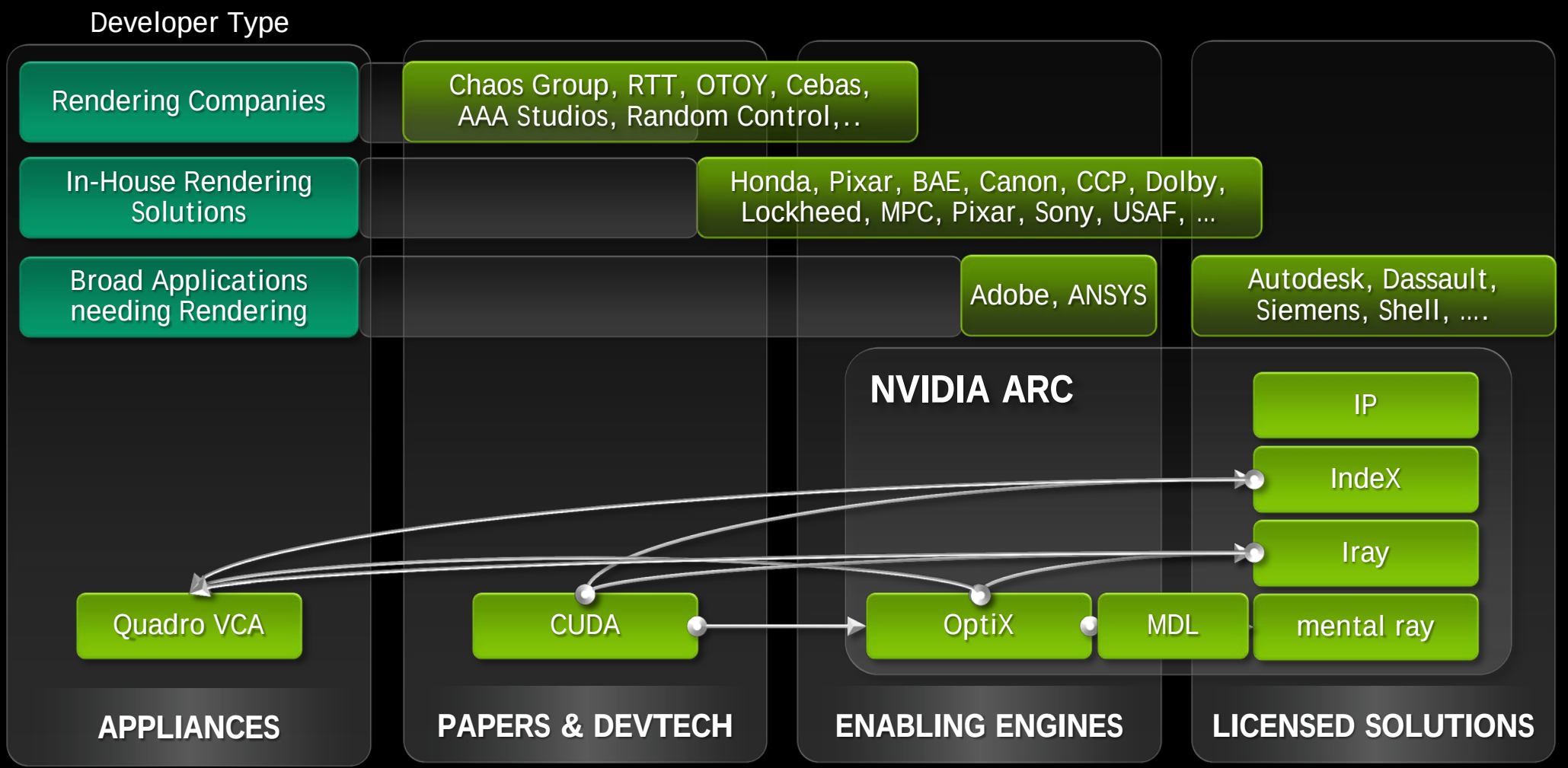
Advanced Rendering Solutions from NVIDIA

Phillip Miller
Senior Director
NVIDIA Advanced Rendering

SIGGRAPH 2015
Los Angeles, California
August 9, 2015

NVIDIA Advanced Rendering Offerings

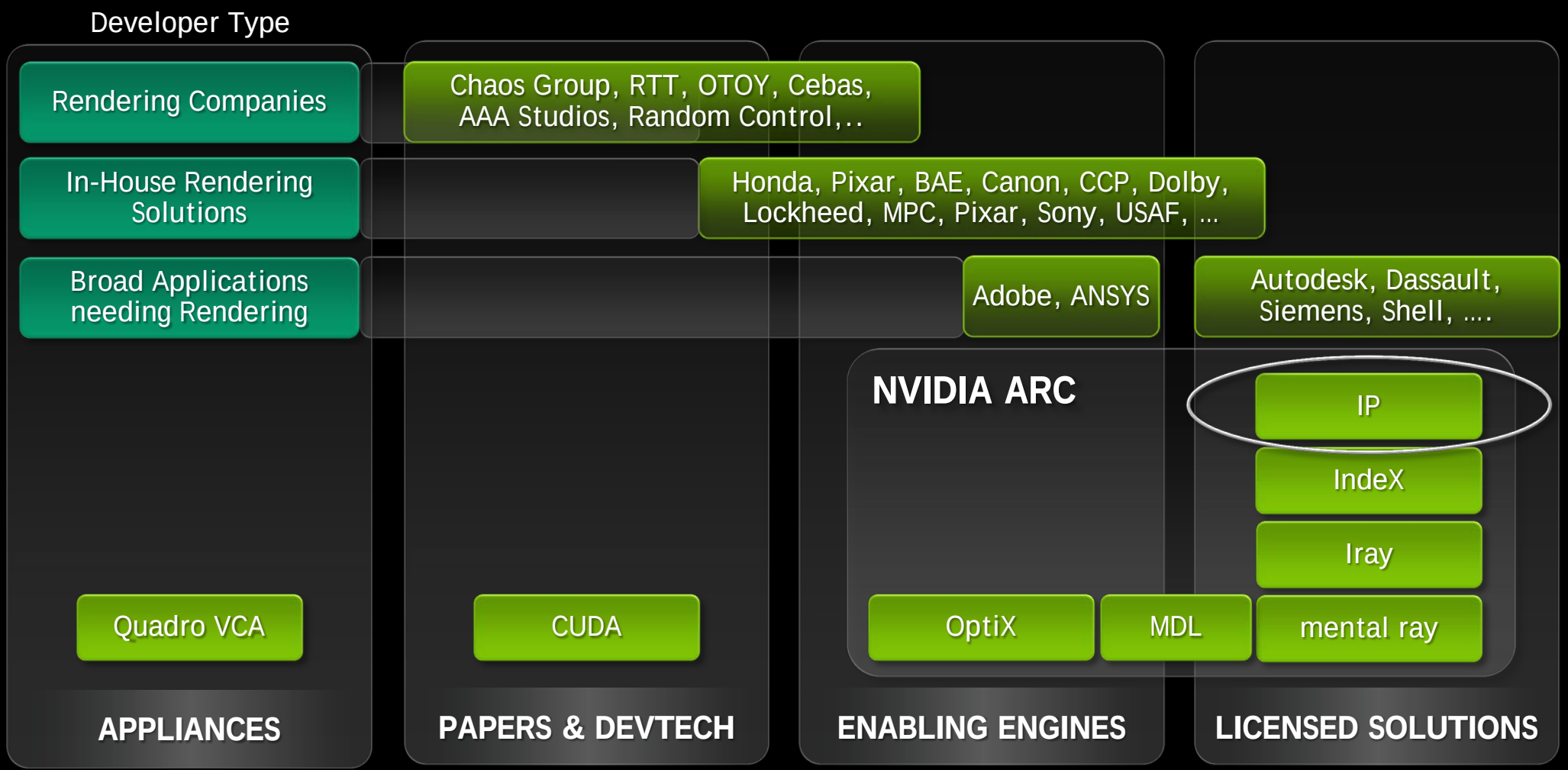


Agenda

- Different but Related Solutions from NVIDIA
  - Custom ray tracing development — OptiX
  - Physically Based Rendering — Iray
  - Shareable, Physically Based Materials — MDL
  - Scalable and accessible rendering — Quadro VCA

GPU TECHNOLOGY CONFERENCE

NVIDIA Advanced Rendering Offerings



NVIDIA Advanced Rendering IP

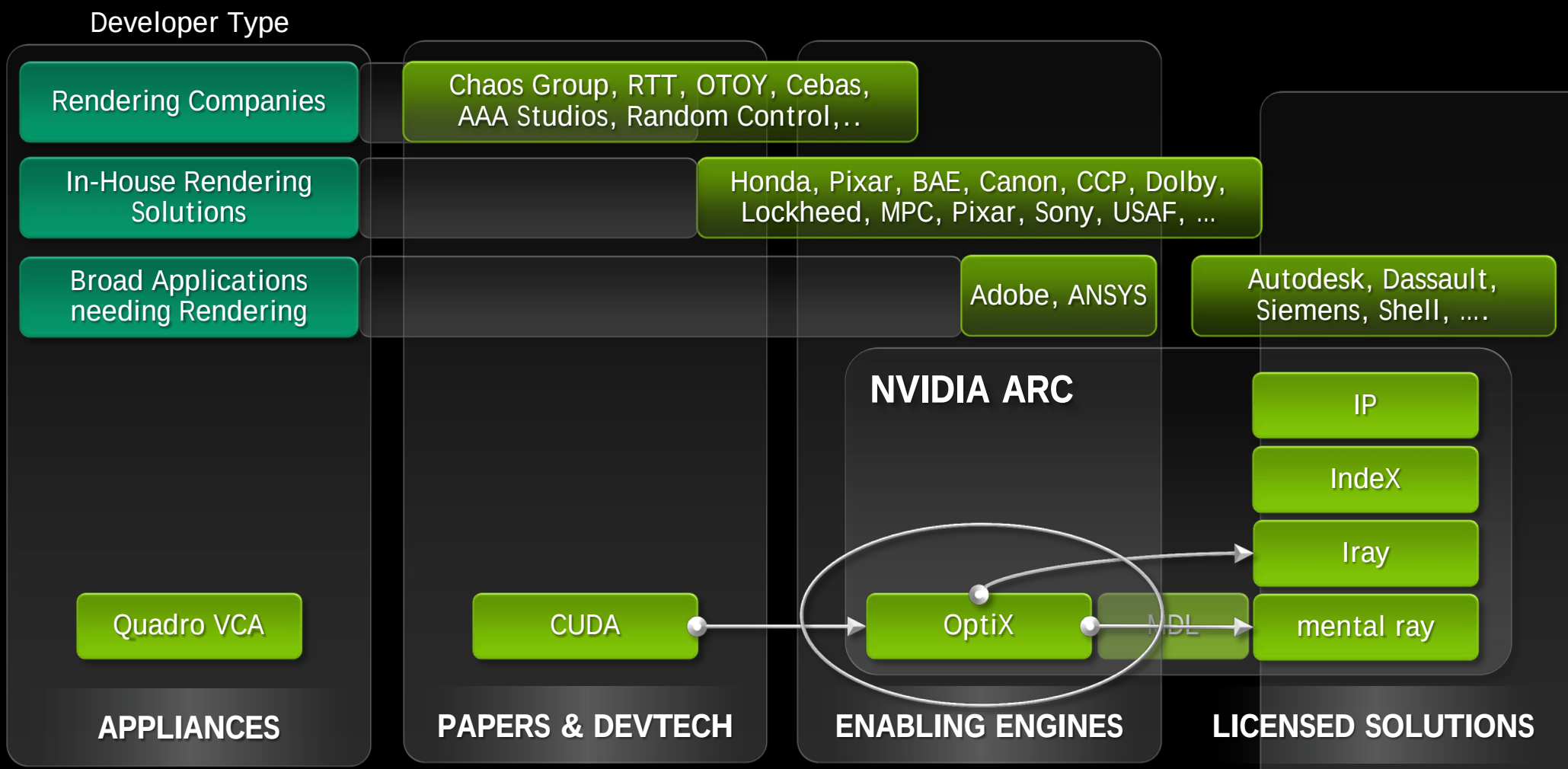
- Licensing important rendering IP to the industry
- News at SIGGRAPH 2015:

- Quasi-Monte Carlo Sampling (QMC)
  - Pixar Studios — for film production
joins DreamWorks and Sony Imageworks
  - Chaos Group — for VRay-RT
the first commercial renderer with a QMC license

- Rounded Corners
  - Chaos Group — for VRay and VRay RT
enables parity with mental ray shaders

GPU TECHNOLOGY CONFERENCE

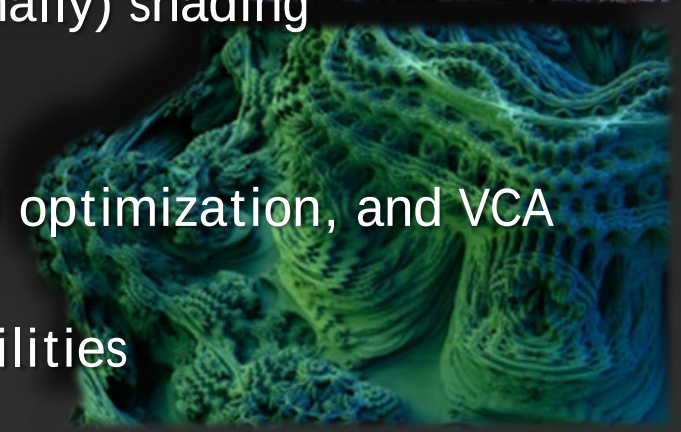
NVIDIA Advanced Rendering Offerings



NVIDIA® OptiX™ ray tracing engine

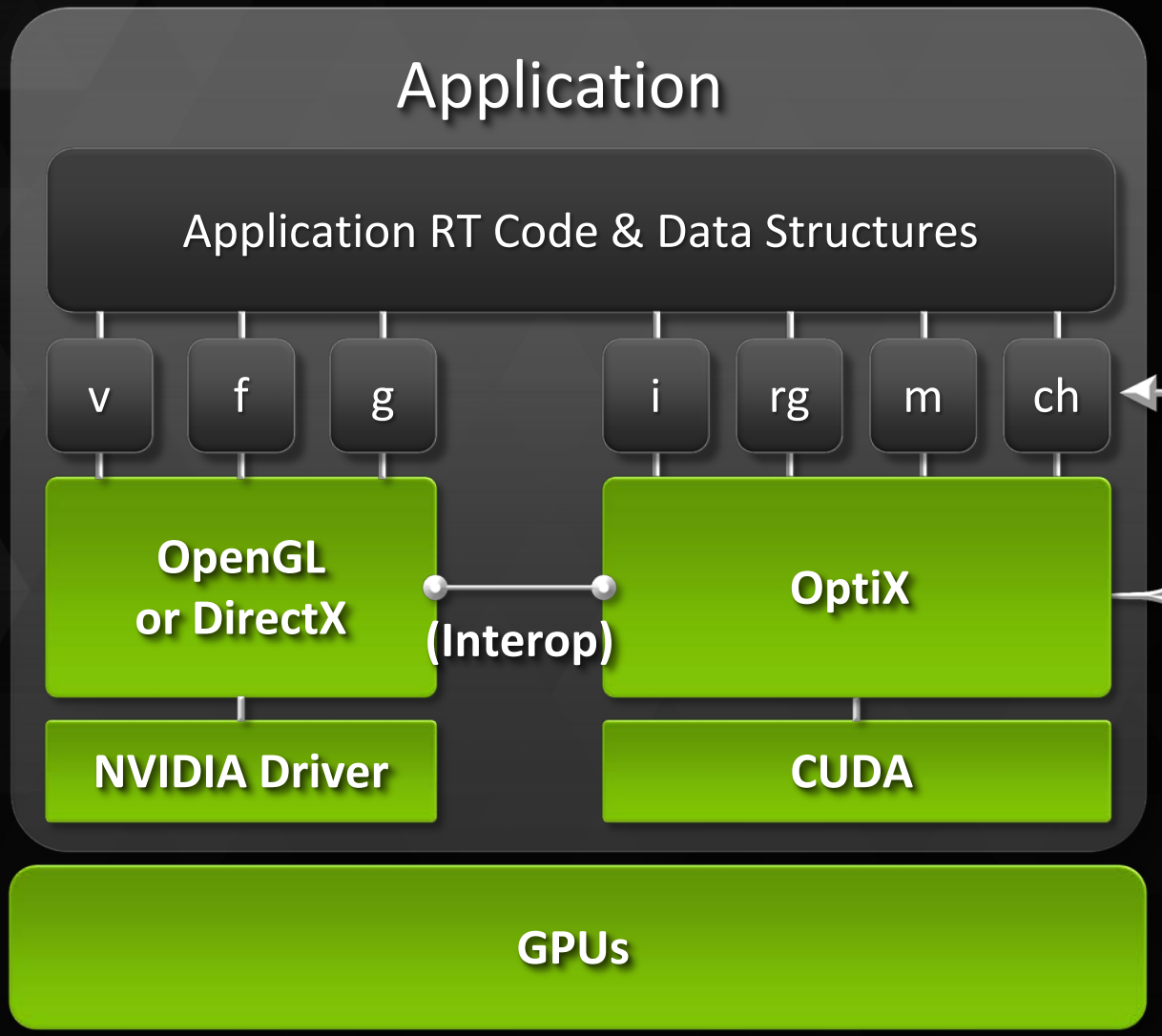
A programmable ray tracing framework
enabling the rapid development of high performance ray tracing applications

- Use your techniques, methods, & data
  using a single-ray programming model
- OptiX does the “heavy lifting”:
  traversal, intersection, acceleration, and (optionally) shading
- OptiX handles the GPU aspects:
  load balancing, parallelism, scaling, paging, GPU optimization, and VCA
- Allows you to concentrate on technique & capabilities



OptiX

Analogous to OpenGL

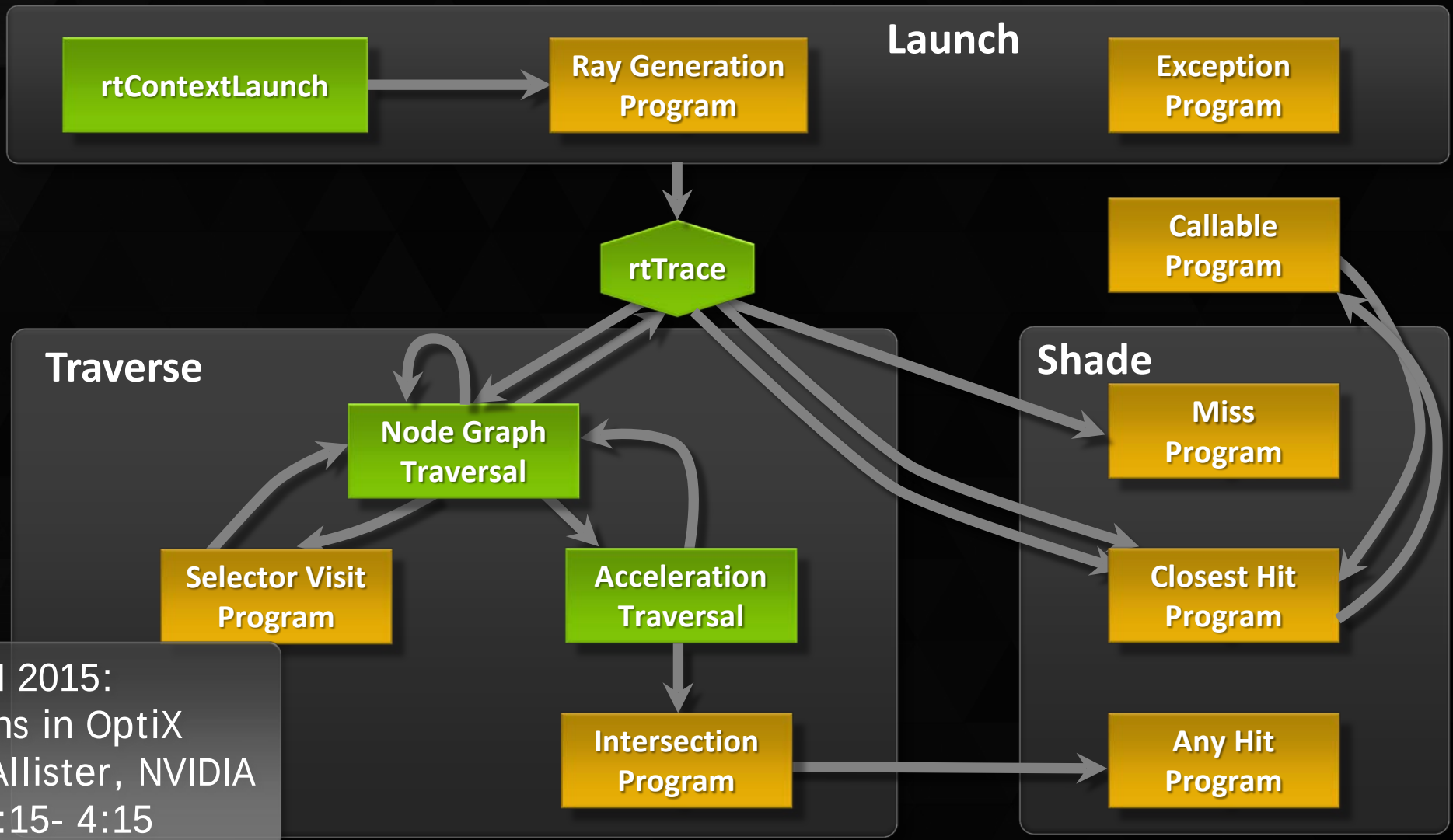


Your C-based OptiX Functions/ Shaders form small, custom programs:

Intersection, Ray Generation, Miss, Closest Hit, Any Hit

- Acceleration Structures Build & Traversal
- GPU parallelism and Performance
- Memory Management
- Out of Core Paging

OptiX Execution Model



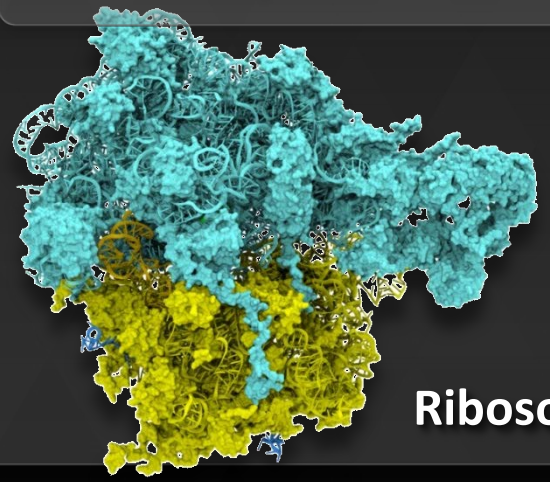
SIGGRAPH 2015:
Innovations in OptiX
David McAllister, NVIDIA
Monday 3:15- 4:15

OptiX in Molecular Research with VMD

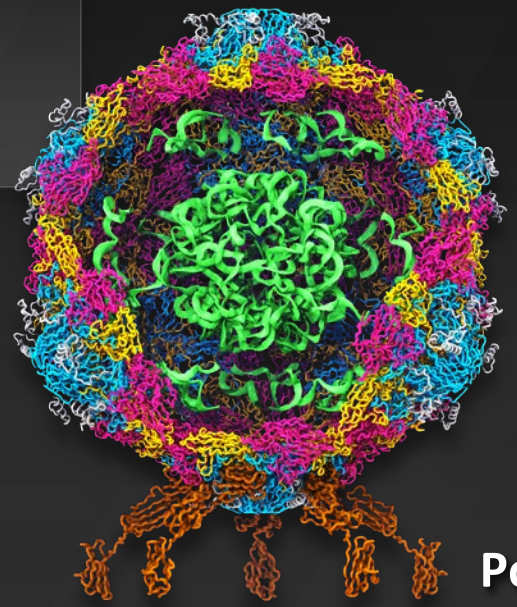
Visual Molecular Dynamics

studying the molecular machines in living cells

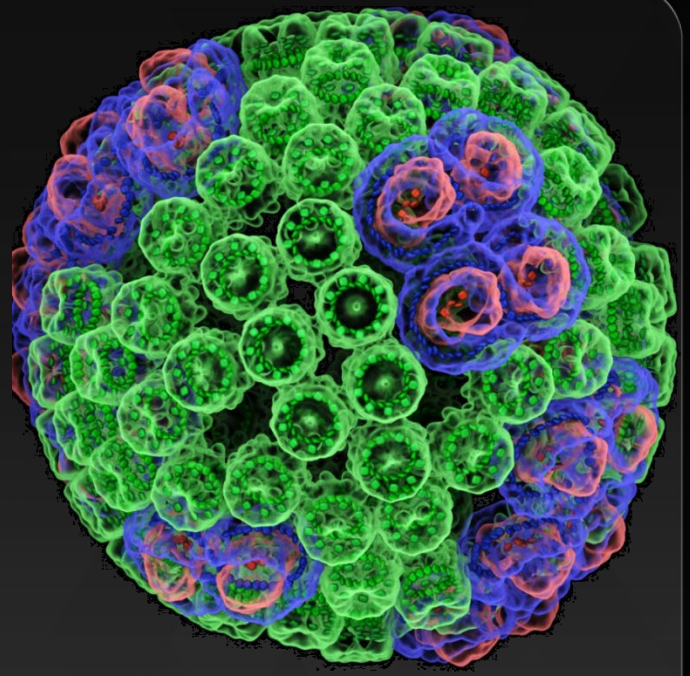
SIGGRAPH 2015:
VMD: Ray tracing with OptiX
John Stone, UIUC
Wednesday 12:00-12:30



Ribosome



Poliovirus



Chromatophore

OptiX in Compositing in Adobe After Effects

Starting w/ Creative Suite 6

- Fully ray traced compositing pipeline
- Built entirely on OptiX, with no x86 code

Running on Windows and MacOS since Spring, 2012

OptiX in Games & Film AO & Light Baking

Original Raster Result

= Higher Quality Gaming Experience

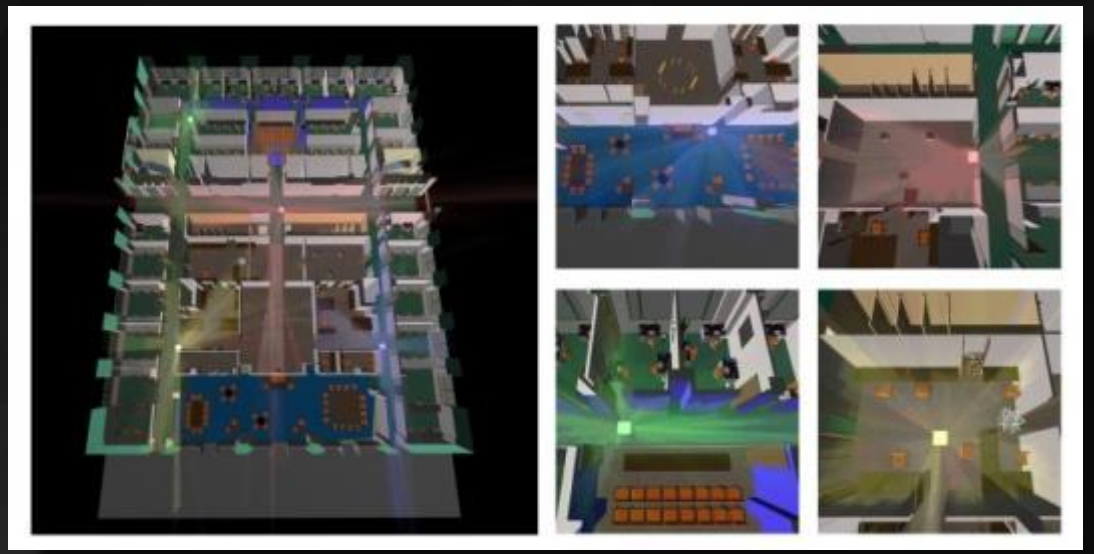
Ambient Occlusion

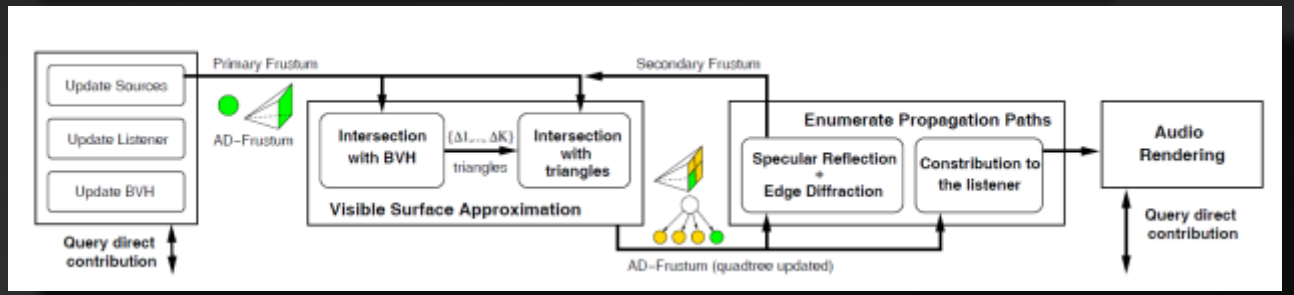
Geomerics

OptiX in Acoustics

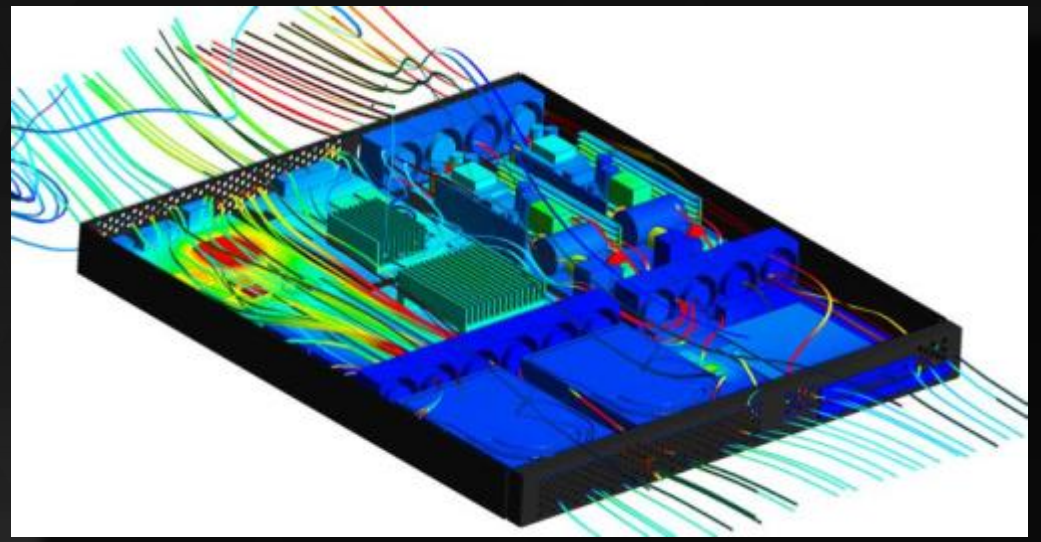
Sound Propagation

DOLBY



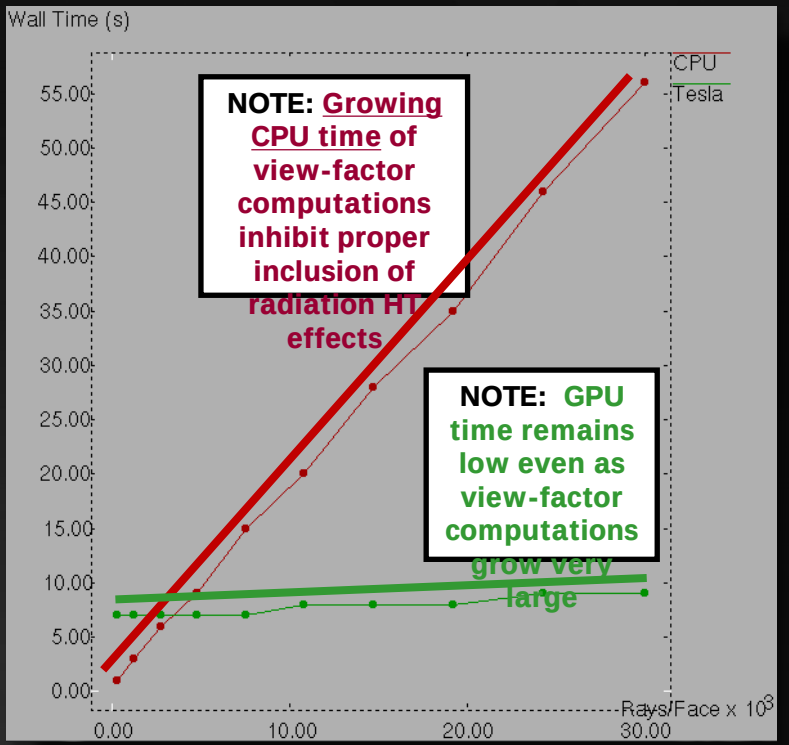


OptiX in Simulation Radiation Heat Transfer



Integral to version 14.5

ANSYS® FLUENT®



OptiX in Furry Ball renderer (for Maya)

- Added ray tracing via OptiX in 3 months
- Great example of using TRBVH in editing

OptiX at Pixar Studios

- Pixar Studios in-house Lighting tool for Katana built upon OptiX
- Achieves +100million divergent rays per second on a single GPU
- Transforms the lighting process – making it interactive

SIGGRAPH 2015:
Shading Film Assets with Interactive Ray Tracing
Danny Nahmias, Pixar
10-10:30 NVIDIA Booth Stage

OptiX 3.8 What's New

- **OptiX Prime**
  for blazingly fast traversal & intersection **(±300m rays/sec/GPU**)
  - You give the triangles and rays, you get the intersections, in a few lines of code
  - CPU fallback with no extra effort

- **TRBVH** Builder
  builds **+100X faster**, runs about as fast as SBVH (previous fastest)
  - Part of OptiX Prime and also in OptiX core
  - Making editing sessions very feasible
  - Used by Iray Interactive in Iray 2015 and Iray Photoreal in Iray 2015.3

- **OptiX Prime Instancing**
  for efficient reuse of geometry
  - **Now in use by Iray Photoreal and Iray Interactive**

OptiX Prime Instancing in Iray 2015

- Quickly powering the instancing in both Iray Interactive and Iray Photoreal
- Also providing the CPU fallback for Iray Interactive

OptiX Prime in Iray 2015

- Iray Photoreal
  - Now using OptiX Prime
  - Far faster rebuild times

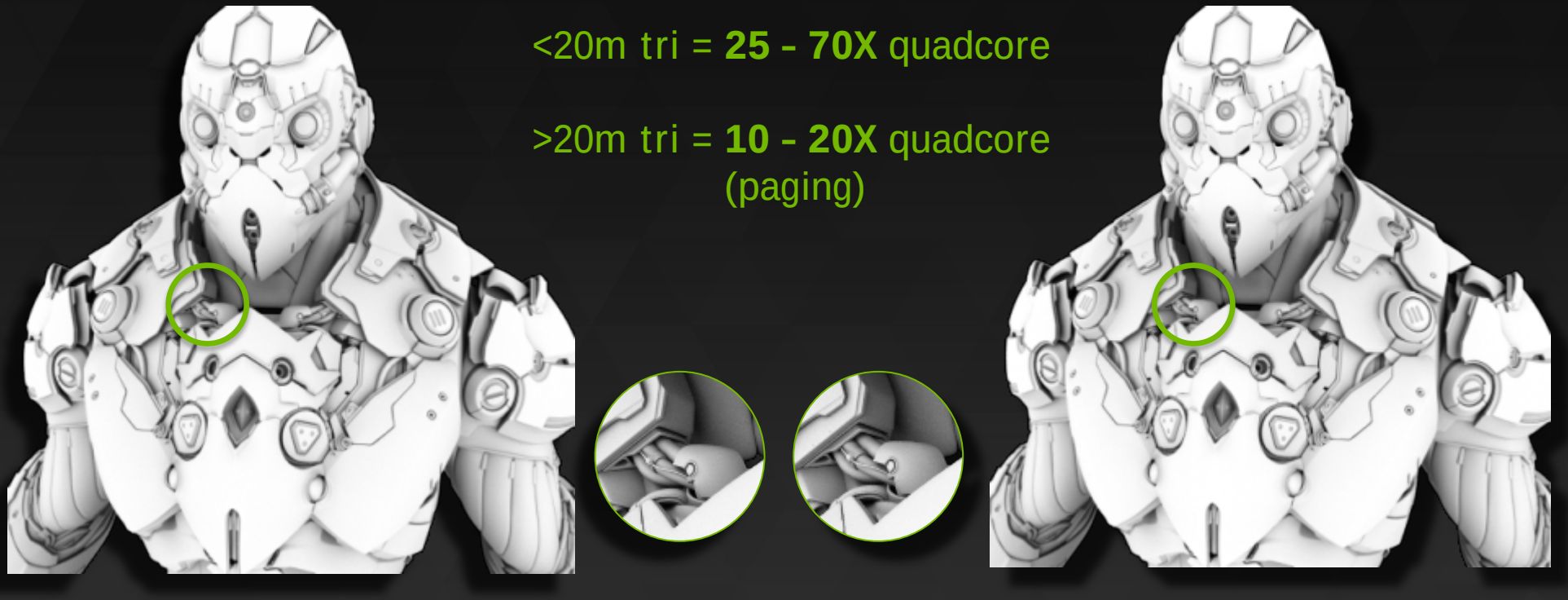
- Iray Interactive mode
  - Now using OptiX Prime
  - TRBVH Builder for 30 FPS rebuilds – of lighting and object transforms
  - Now with CPU fallback

OptiX & OptiX Prime in mental ray

- Shipping since v2014 of Autodesk Maya, 3ds Max, and Softimage

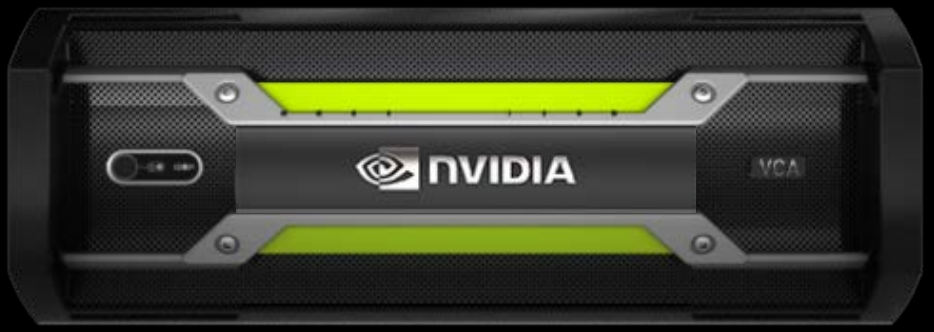
<20m tri = **25 – 70X** quadcore

>20m tri = **10 – 20X** quadcore (paging)



- What used to take many minutes is now essentially free with a beauty pass
- GI GPU (proof of concept) in Maya 2015 – in development

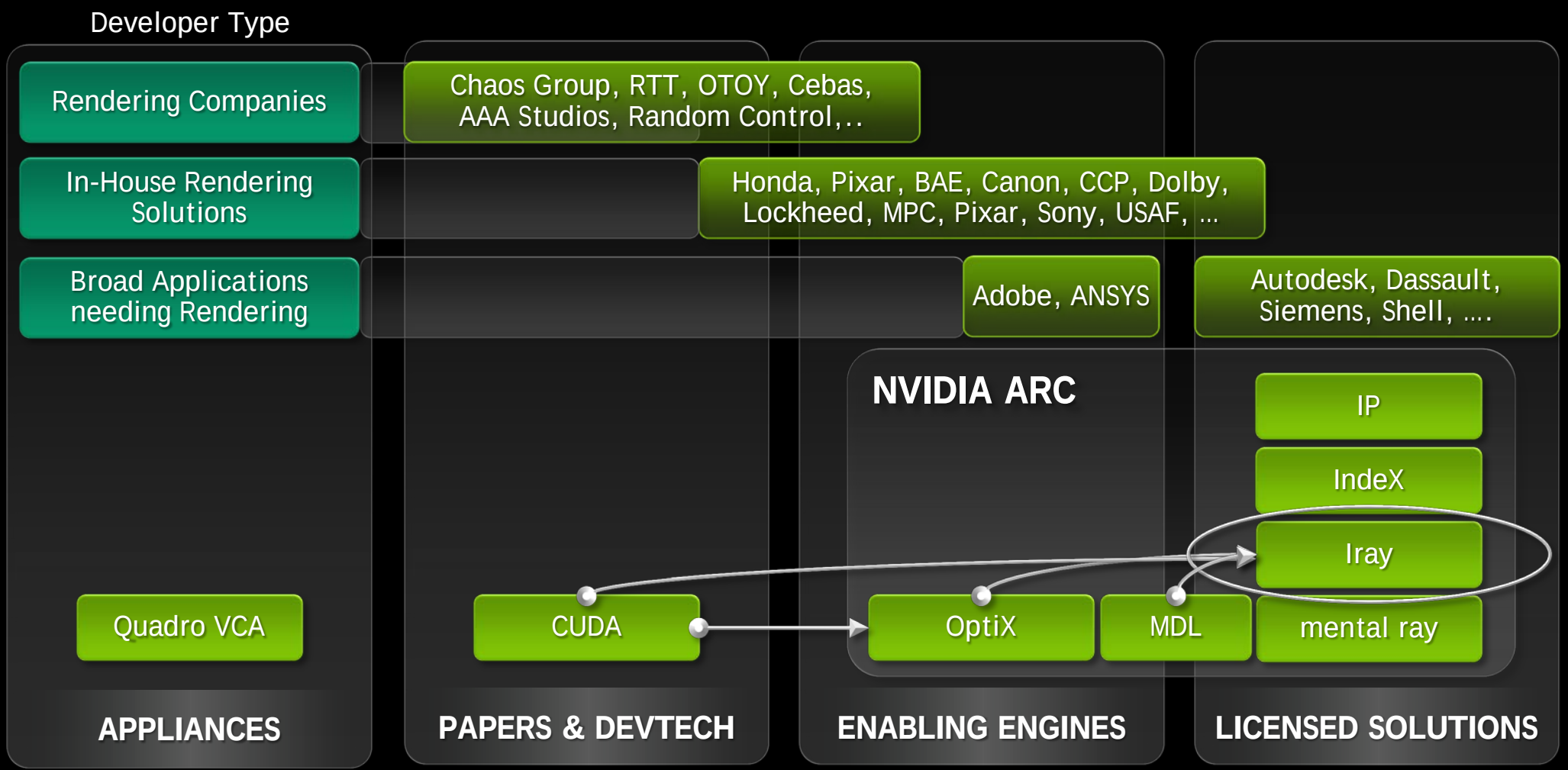
OptiX 3.8



- **Progressive API**
  - Single call to accumulate iterations/sub-frames into final frames
- **Quadro VCA Support**
  - Minimal effort to obtain client-server rendering when using the new Progressive API
- **Future "VCA on Demand"**
  - Look for a Prototype Service coming from NVIDIA later this year

SIGGRAPH 2015:
Innovations in OptiX
David McAllister, NVIDIA
Monday 3:15- 4:15

NVIDIA Advanced Rendering Offerings



NVIDIA®
Iray®

Realism Made Easy

Built for Designers

Intuitive & Easy to Use

Easy to Integrate

Built for Developers

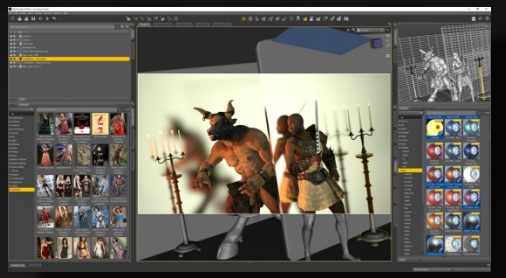
Fully Interactive

Fully Scalable

within Commercial Products

Catia
SOLIDWORKS
Industrial Designer

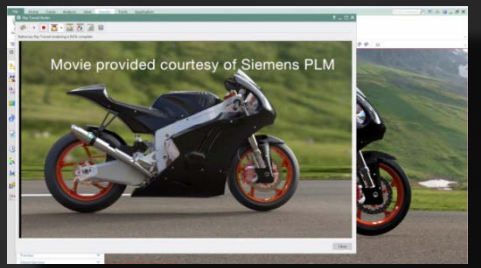
3ds Max (mental ray)



DAZ Studio

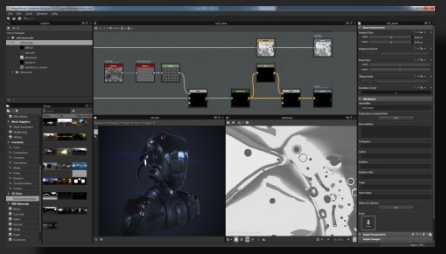
Patchwork 3D

Shot & Zoom



In Beta now

For SketchUp)



Substance Designer

NVIDIA® Iray®

Highly scalable photorealism for your application

- Robust rendering solution with a modern and easy to implement SDK
- Designed from the beginning for interactivity
- Scalable across processors, network, cloud
- Rich material and lighting material
- Highly accurate, with measured results
- Flexible post production solution

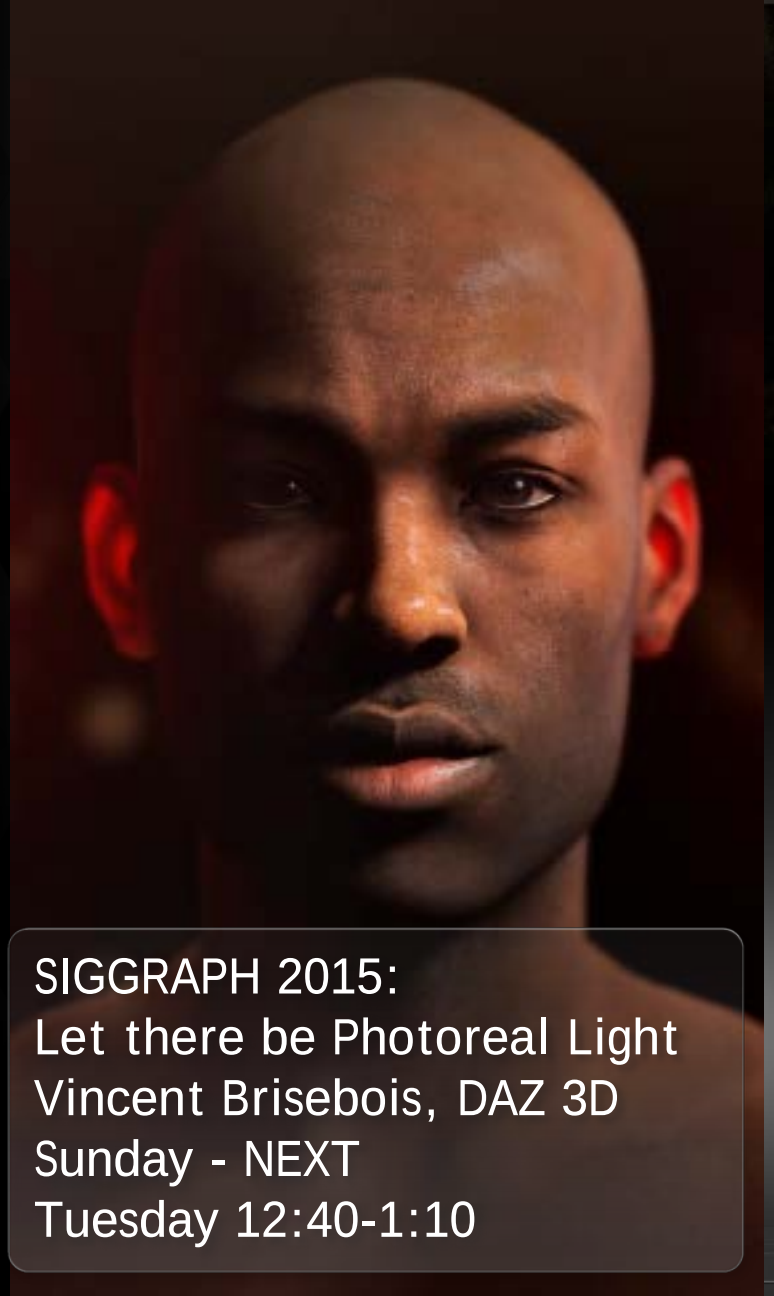
Iray in Production

Iray in Production
timeless racer
MACHINES OF A TIME TRAVELING SPEED JUNKIE
FAUBERT
cifiq
SGM
DSX
ALLGRIFF
MASUCCI
timeless racer

Iray in DAZ 3D Studio

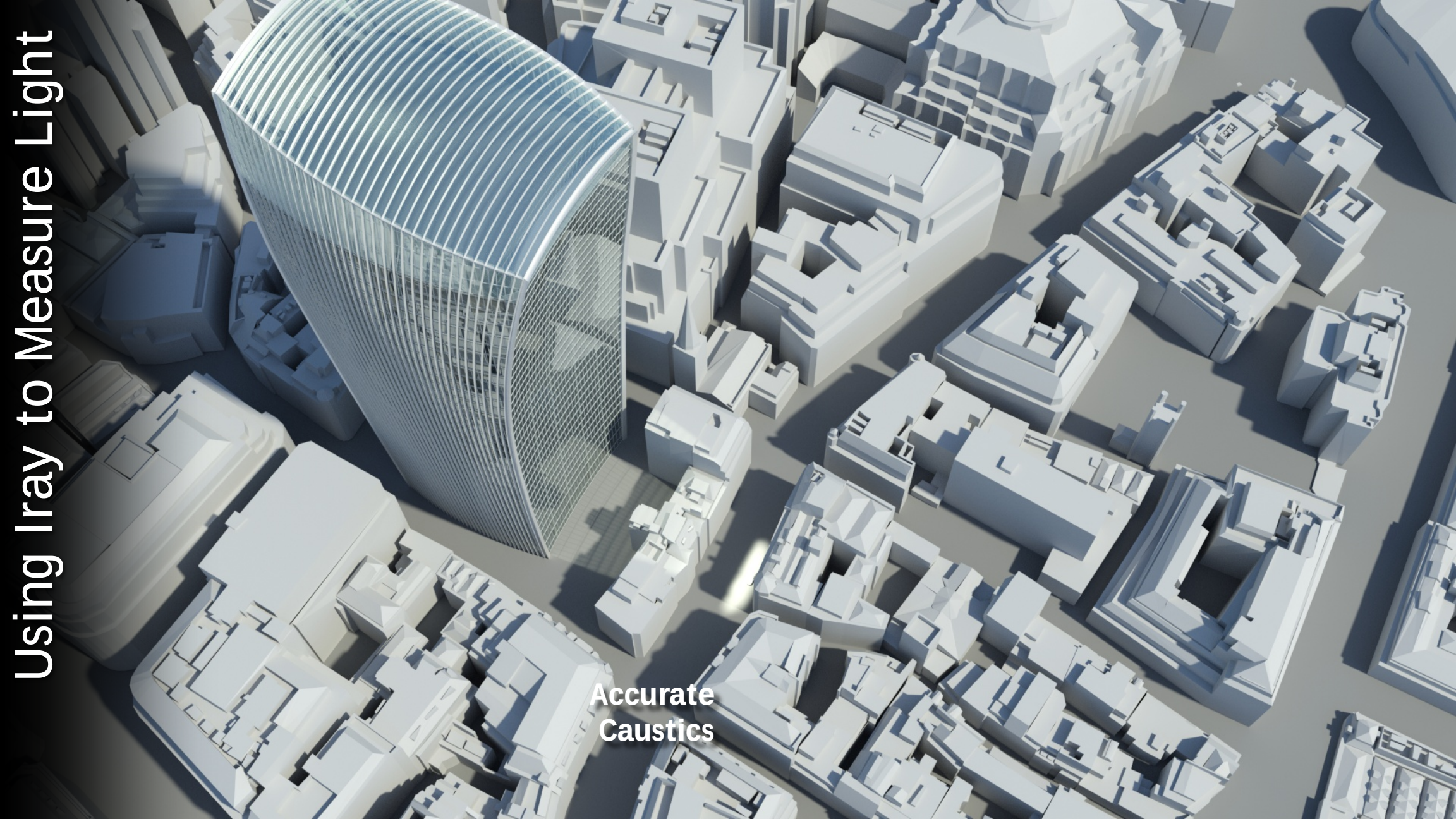
Iray in DAZ 3D Studio

Iray in DAZ 3D Studio

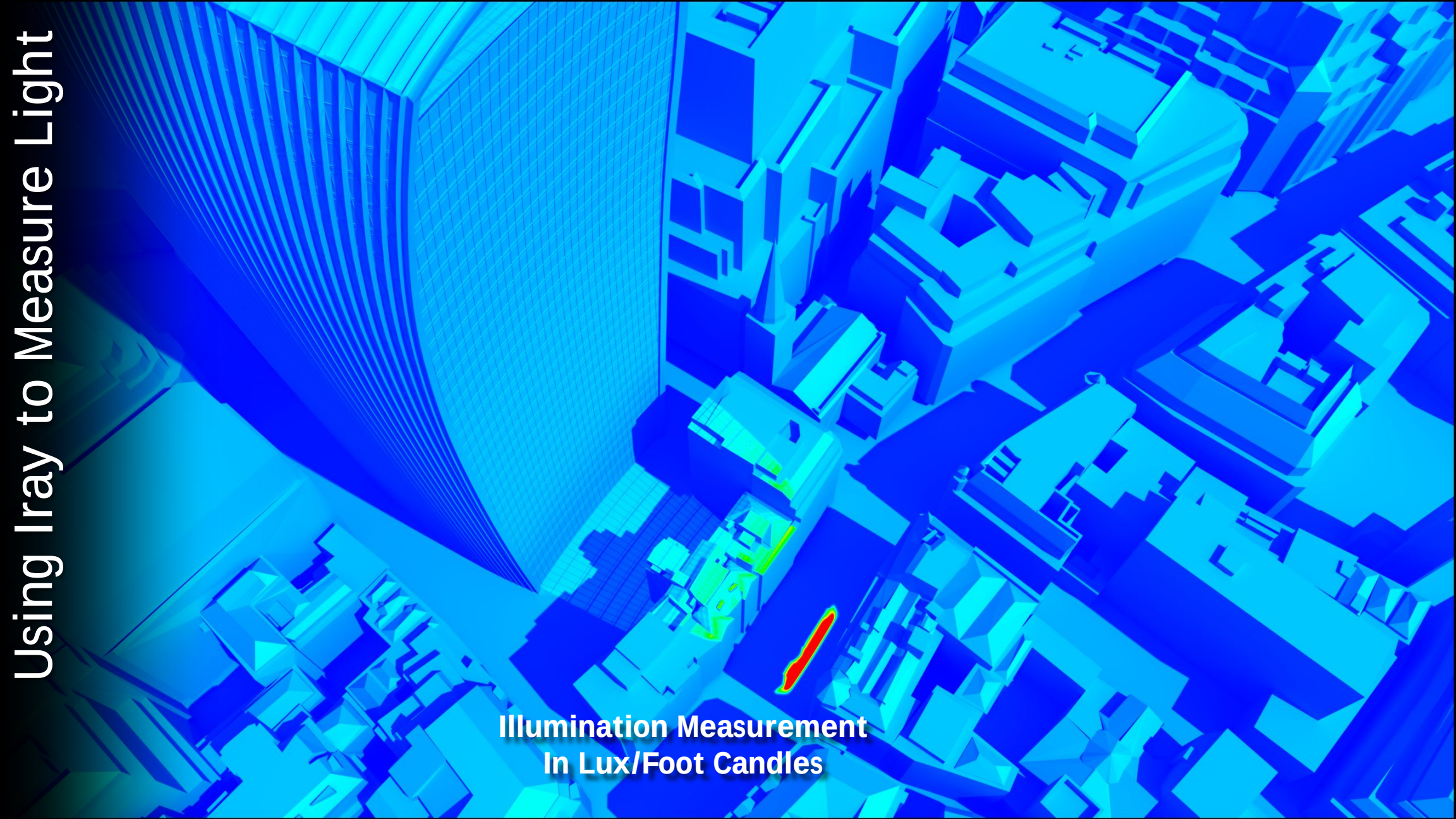


SIGGRAPH 2015:
Let there be Photoreal Light
Vincent Brisebois, DAZ 3D
Sunday - NEXT
Tuesday 12:40-1:10

Using Iray to Measure Light

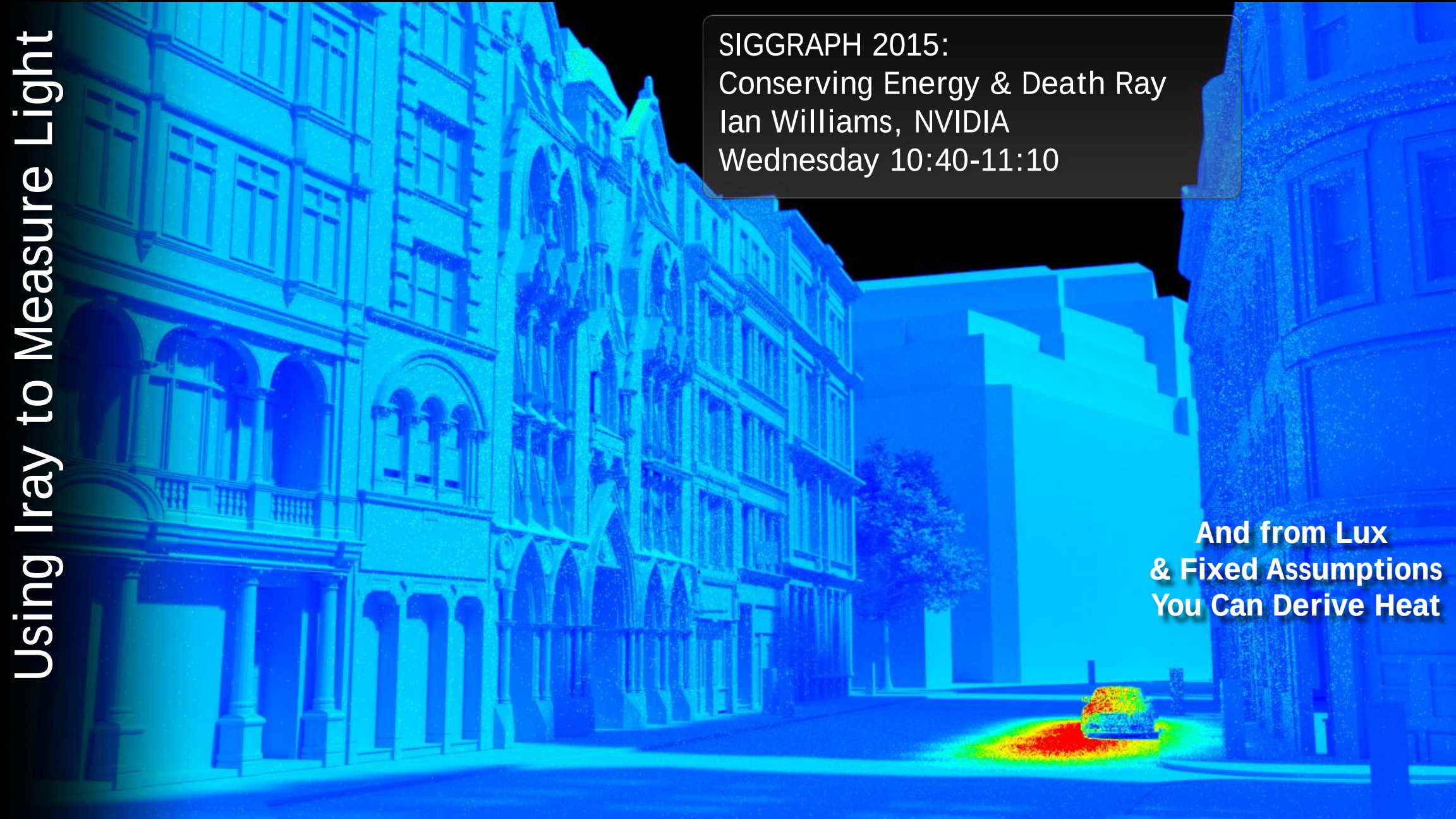


Using Iray to Measure Light



Using Iray to Measure Light

SIGGRAPH 2015:
Conserving Energy & Death Ray
Ian Williams, NVIDIA
Wednesday 10:40-11:10



And from Lux
& Fixed Assumptions
You Can Derive Heat

NVIDIA® Iray®

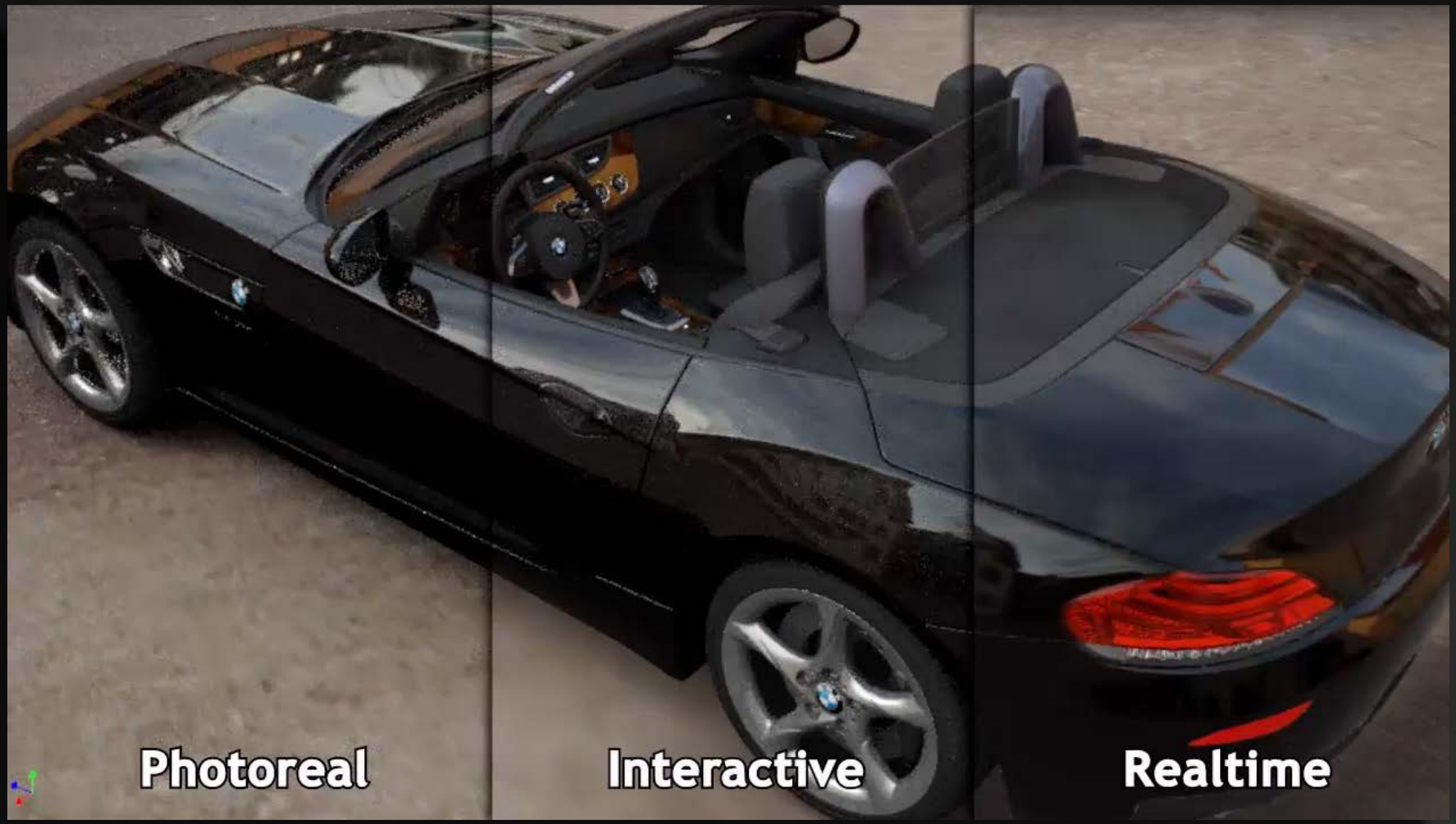
Fulfilling on the Promise

- Gave you our vision
  4 years ago
- Iray 2013
  shipped Dec 2012
- Iray 2014
  shipped Dec 2013
- Iray 2015
  shipped March 2015

SIGGRAPH 2011:

Iray Render Modes

Demos at Booth



Constant Material Definitions with MDL
B TZ 2012
Iray Interactive
Direct Illumination & IBL

Constant Material Definitions with MDL

Constant Material Definitions with MDL
Iray Interactive
Direct Illumination & IBL

Constant Material Definitions with MDL

Iray Photoreal
Path Tracing

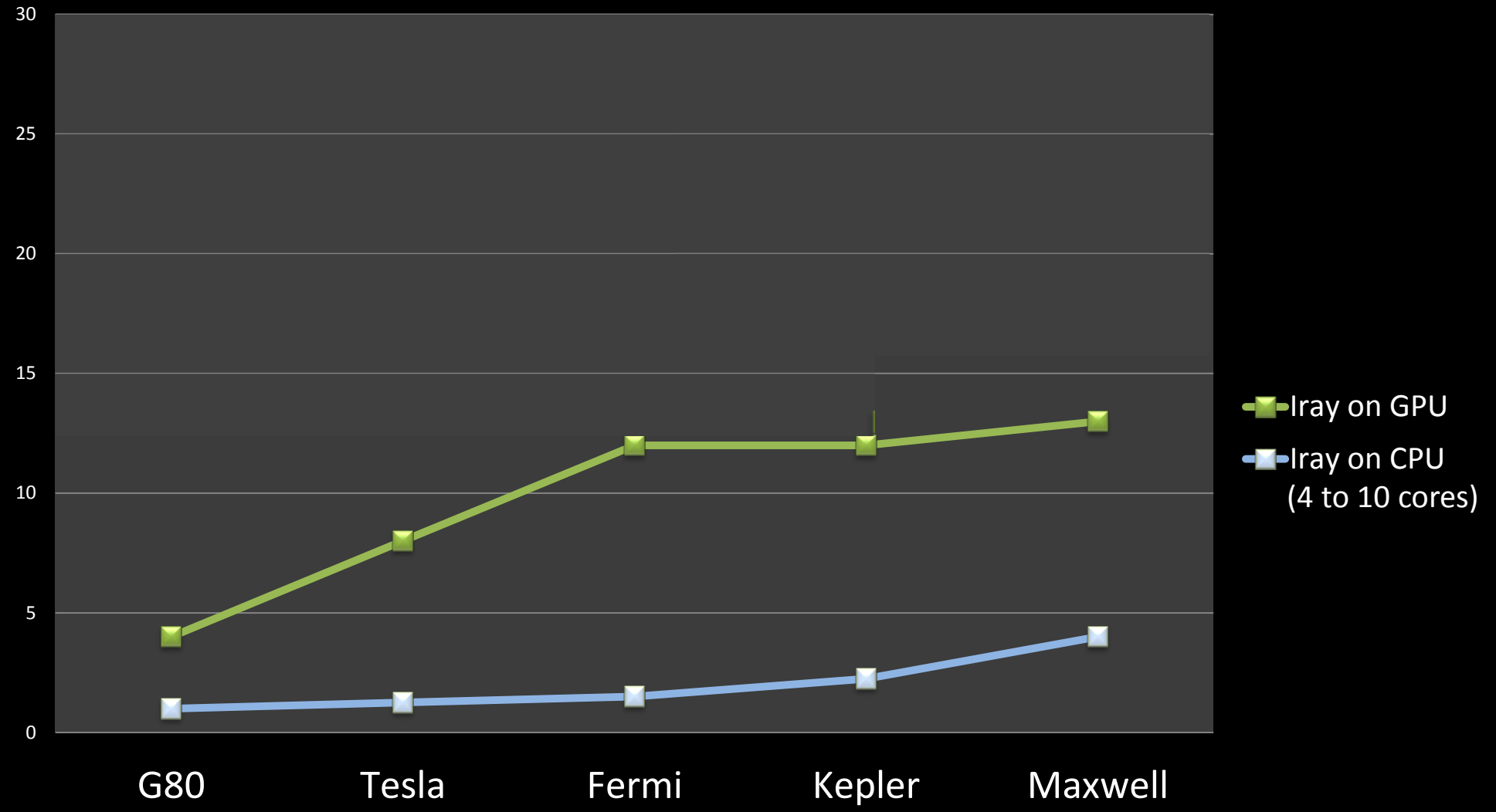
Iray 2015

Faster than Ever

- Now using multiple kernels rather than one megakernel (AKA “wavefront” approach)
- Both render modes now employ OptiX Prime

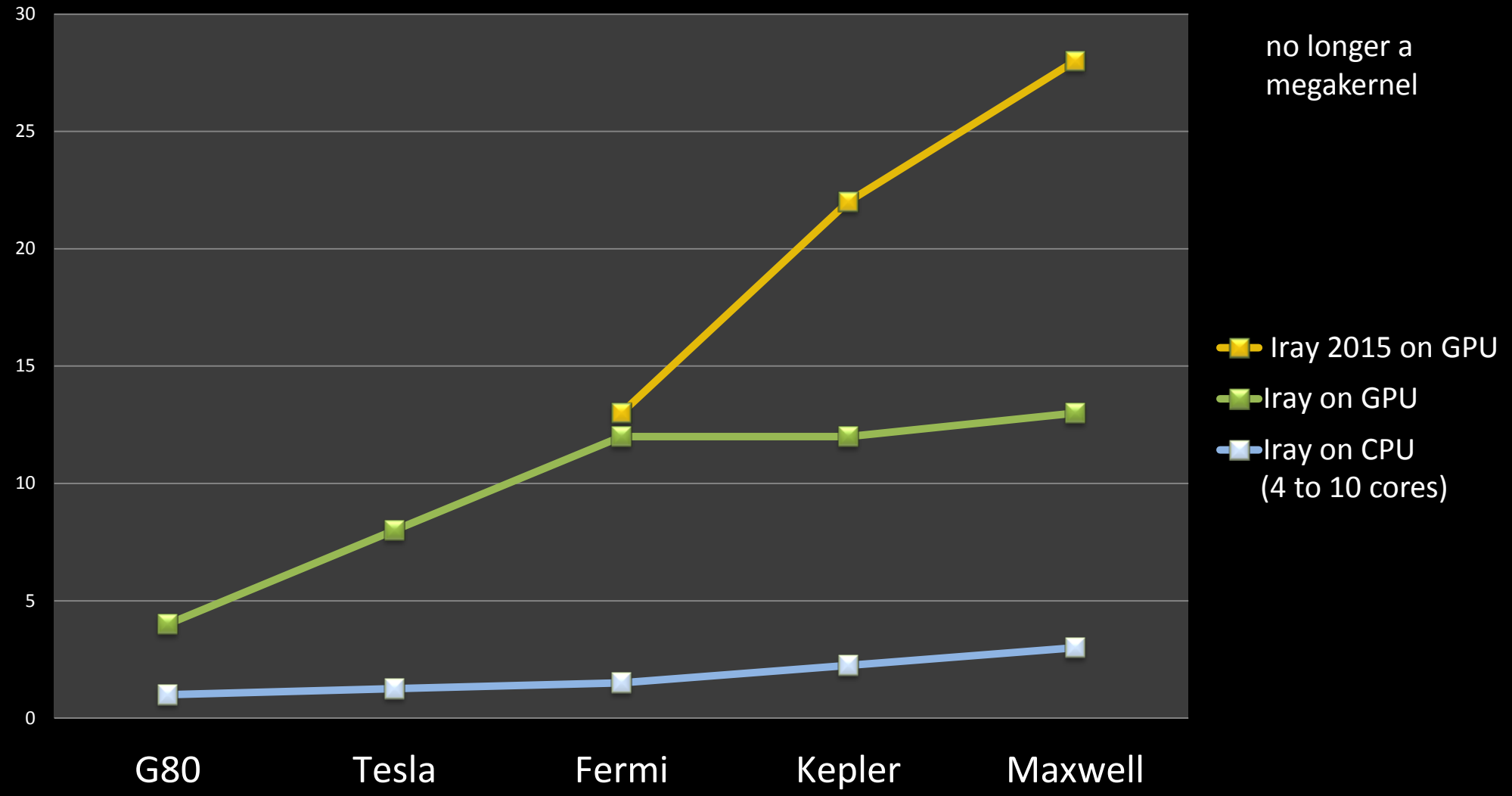
Iray Performance

GPU vs. CPU over time



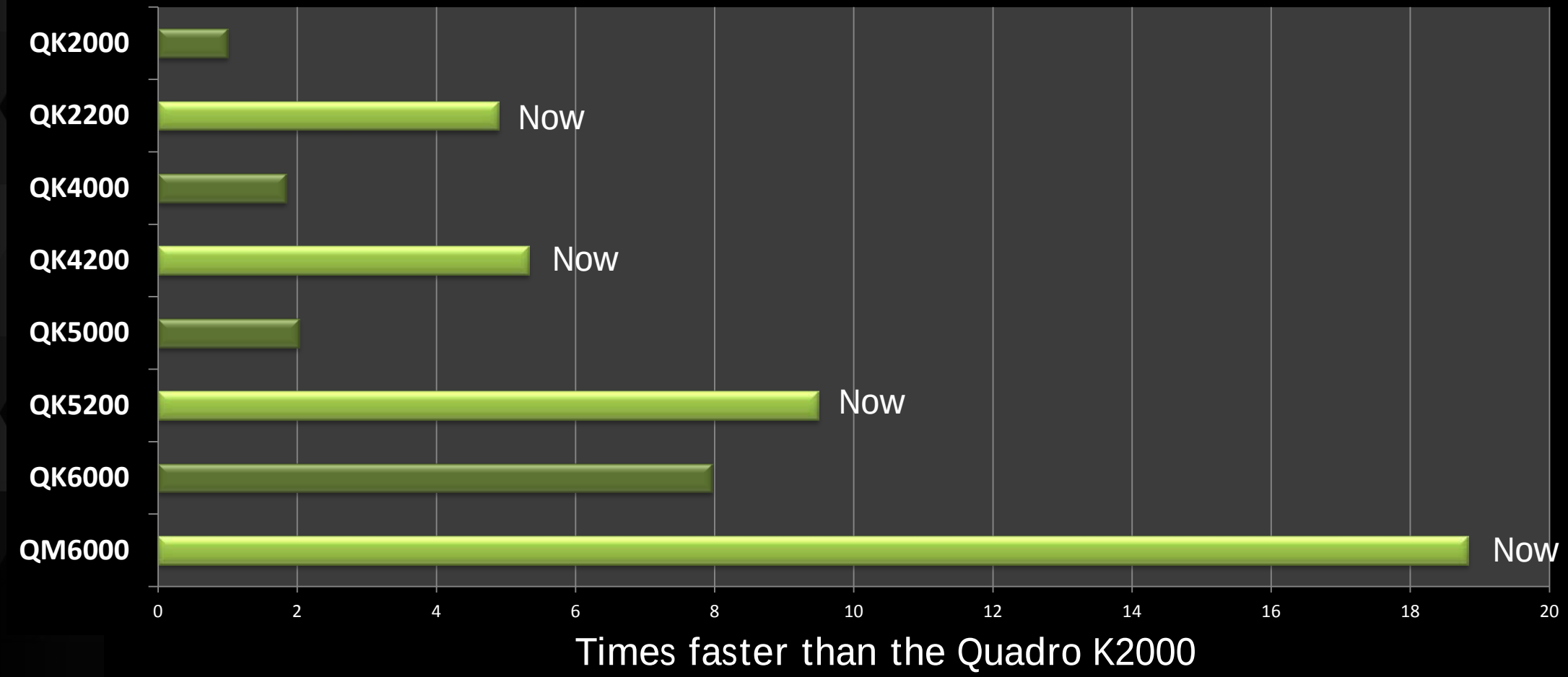
Iray Performance

GPU vs. CPU over time



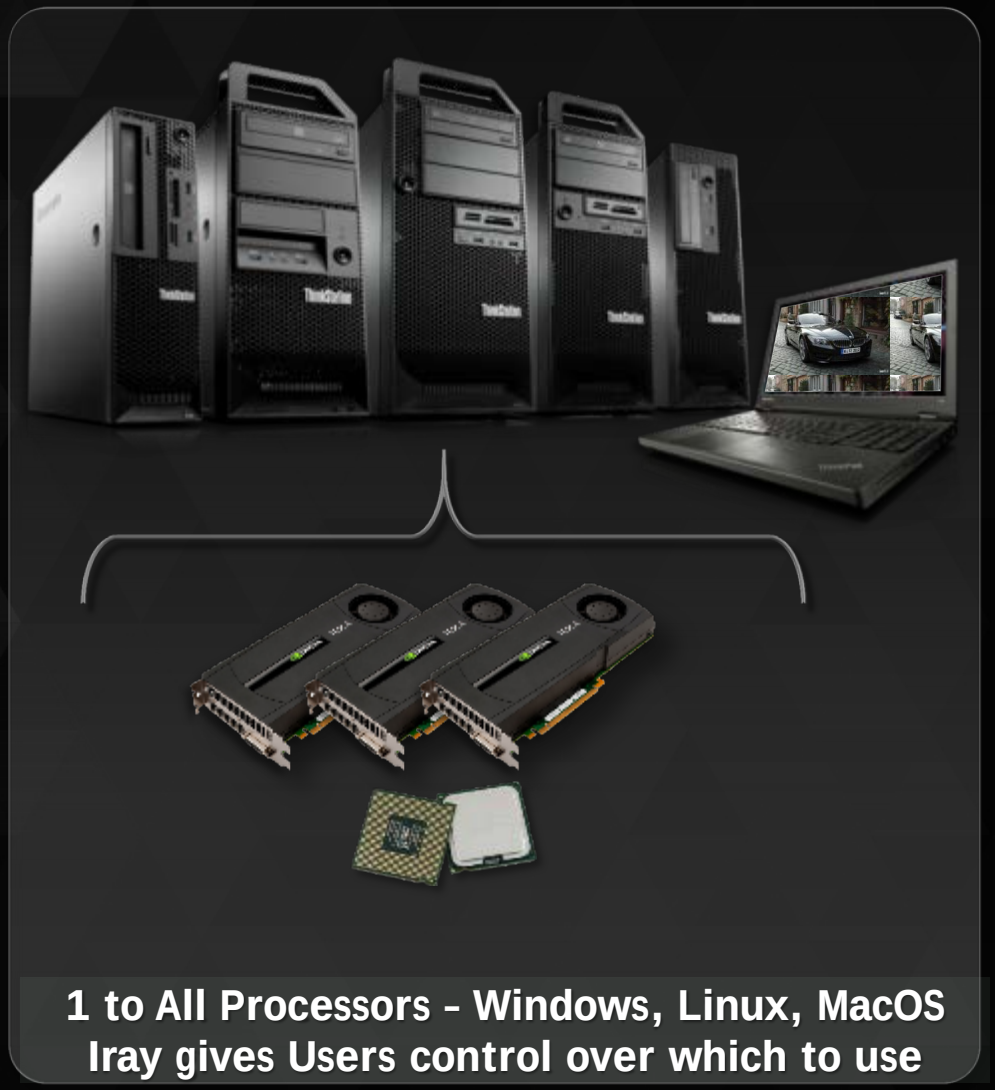
Iray 2015 Faster than Ever

Iray 2014 vs. Iray 2015 on new vs last year's GPUs

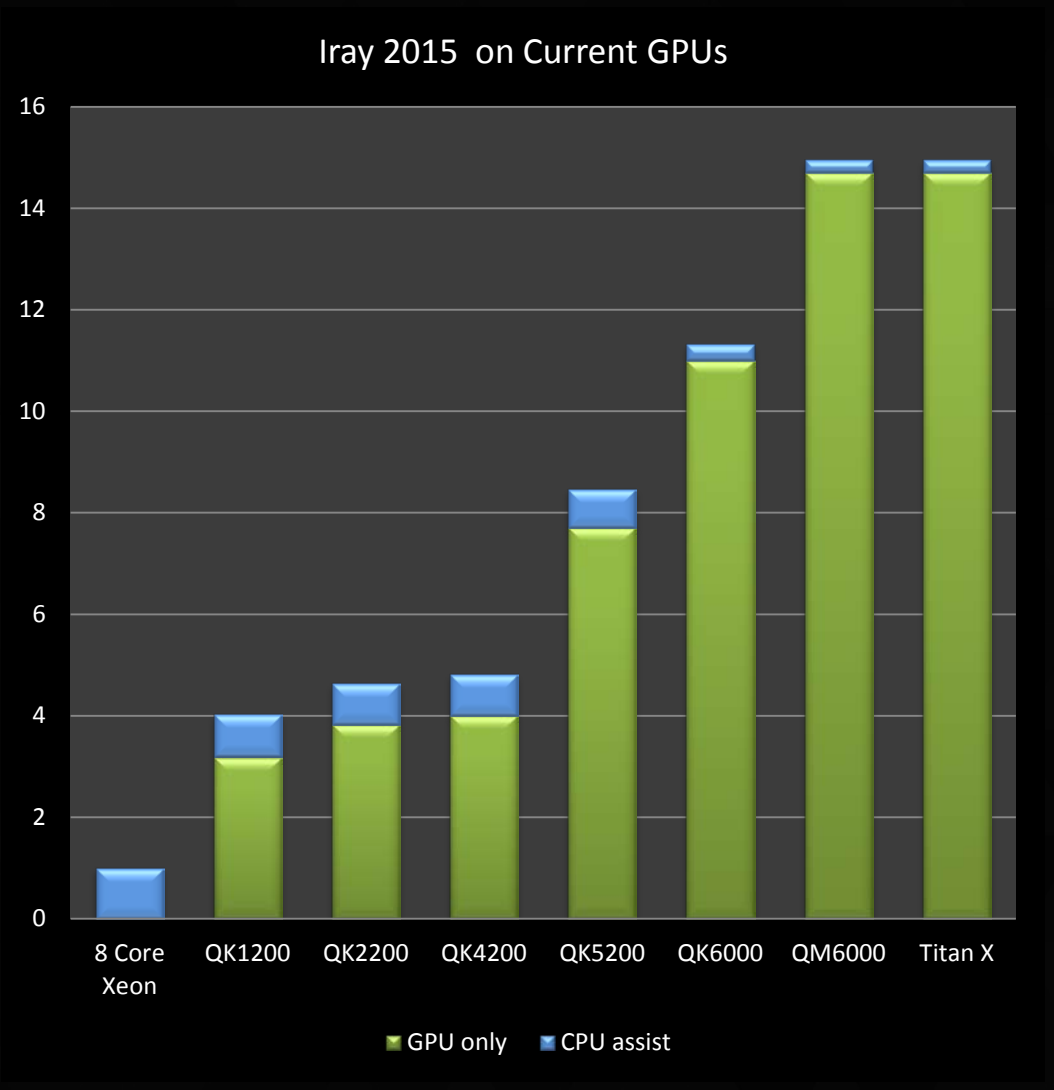


Iray

Scaling within a Machine



1 to All Processors – Windows, Linux, MacOS
Iray gives Users control over which to use



Iray Rendering Modes & Materials

Iray Realtime | **Iray Interactive** | **Iray Photoreal**

60 FPS ‹ › 15 FPS*

20 FPS ‹ › 2 FPS*.

10 FPS ‹ › Minutes

Material
Definition
Language

MDL making this all Easy:

Create without algorithmic knowledge or programming

Measurement Device support

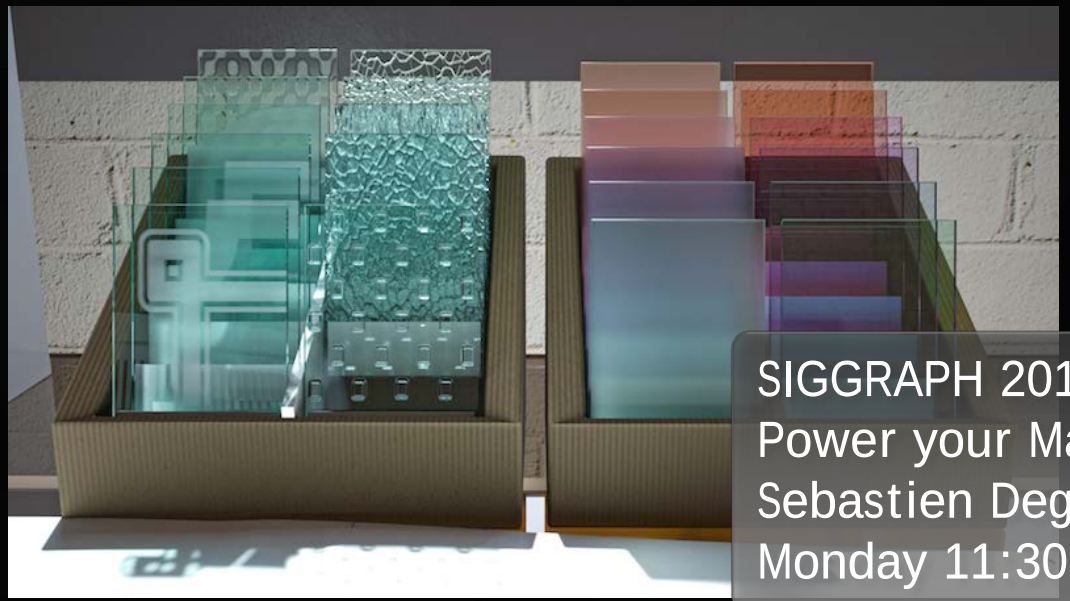
Easily customized

Material Definition Language

Public

Shareable materials and lights between Physically Based Renderers

- Supported in the mental ray 3.13 within Maya 2016
- Coming to VRay (all versions) from Chaos Group
- Coming to Allegorithmic Substance Designer & Painter



SIGGRAPH 2015:
Power your Material Editing
Sebastien Deguy, Allegorithmic
Monday 11:30- 12:30

Announcing MDL SDK

- Making it easier for other PBR renderers to adopt MDL
- Currently in use by Chaos Group for VRay
- In discussion with several other companies

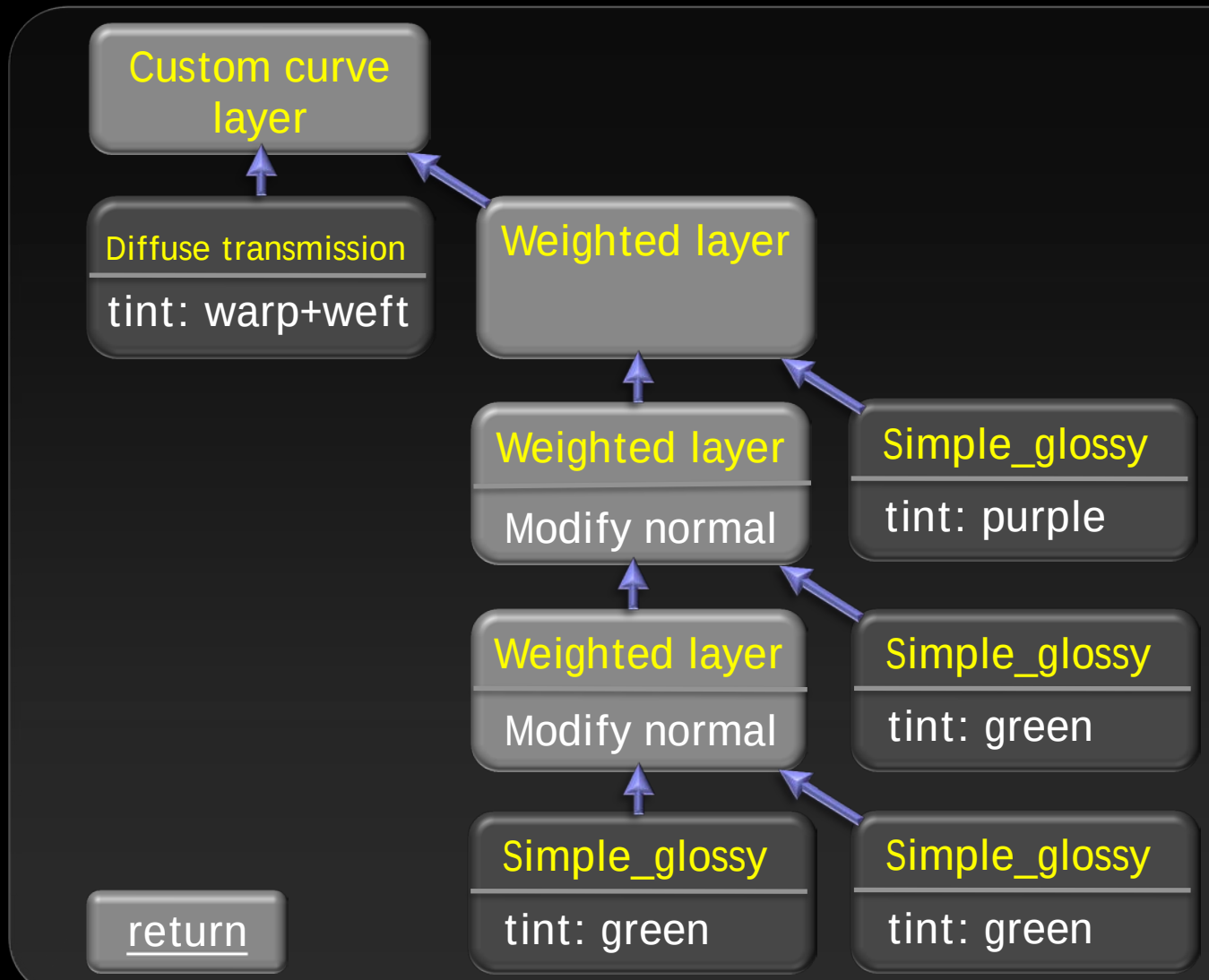
SIGGRAPH 2015:
Sharing MDL between Renderers
Jan Jordan & Lutz Kettner, NVIDIA
Monday 9:00-10:00

MDL Shimmering Cloth Example

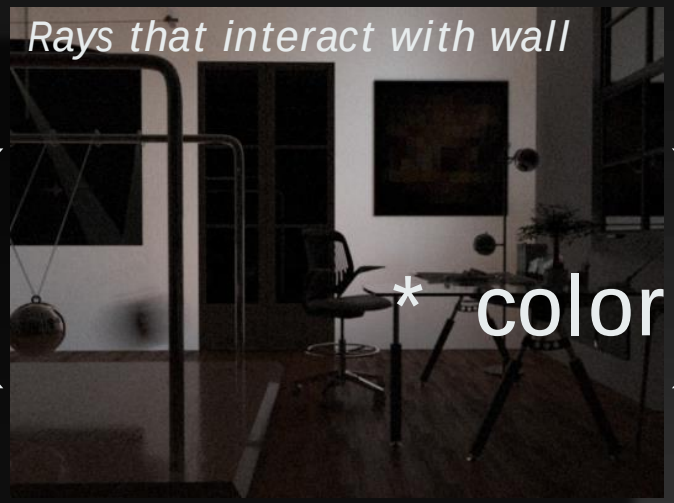
- The building blocks of MDL enable materials of a complexity previously only possible through custom shader writing
- Same rendered result across renderers supporting MDL

detail

MDL Shimmering Cloth Example



MDL Friendly to Light Path Expressions



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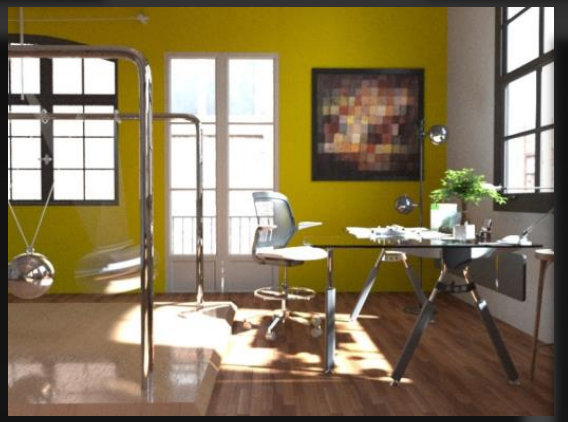
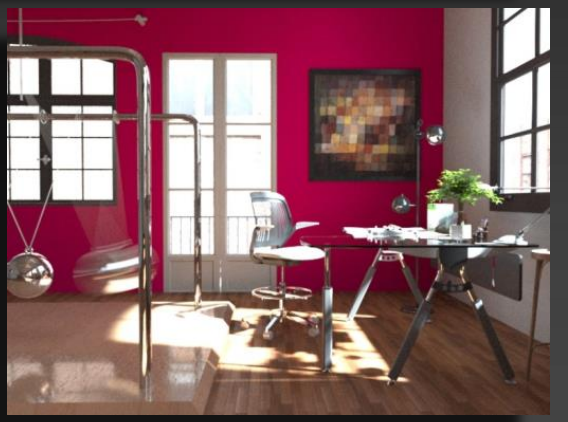




Edit the Wall Color easily in Post – and get proper reflections and color bounce

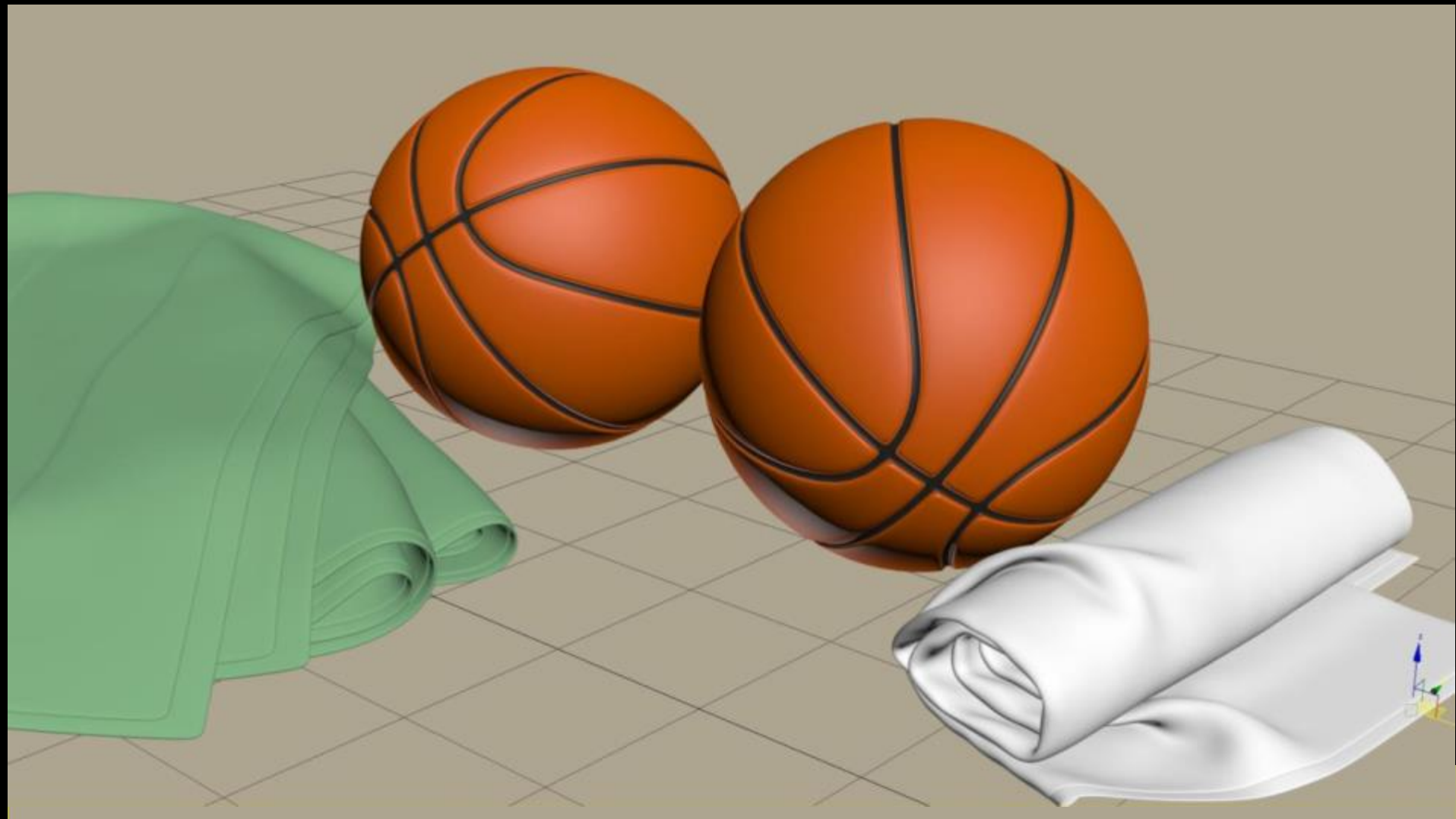
Iray 2015

X-Rite AXF Support

- Direct loading of AXF as a ready to use material in Iray
- Can then be layered and adjusted via MDL
- Currently a service from X-Rite
- TAC Devices coming over the next 12 months

Material Progression

Raster Viewport



Iray Default Materials & Lighting

Iray

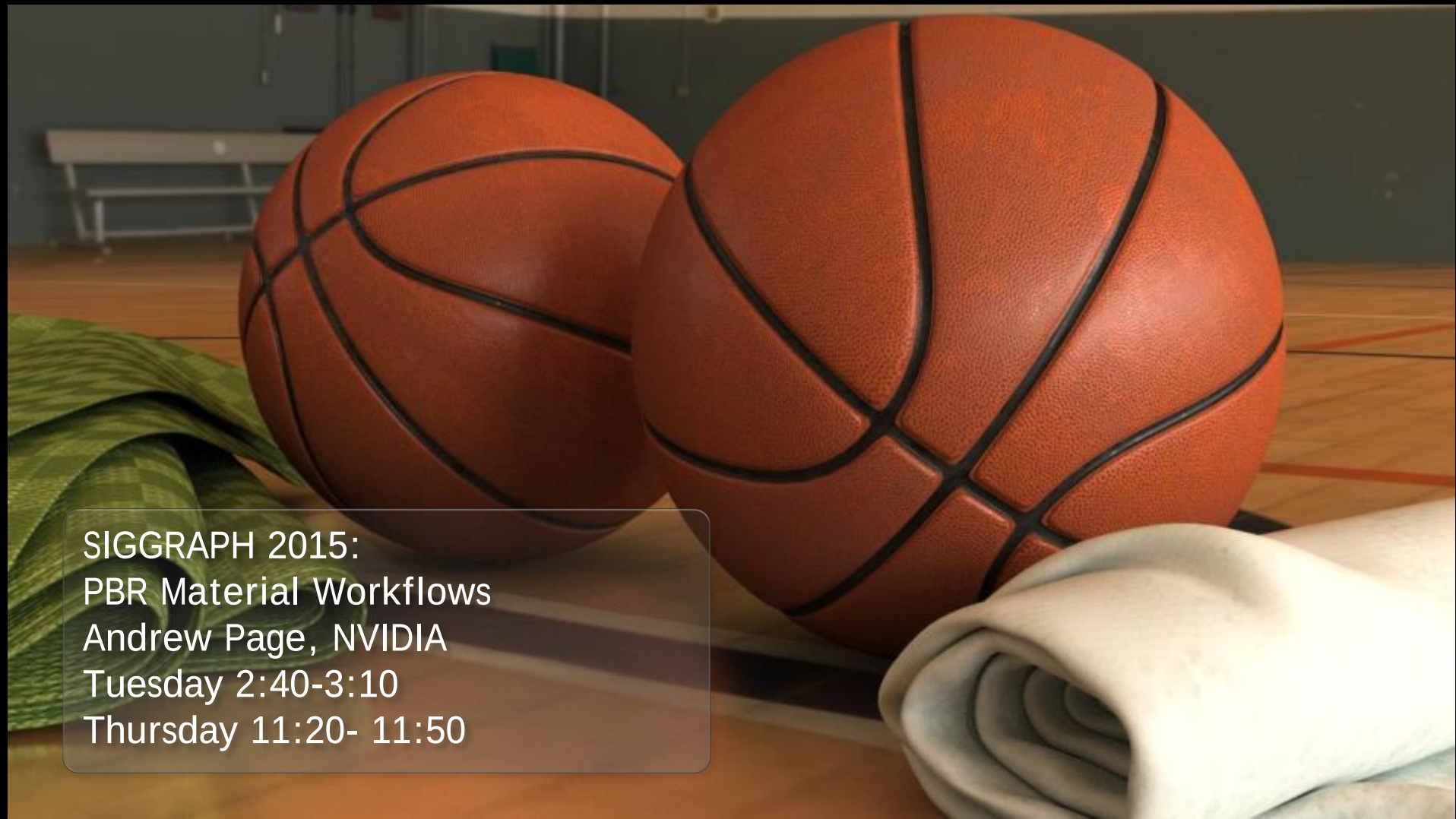
Environment Added (IBL)

Iray

Measured Materials Applied

Iray Measured Materials with MDL Layering

Iray Measured Materials with MDL Layering



Application Opportunities are Infrequent

NVIDIA also Going Direct
Bringing Iray to Key Products as Plug-in Products

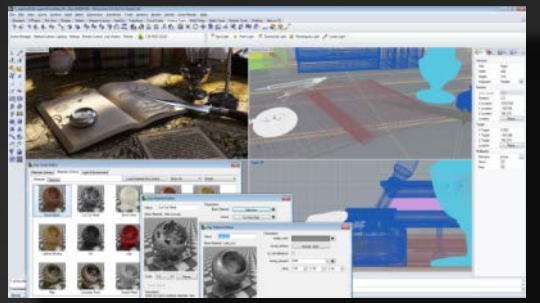
Coming this year from NVIDIA

Iray for Maya

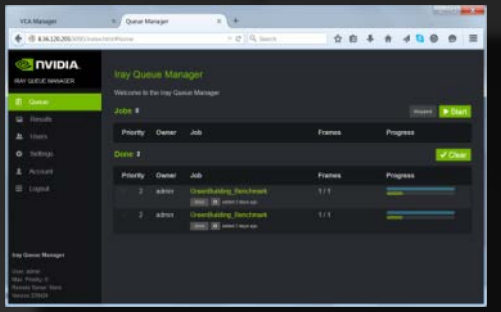
BIM IQ Render - Iray for Revit

Iray+ for 3ds Max

Iray for Cinema 4D

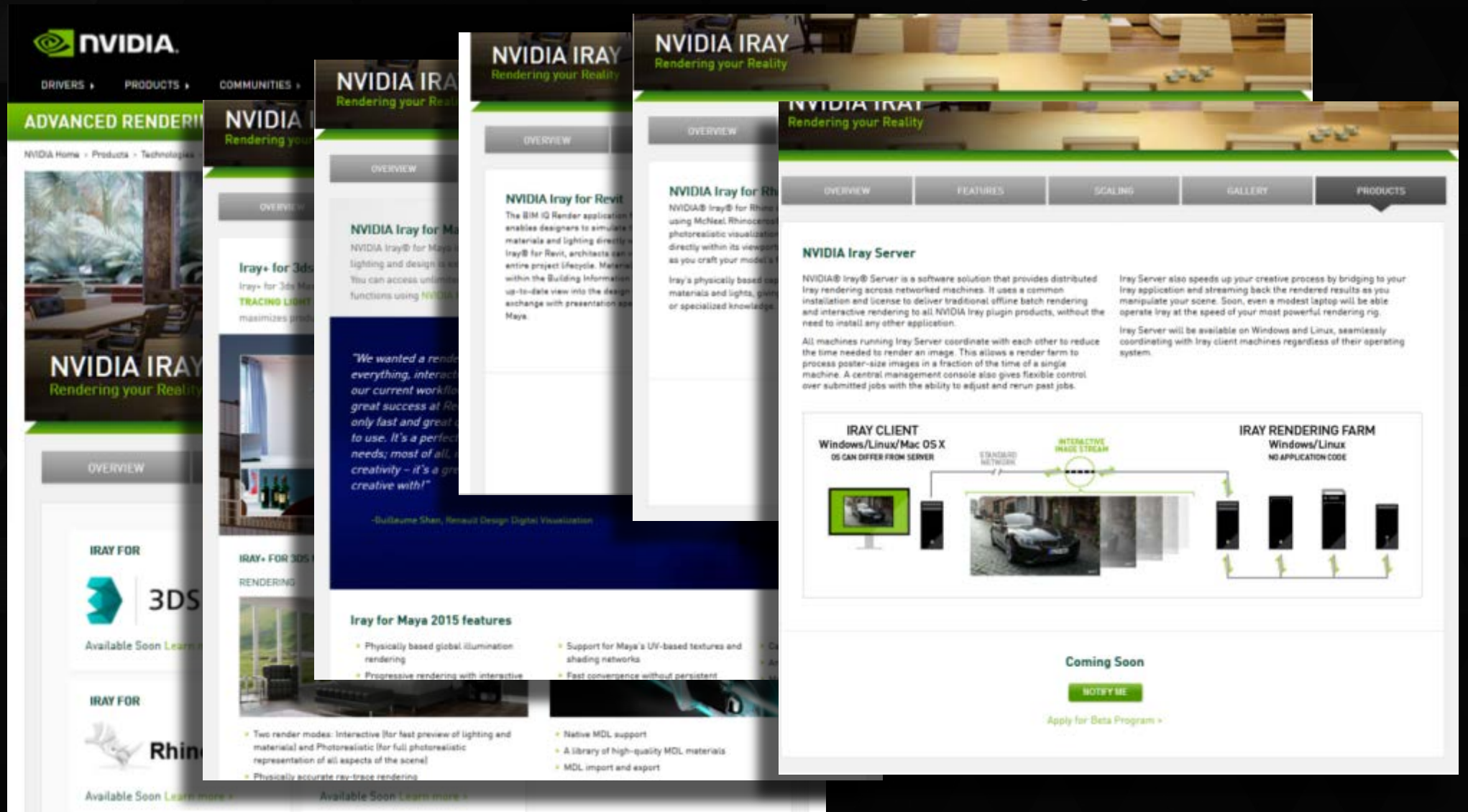


Iray for Rhino



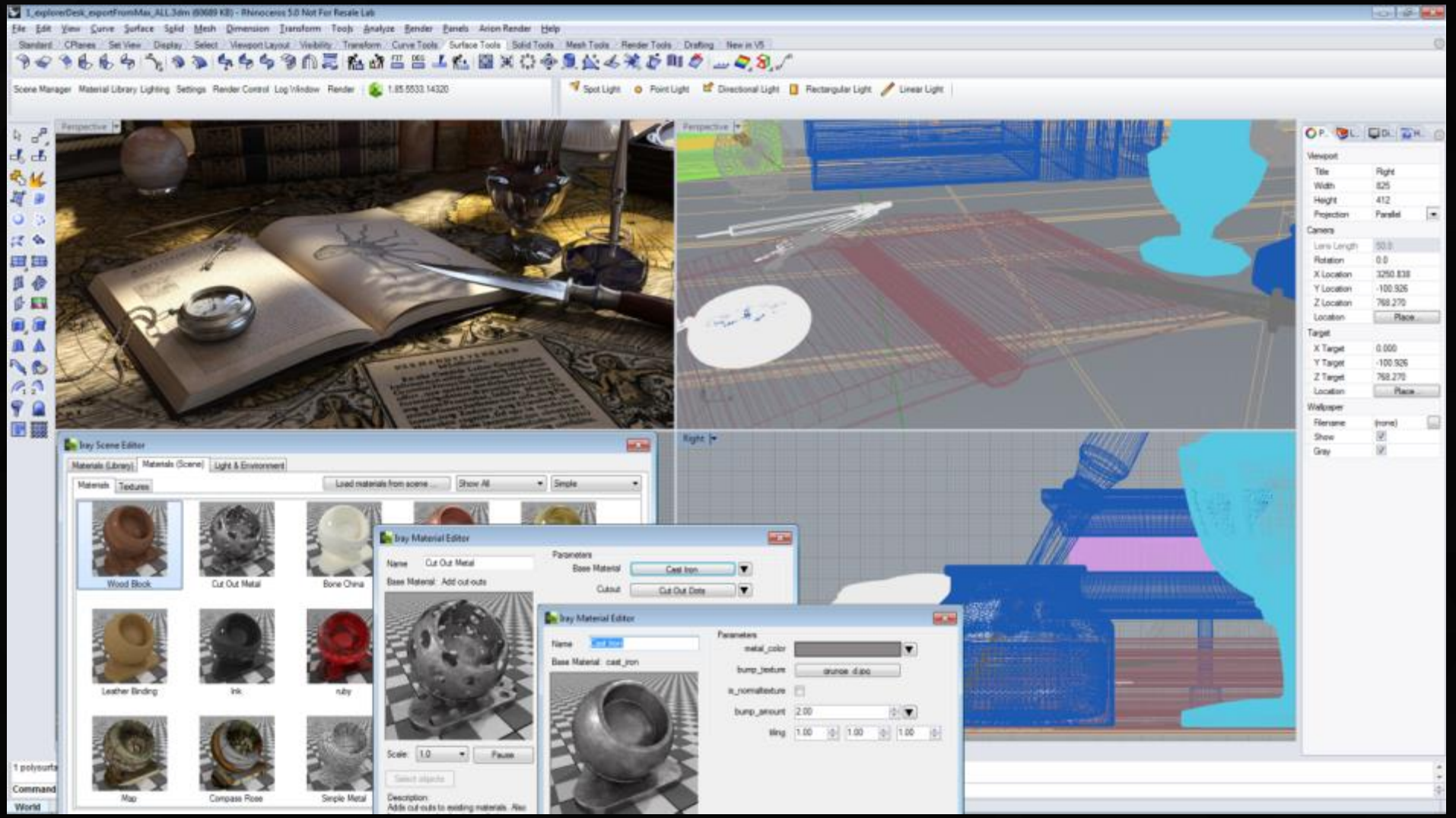
Iray Server

www.nvidia.com/object/iray-plugins



Iray for Rhino

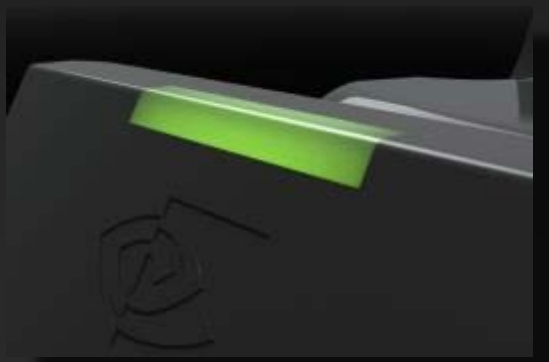
Now in Beta



Iray for Rhino within NVIDIA

4 Rounded Notch

5 Facet cut, half-round grooves



Iray

Enabling Predictive Design

- Integrated for interactivity
- Scalable Performance

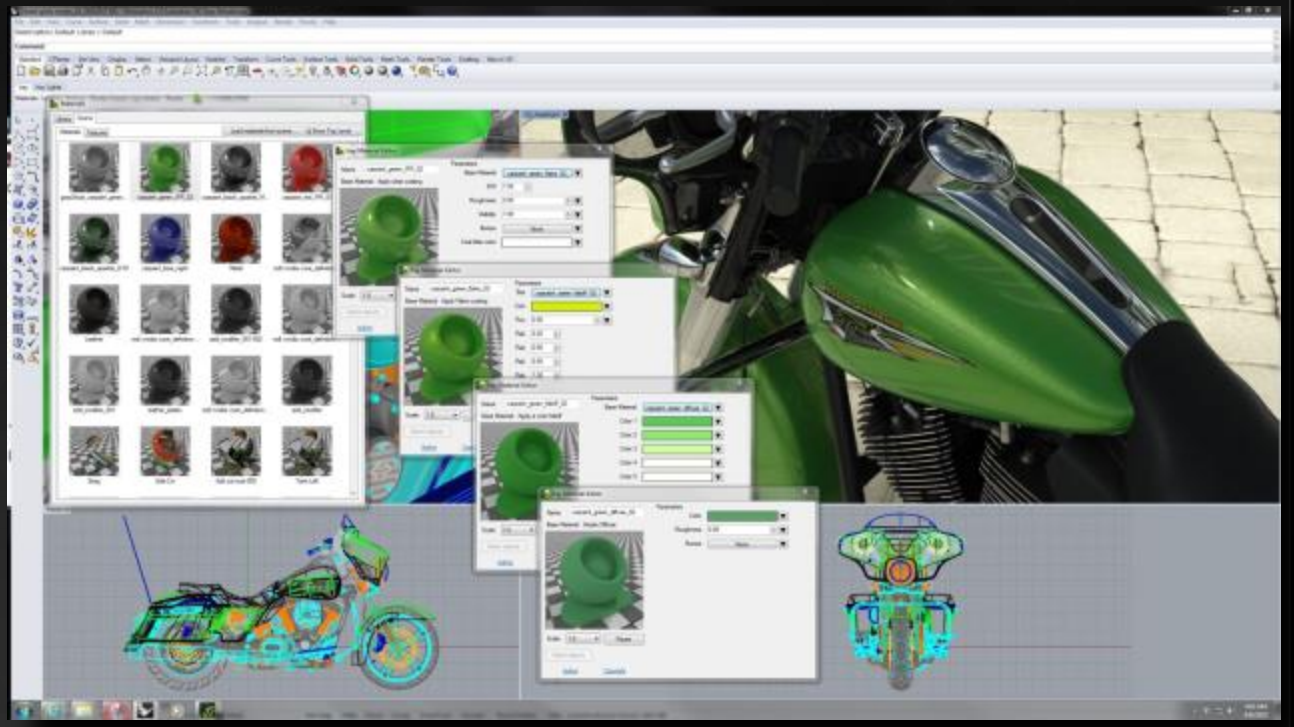
= Fluid Workflow

- Accurate materials
- Accurate lighting

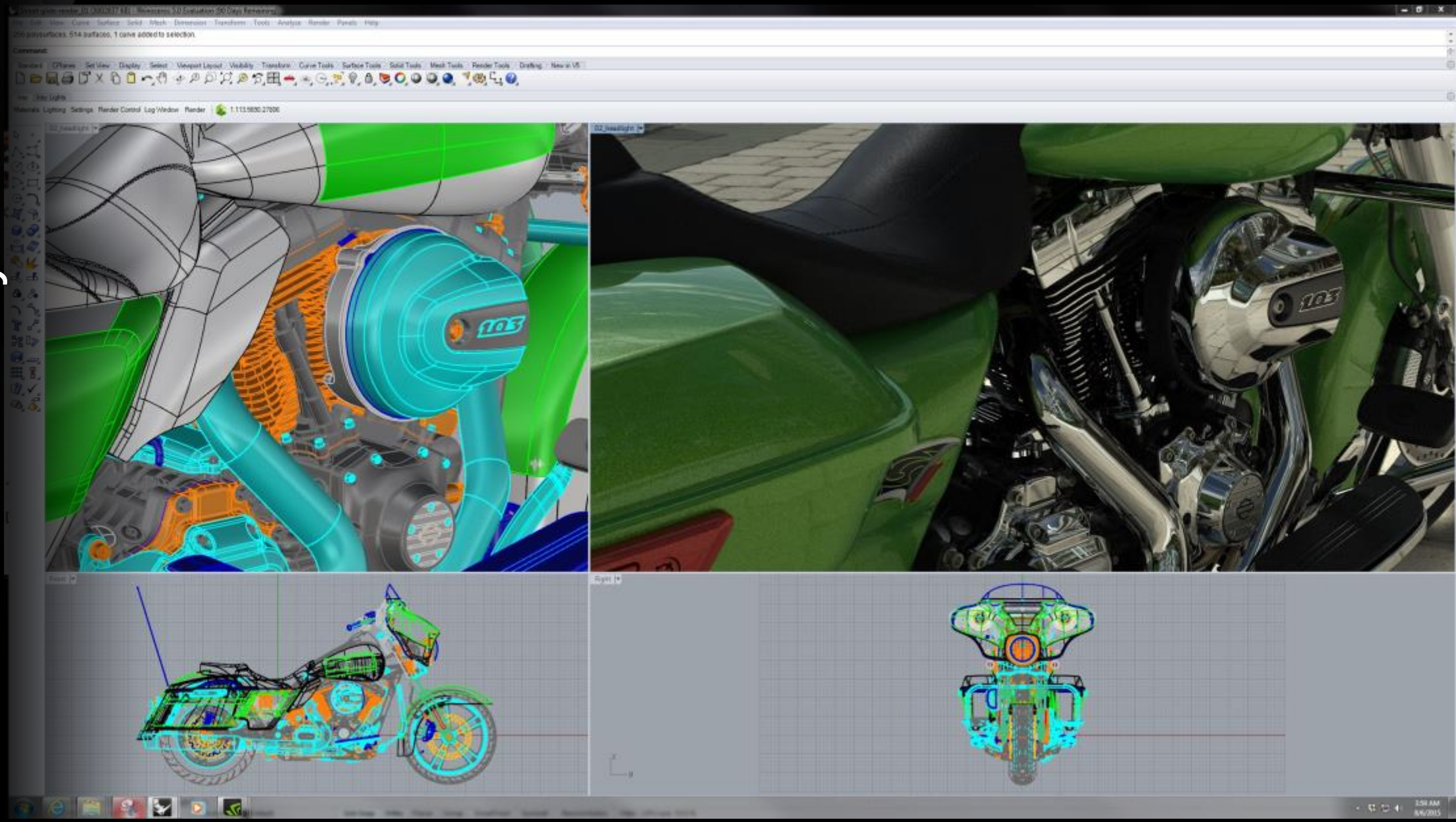
= Predictive results

- Material Exchange

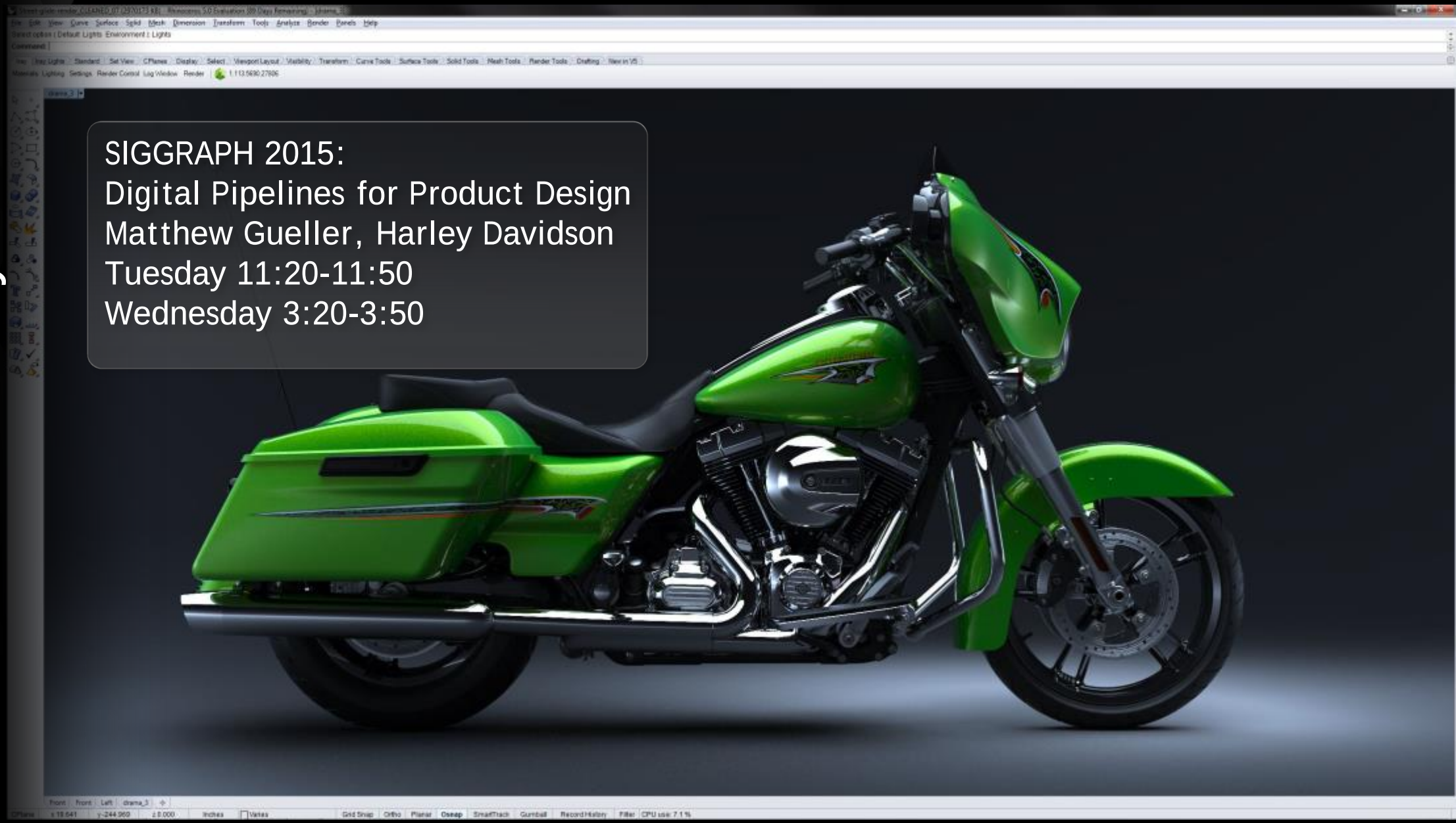
= Maintain Design Intent between Design Tools



Iray for Rhino



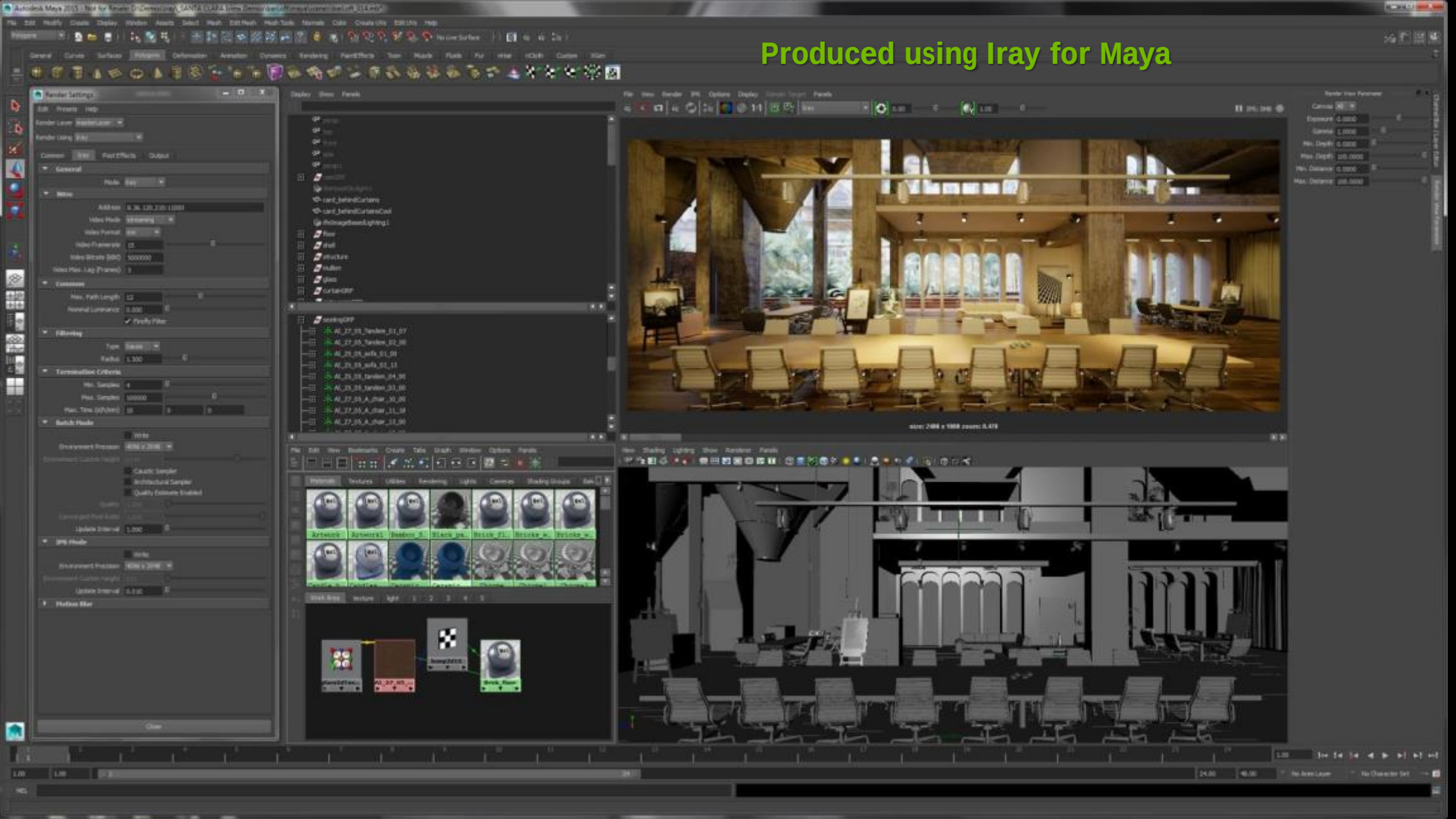
Iray for Rhino



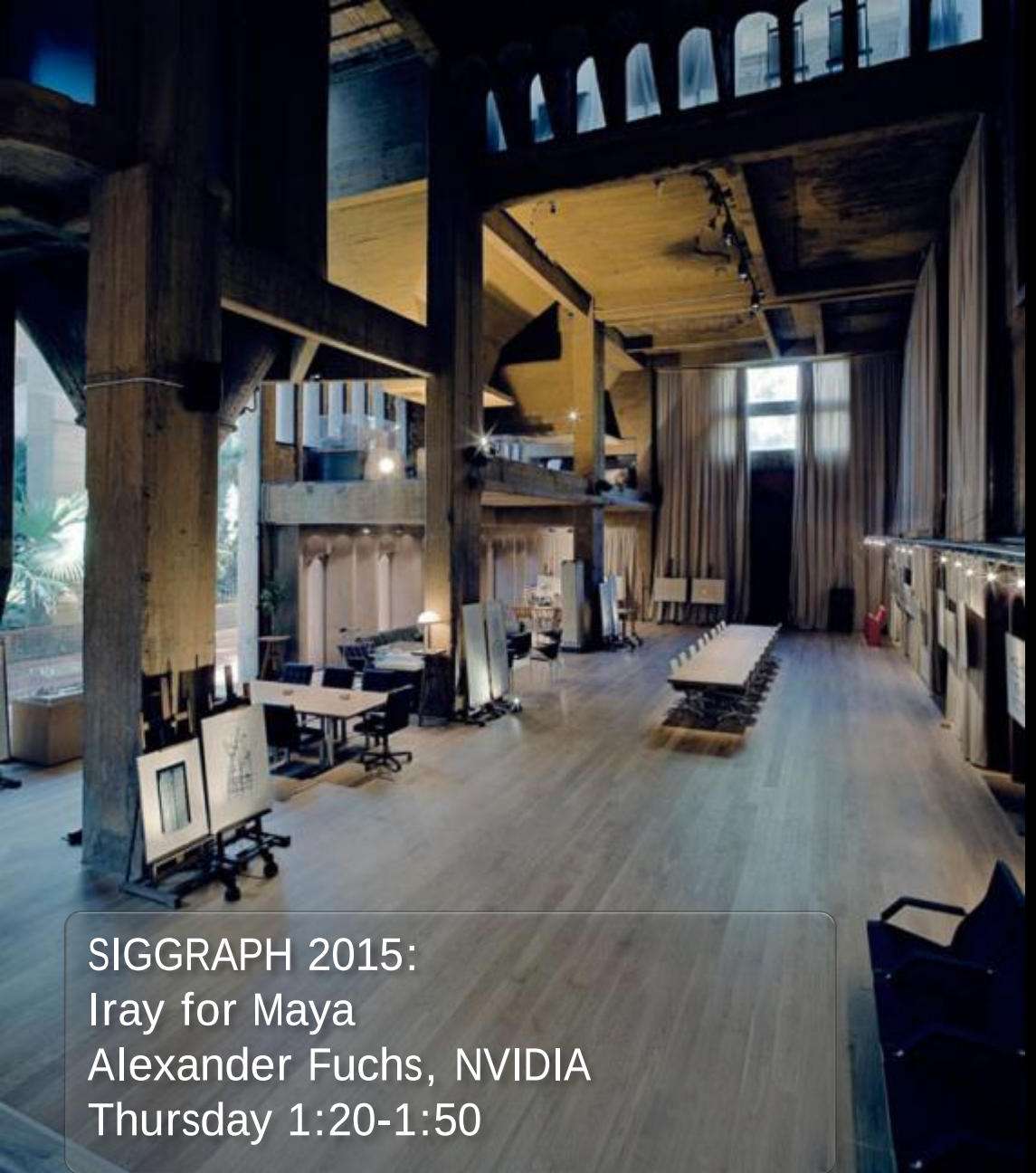
Iray for 3ds Max

Iray for 3ds Max

SIGGRAPH 2015:
Using Iray+ for 3ds Max
Dave Coldron, Lightworks Design
Tuesday 4:40-5:10


Produced using Iray for Maya

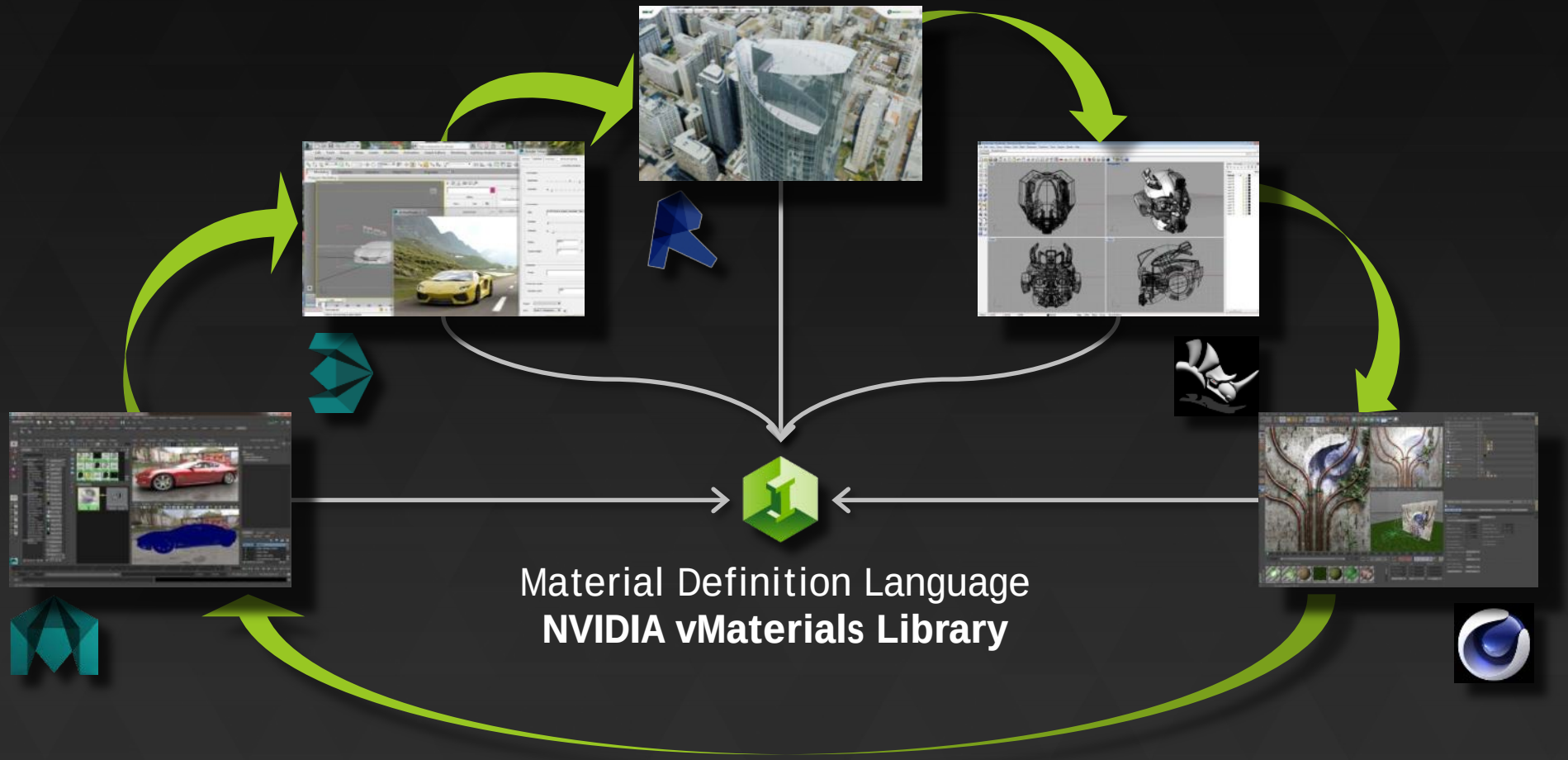
NVIDIA Internal Project
1 Artist working from
Turbo Squid Model and Reference Images
using Iray for Maya
and VCA acceleration



SIGGRAPH 2015:
Iray for Maya
Alexander Fuchs, NVIDIA
Thursday 1:20-1:50

NVIDIA Iray Product Interoperability

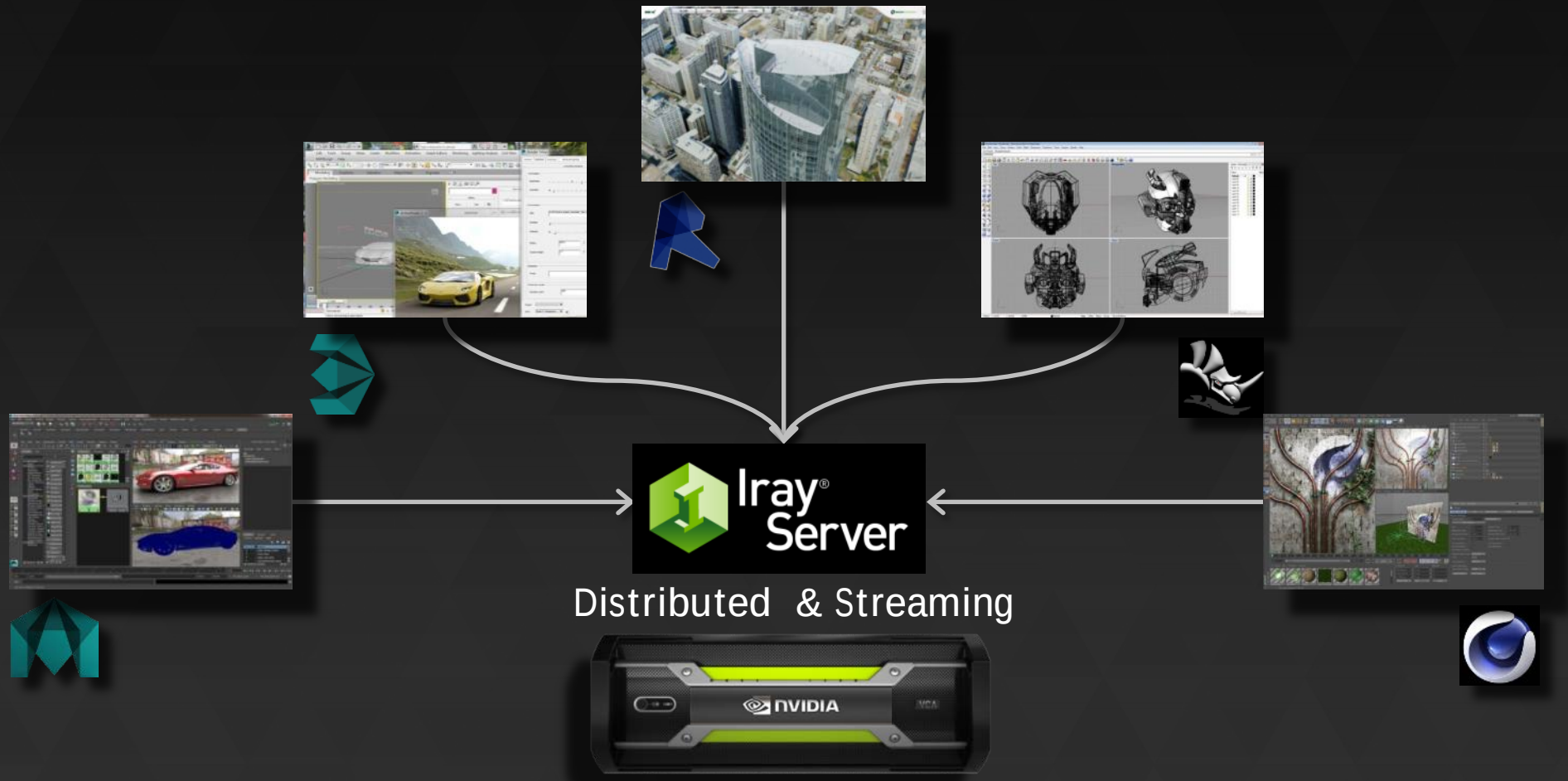
The loading and exchanging of materials, lights, and measurements



Material Definition Language
NVIDIA vMaterials Library

NVIDIA Iray Server Scaling out of the Box

Single Installation will Serve Any of the NVIDIA Iray Products



NVIDIA Iray

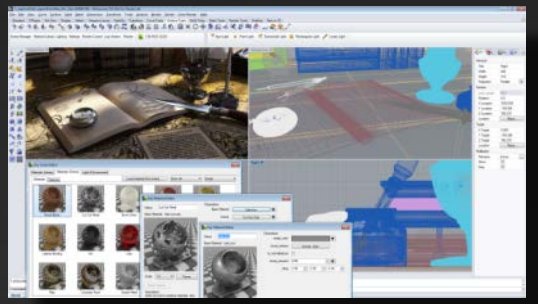
Coming later this year

Iray+ for 3ds Max

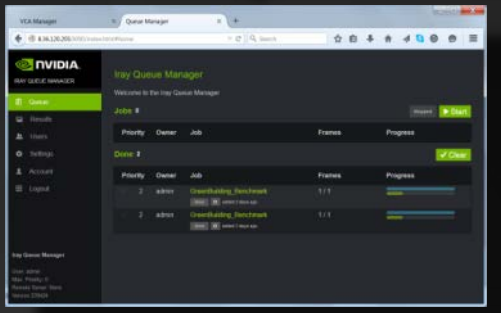
Iray for **Maya**

BIM IQ Render - Iray for Revit

Iray for Cinema 4D

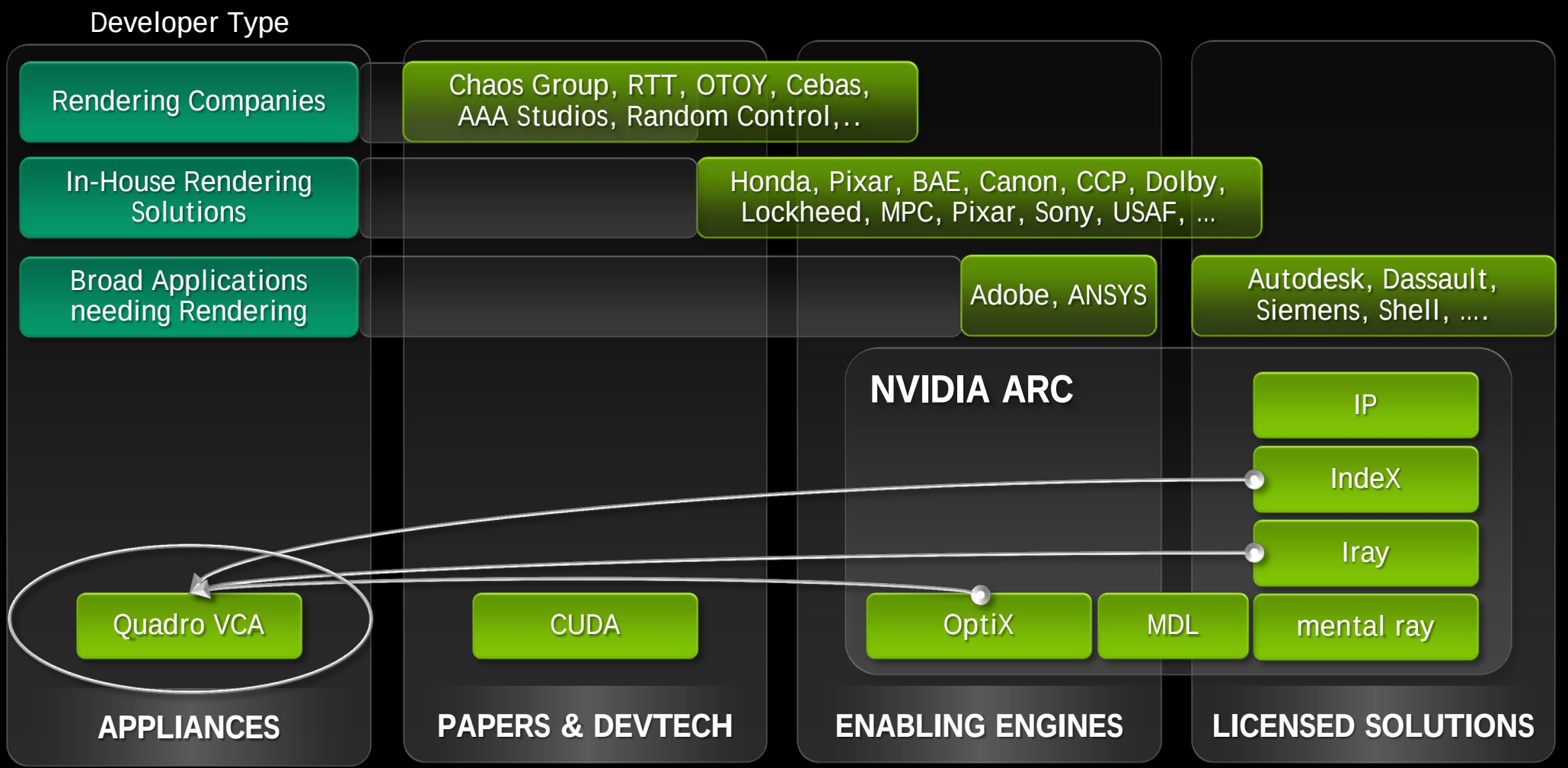


Iray for **Rhino**



Iray Server

NVIDIA Advanced Rendering Offerings



Quadro VCA

From NVIDIA

Quadro VCA

Under the Hood

GPUs	8 x M6000-VCA GPUs
GPU Memory	12 GB per GPU
CUDA Cores	23,040
CPU Cores	20 Physical
System Memory	256 GB
Storage	4 x 512GB SSD
Network	2 x 1GigE 2 x 10GigE (SFP+) 1 x InfiniBand
Installed Software	Iray IQ + Cent OS Linux + VCA Cluster Manager
U.S. MSRP	$50,000

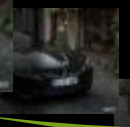
Iray on VCA On Demand Rendering Power

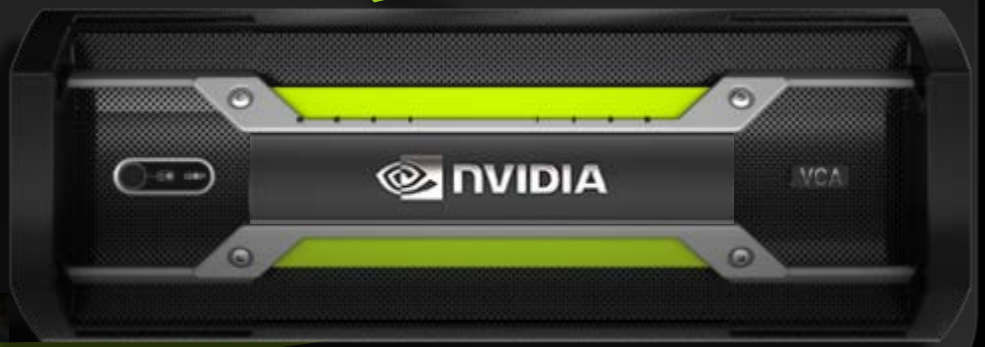
Incremental Updates

Ethernet or Internet

VCA in Data Center via LAN or WAN

Iray Client App





+10Mbit Down Preferred

Persistent Storage for Rapid Updates and Minimal Uploads

Interactive Image Stream

Iray IQ

Scalability Comparison

- Interactive Quality Scales Linearly with the number of Iray VCAs
- Noiseless Interactive GI now within reach

OptiX on VCA

Part of OptiX 3.8

Ethernet or
Internet

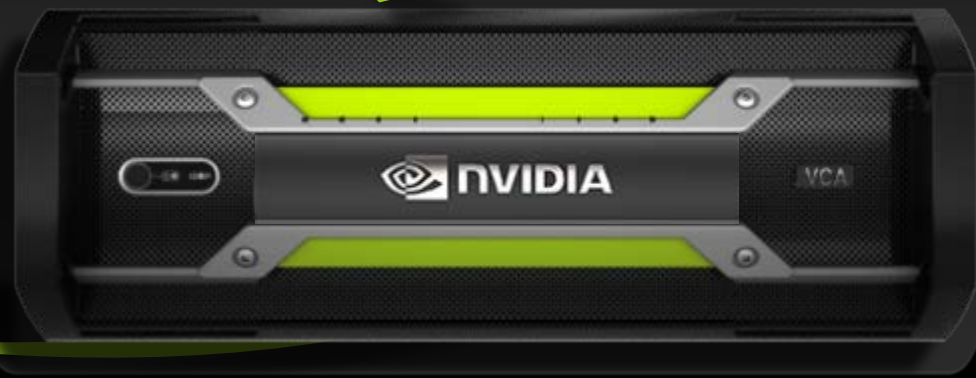
Incremental
Updates

Custom OptiX Applications
All Processing on VCA

OptiX Leveraging
Same Infrastructure as Iray
(using DiCE)

OptiX App

Minimal Work
within the OptiX App



Interactive
Image
Stream

Quadro VCA & Third Party Applications

- Third party Linux applications can be installed
- Chaos supports VCA for running VRay-RT

- NVIDIA provides access to Quadro VCAs for remote testing & certification
- Applications can register with the VCA Manager for management
- Scaling, distribution, and client/server capabilities are (of course) up to the respective application solution

Quadro VCA In Action

- Bay Area cluster of 15 VCAs
  in constant use at the NVIDIA Booth

SIGGRAPH 2015:
Flexible Cluster Rendering
Ankit Patel, NVIDIA
Tuesday 1:20-1:50
Thursday 2:00 -2:30

Advanced Rendering Solutions from NVIDIA

Phillip Miller
Senior Director
NVIDIA Advanced Rendering

SIGGRAPH 2015
Los Angeles, California
August 9, 2015