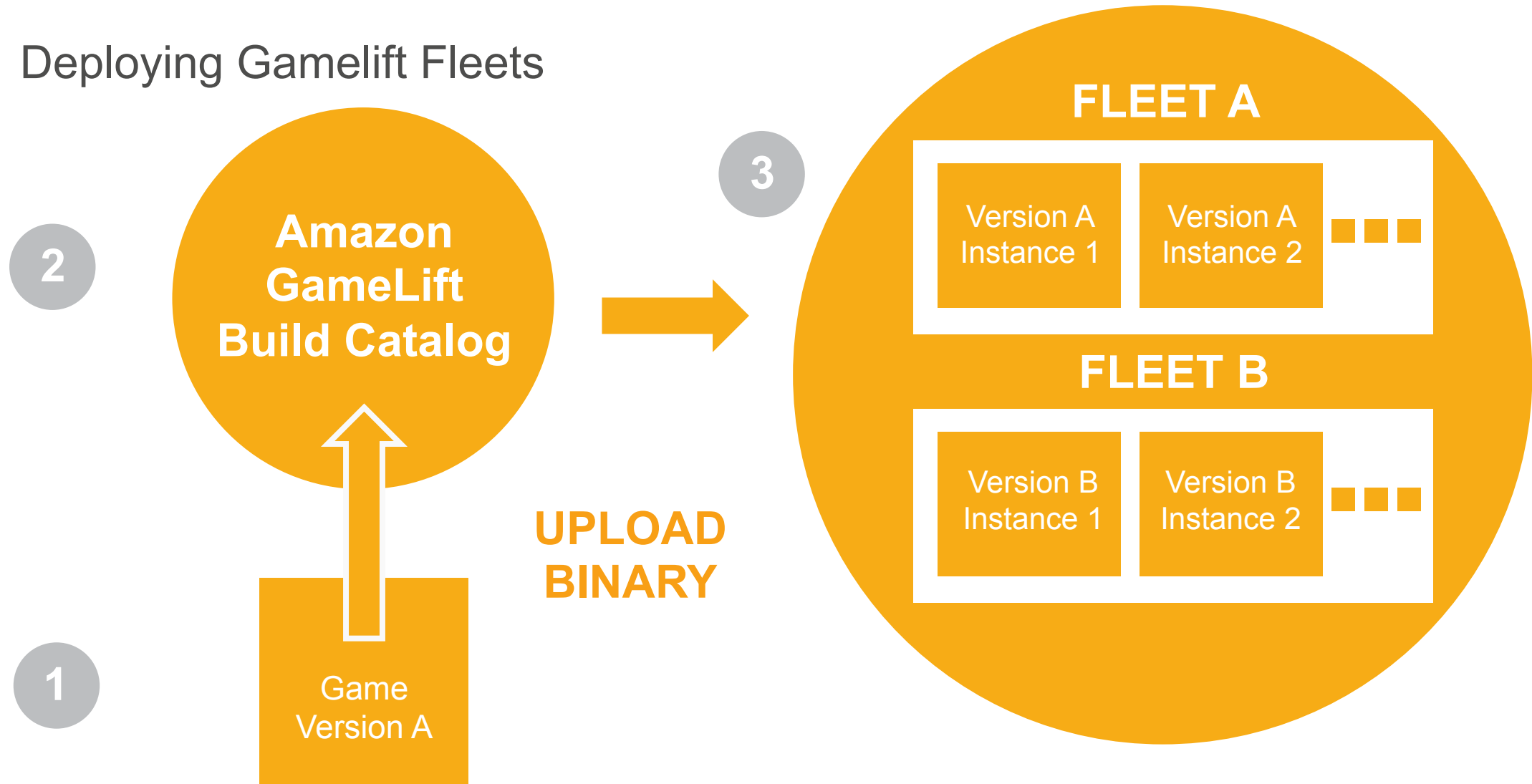


Get started in minutes, even with little backend experience



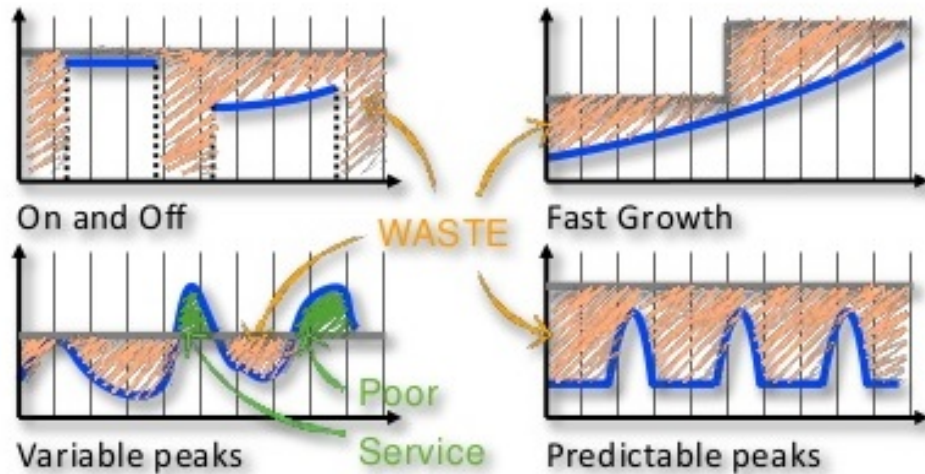
Reduced ongoing engineering and operational effort

- Deploying Gamelift Fleets

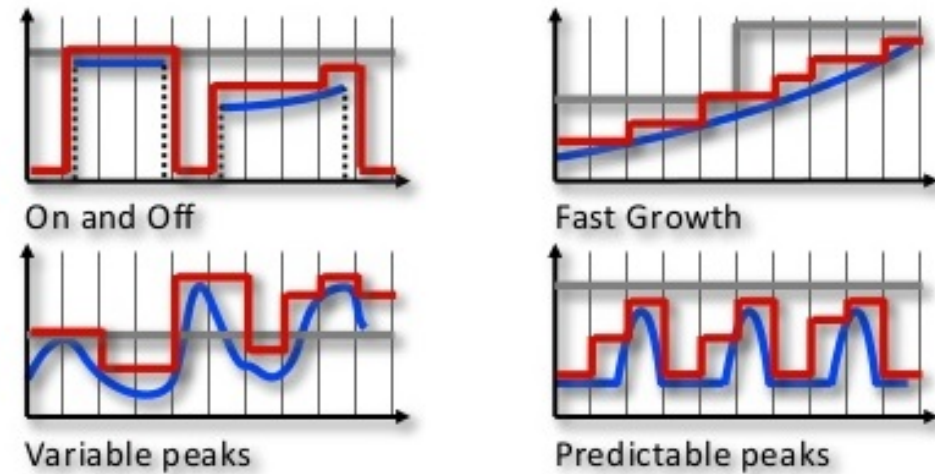


Scale based on player demand (coming soon)

Traditional dedicated servers

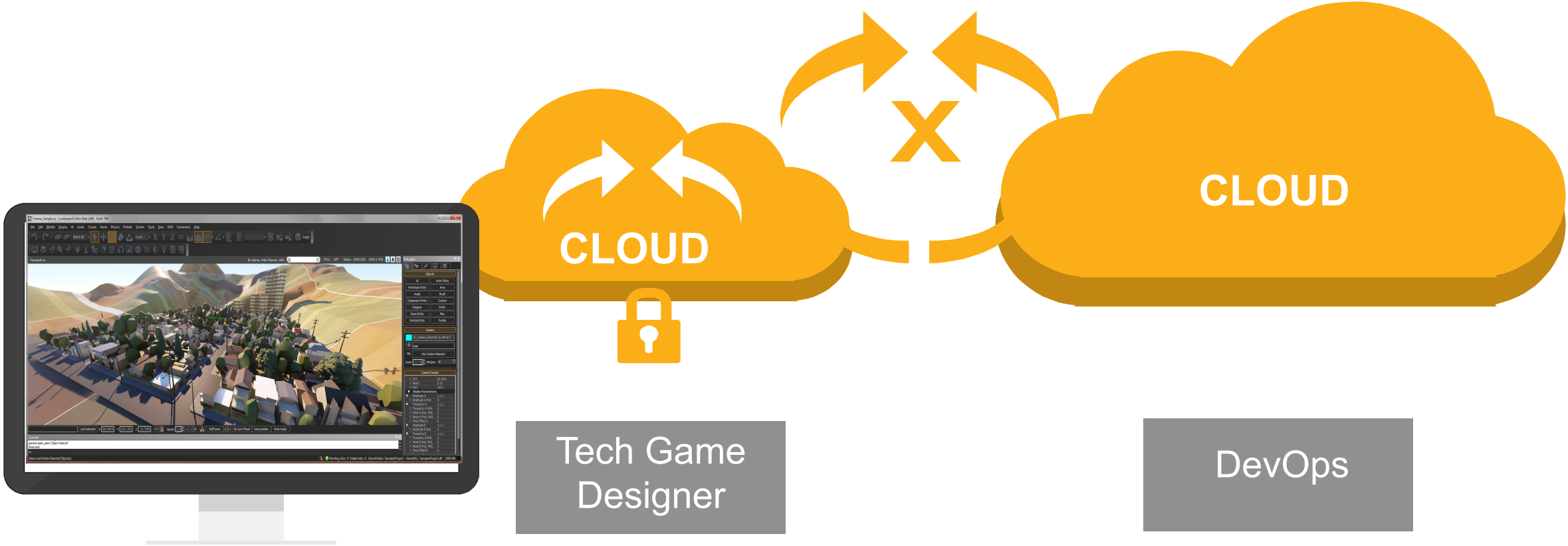


On-demand auto scaling



Amazon Lumberyard - Cloud Canvas

Problem we are solving?



Cloud Canvas - Details



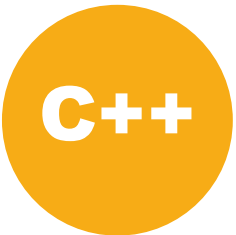
AWS Primitives

Cognito
S3
DynamoDB
Lambda
SNS
SQS



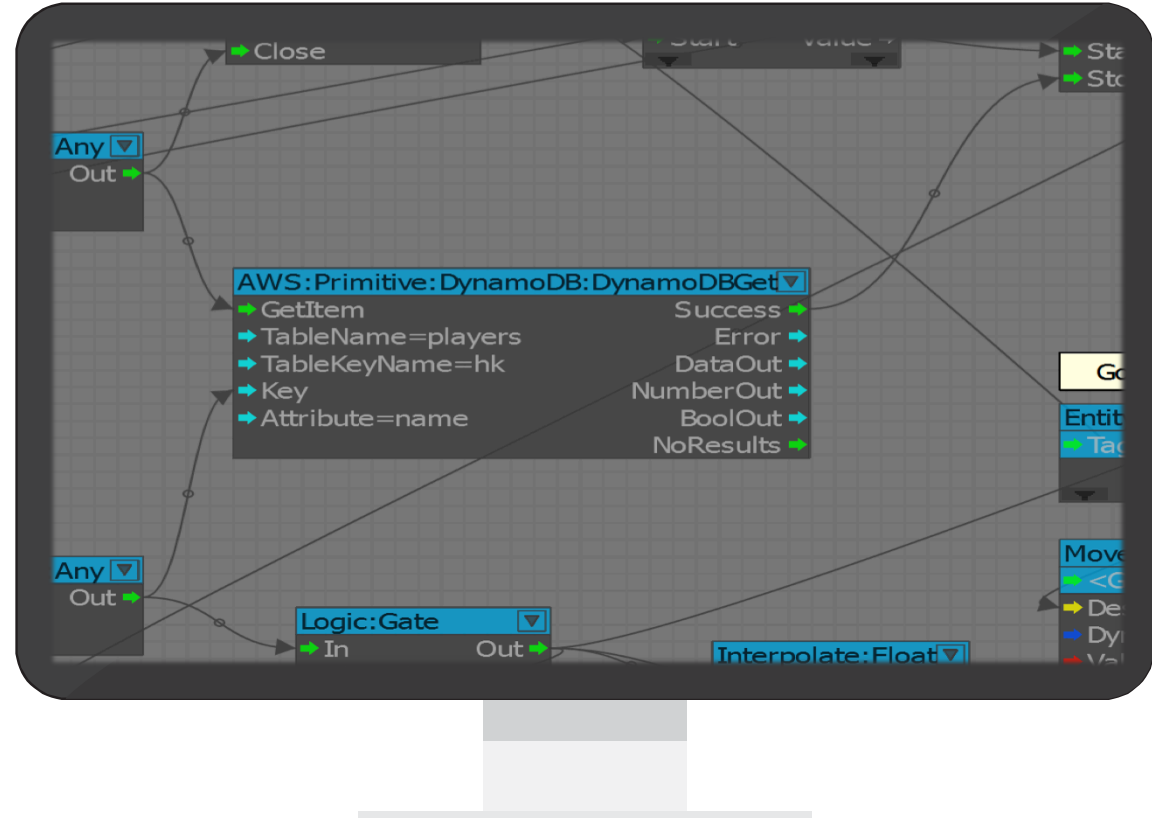
Callable from Script

Gifting system
Leaderboards
News Ticker

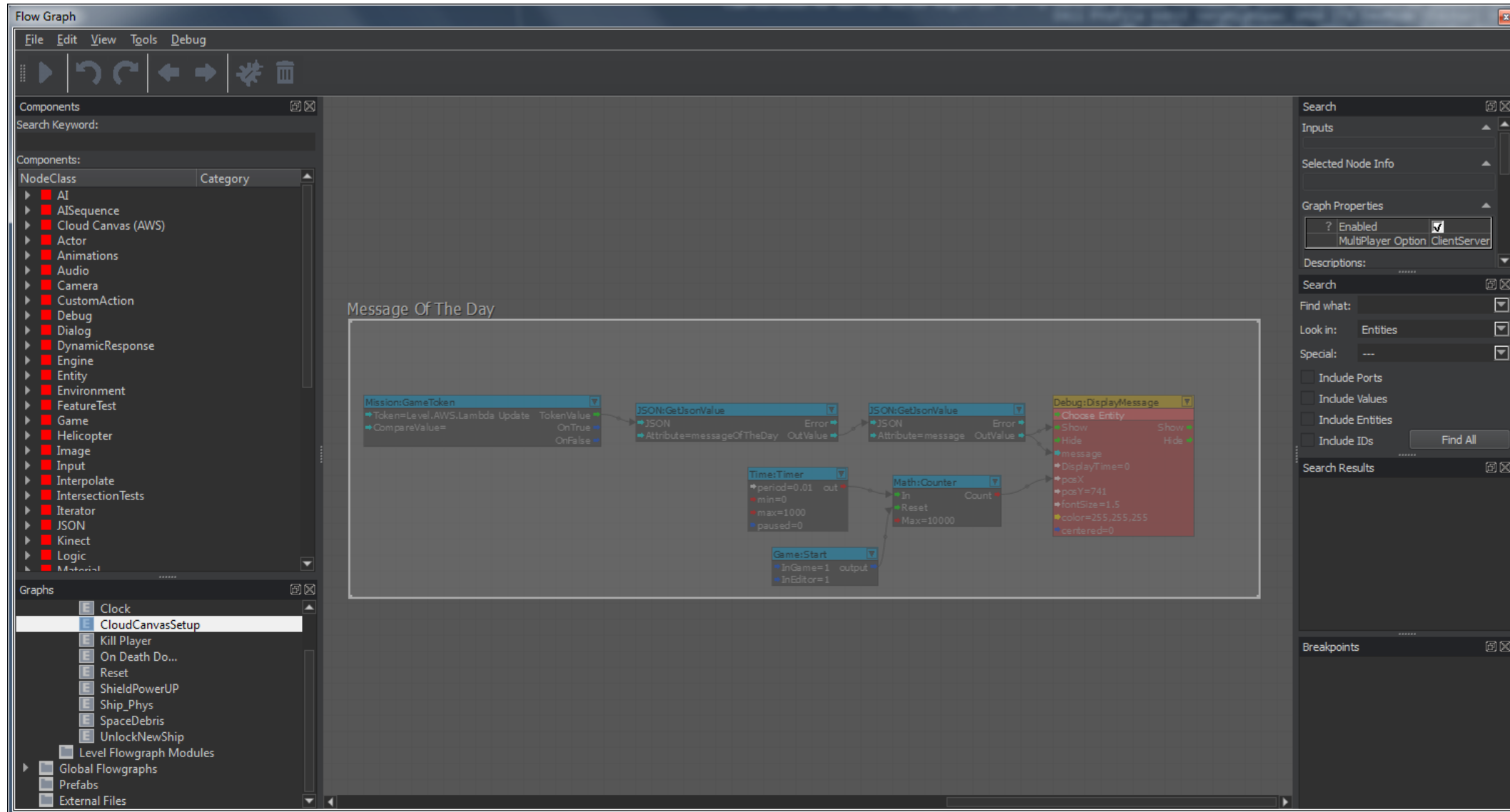


C++ SDK

Create your own
nodes



Cloud Canvas – Visual Scripting



Game Engine 2018



Almost No Aliasing



Right Space



Right Frequency



Right Place



Perception Guided “Importance”



Procedural Content



Cloud Connected

Hot Research Topics



Procedural Synthesis



Compression



3D Scanning



Perception Science



Multi-rate Rendering



Animation



Distributed Physics/AI/Rendering



Q and A

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