

DV22441

# Choosing the Best Renderer for the Job in 3ds Max

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Autodesk

## Learning Objectives

- Discover common terms and technologies for rendering
- Discover some of the major and new titles available
- Distinguish strengths and weaknesses for each of the titles
- Learn best practices for a better rendering experience

## Description

As artists are inundated with more and more rendering technologies in 3ds Max software, the ability to choose the right one for the job is becoming less clear. In this session, we will examine the differentiation between some of the top and new offerings, as well as look at best practices that can improve your rendering experience no matter which technology you use. This session features 3ds Max.

## Your AU Expert(s)

Eddie Perlberg is the product manager for 3ds Max software, as well as a representative of some of the other members of the Autodesk, Inc., family, including the Live Design initiative and other software titles and services. Prior to taking this roll, he was a technical specialist at Autodesk in Media & Entertainment, evangelizing and demonstrating how 3ds Max software fits into various workflows with a focus on design visualization. Prior to Autodesk, he was CAD manager and visualization artist at a number of U.S. architectural firms. Like many of you, he has extended his passion for working with 3ds Max software to working in motion graphics, as well as consulting for the pipeline development of a few games companies.

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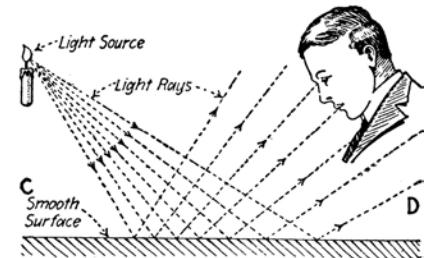
## What is a Renderer?

Rendering is the name given to the process in three-dimensional graphics whereby a geometric description of an object is converted into a two-dimensional image-plane representation that look real. Allen Tucker Computer Science Handbook Second Edition

## How do they work?

### The human eye and how natural light works

According to the American Optometric Association  
“When light rays reflect off an object and enter the eyes through the cornea (the transparent outer covering of the eye), you can then see that object.” So, we are trying to recreate the phenomenon of light rays reflecting off of physical objects, entering our eye and being converted into an image in our brain. This is why many of the terms we encounter in the creation of a material and rendering are from the science of light.



- Specular
- Diffuse
- Ambient
- Reflection
- Refraction

## Math

The computer is a large calculator. Everything it does needs to be defined as a calculation. When creating a rendering the engine calculates:

- Geometry
- 3D Coordinates
- Vectors
- Matrices

Luckily, we don't have to worry about all of the math. That's what we purchase a renderer to do. But, the better we understand the underlying science of light and the way it is processed, the better we will be at rendering.

Another problem we have to reconcile is between how light “works” both in nature and in the computer. In the natural world, there are no calculations. Light rays are projected and reflected in infinitum. In the renderer, everything, everything must be calculated. Since calculation requires time, the more things we need to calculate, the more time it will require. Reproducing nature is impossible. Instead we focus on the things that are important to the image.

### Rasterization

Rasterization starts at the object, looking at each triangle of a polygon and projecting or “converting” that back to the eye (camera) as pixels. Of course there is more to it than that, but that's the basics. Developed in the early 1970's, this is still used by many renderers and real-time solutions in OpenGL and Direct3D. This technique can be quicker as there are no calculations for areas of open space. Some of the drawbacks are questions like draw order. Object created behind another in 3d space may be render in front if they were created after the original object. Light and transparency accuracy was also questionable.

### Ray tracing

Ray Tracing and Ray Casting starts at the camera and projects rays to the objects in the scene. Where the ray strikes an object, it calculates the transparency, color and surface

reflectivity. From the point that the ray strikes an object, the renderer must cast rays for light, shadows, reflections, etc. Initially, Ray casting was impractical. Higher in number of calculations, it exceeded the capability of early processors to create images in an acceptable time. The first ray-traced image was 512 x 512 pixels and took 74 minutes. The same image now can be reproduced in less than 1 second. Approaching a more “natural” approach, the more rays calculated provide more accurate results. So why do rendering still take so long? The answer is found in Blinn’s Law which states, “As technology advances, rendering time remains constant.” James Blinn was a Computer Scientist who worked at NASA and the Father of the Blinn–Phong shading model.

Consider the first ray-traced rendered image. At that resolution, it would barely be the size of a postcard printed at 100 pixels per inch. How many rays were calculated? How many light sources? As we become comfortable to an average rendering time, we use that comfort factor to add more things to the scene to improve its impact while staying in that comfort zone.

### **Photorealistic**

As the name implies, the goal of a photorealistic rendering is to fool the observer to believing the results are a photograph of the actual object. Photorealistic renderings are often needed when blending live footage and rendering asset. They give an inherent level of confidence and believability. Of course, to achieve that realism, the artist must use more precise models, calculate more rays and provide more information to create the desired effect.

### **Non-photorealistic**

Conversely, a non-photorealistic rendering (NPR) techniques may be trying to emulate an artistic effect like watercolor or cel-animation. Above the obvious uses of NPR for cartoon animations, artists employing non-photoreal techniques may be trying to create technical illustrations or design review assets. Often photorealistic renderings don’t allow for conversations regarding design intent over presentation. Artists using NPR techniques can steer clear of the observers concerns over color or types of building materials used when the focus should be on layout or flow.

## **Common Terms**

As we have seen, rendering is a science. And with all sciences, they have their own terms that need understanding.

### **Teapot**

Rendering is often associated with a Teapot. Not only in 3ds Max but many applications like Revit, Inventor, and Renderman.

The teapot was originally modeled and rendered in 1975 at the University of Utah. There are numerous advantages to the teapot as a standard primitive. It provides a unique shape that can create a shadow on itself, its curvature can display dynamic highlights and stretching and its shape quickly identifies the objects orientation in 3d space.

Originally used in raytracing demonstrations, we continue to use it as an homage to that first model.



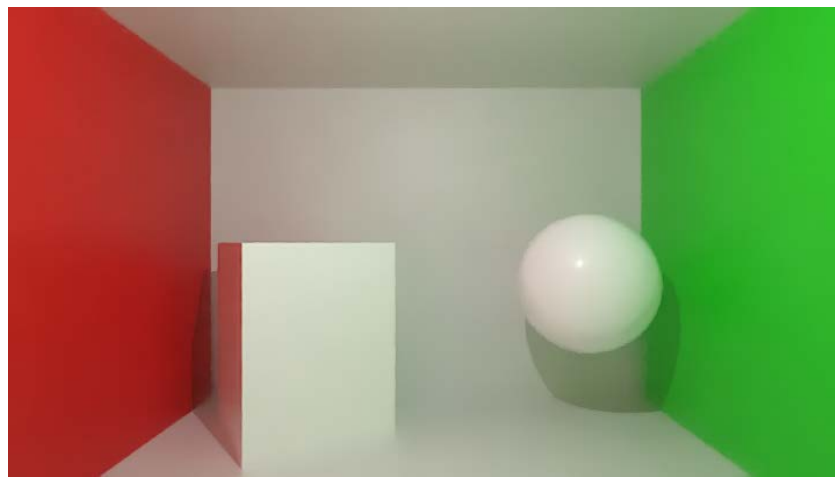
*THE 3DS MAX TEAPOT PRIMITIVE*



*3DS MAX 2017 RENDERING ICONS*

## **Cornell Box**

To see the effects of different lighting calculations, we often turn to the Cornell Box. Developed in 1985, the Cornell Box has been a standard in testing how light moves inside a space. Often with different objects and materials inside the box, we will use a standard box and sphere. It shows indirect lighting and color bleed.



*CORNELL BOX*

## **Shader**

Shaders in 3ds Max are a small set of instructions or algorithms that define how the surface properties of objects are rendered, and how light interacts with that object. Shaders are written for CPU (Computer Processor) or GPU (Graphic Processor) calculation and can be used to affect scene geometry on the vertex or pixel level. Shaders will define simple or multiple aspects of how an object reacts when rendered to the screen or image. For example, the Ocean shader could be created with multiple definitions to make objects look like water with parameters like wave height, wave speed, depth and more. Another shader could be created for Car Paint and will have definitions for glossiness, paint flecks and top coat. Shaders could also be written to define raindrops on a surface. Shader are written for objects, cameras, light and other render time functions.

## **Material**

Shaders and materials share many applications. A material can define an object to be shiny and red. A shader could be written to do the same. Because they tend to be very similar, the words are often used interchangeably. Materials focus on the appearance of an object.

Materials are result of layering a number of different parameters (maps) together to get a desired look. Some of the most recognizable are color, transparency, bump and glossiness.

## Maps

The most common use for maps is to improve the appearance and realism of Materials. You can also use maps to create environments or projections from lights.

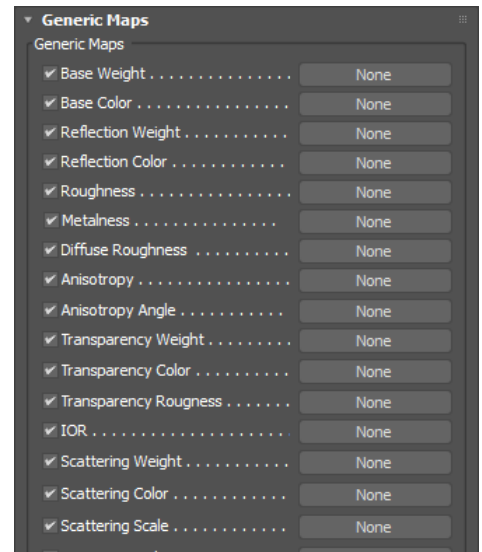
Maps can simulate textures, applied designs, reflections, refractions, and other effects. Used with materials, maps add details without adding complexity to the geometry of an object (an exception is the Displacement mapping, which can modify geometry.)

For example, let's actually compare apples to oranges.

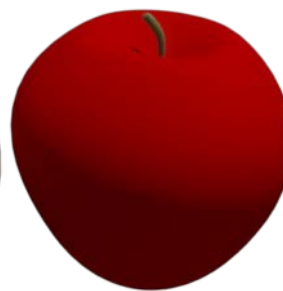
How do you define the look of an apple? Red? Shiny? Smooth?

Now an Orange. Color? Texture? Surface Scattering (Translucency)?

Using different values in each of these map slots, including pictures (bitmaps), we can take two similar shapes and make one look like an apple and one look like an orange.



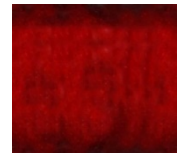
*NO MATERIAL*



*SIMPLE RED COLOR*



*APPLE TEXTURE  
INCREASED  
GLOSSINESS*



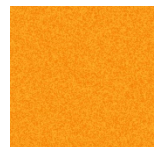
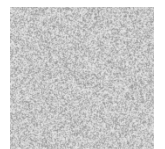
*NO MATERIAL*



*SIMPLE ORANGE  
COLOR*

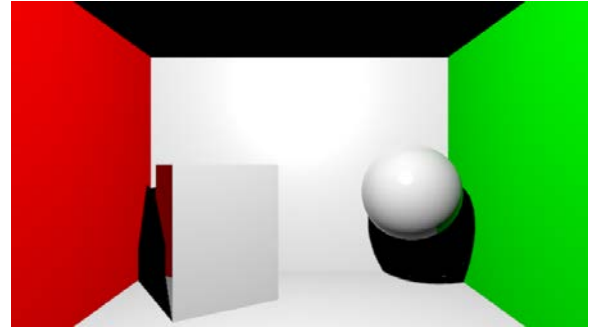


*ORANGE TEXTURE  
BUMP MAP  
SURFACE SCATTERING  
(TRANSLUCENCY)  
INCREASED GLOSSINESS*



### Direct Illumination

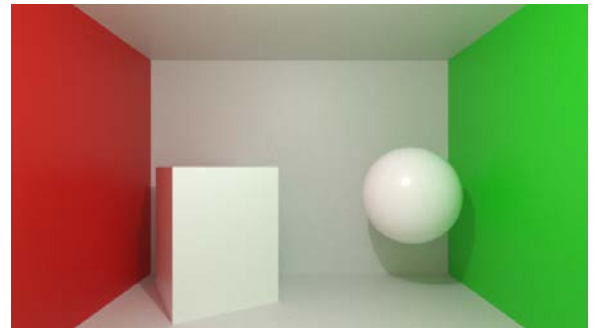
The easiest to understand, Direct Lighting is the effect of the light source as it strikes a surface. Notice, the harsh shadows because direct light does include any indirect illumination.



*DIRECT LIGHTING ONLY*

### Indirect Illumination

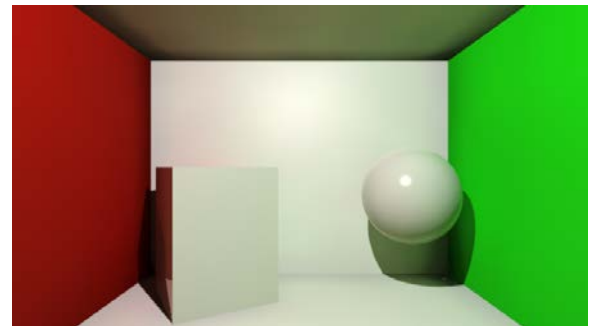
As we have seen, most of the rendering solutions are very straight forward when it comes to calculating and displaying Direct Illumination (Light from a source striking and object). There are multiple ways of calculating Indirect Illumination or how light bounces around a scene. Many of the technologies are render specific and are the differentiators for why choose one or another.



*INDIRECT ILLUMINATION*

### Radiosity

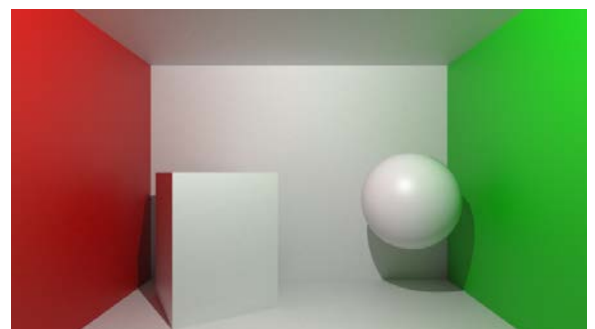
Radiosity was one of the earliest approaches to solving Indirect Illumination. Before rendering, all light sources and light bounces are pre-calculated. Simulating nature with a pre-determined number of bounces, the renderer would “paint” the objects with a radiosity grid and store the effects of light in the grid. The smaller the grid, the more accurate the radiosity solution. When rendered, the grid would apply the solution onto the objects underneath. This could take consider amounts of time to calculate and if saved to the scene, would increase the size of the file.



*RADIOSITY SOLUTION*

### Photon Mapping

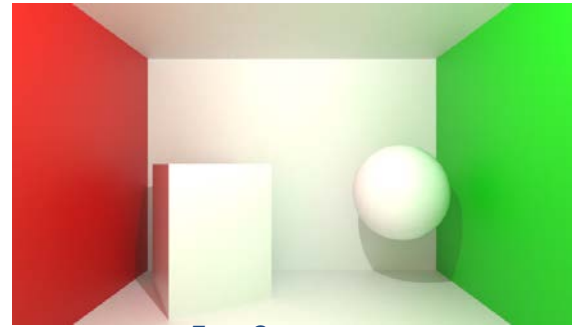
Starting at the light source, photon mapping is a technique of calculating indirect illumination by bouncing particles (photons) around the scene. When photons strike a surface, they distribute light to that surface and pick up some color. As the particle continues to bounce around the scene, the amount of light diminishes and the color bleed lessens. Photon Mapping requires more than one object so it can bounce photons from on object to another.



*A PHOTON MAP SOLUTION*

### Final Gather

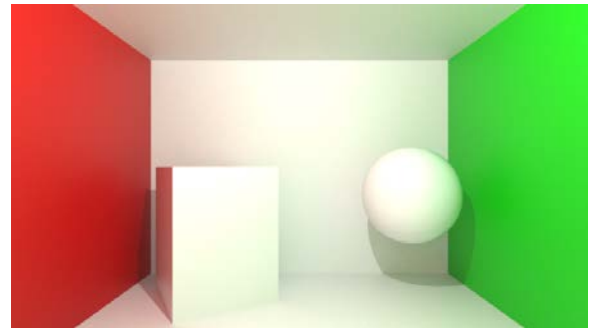
Final Gather is the opposite of photon mapping in that it starts at the images and calculates, per pixel the amount of illumination that the surface would receive. Often used in conjunction with photon mapping, final gather can help improve areas of indirect illumination by adding separate rays to add more information. When used separately, final gather can simplify the calculation by only calculating the first bounce of indirect light. Accuracy can be increased or decreased by adding or subtracting the number of bounces.



*FINAL GATHER*

### Irradiance Map

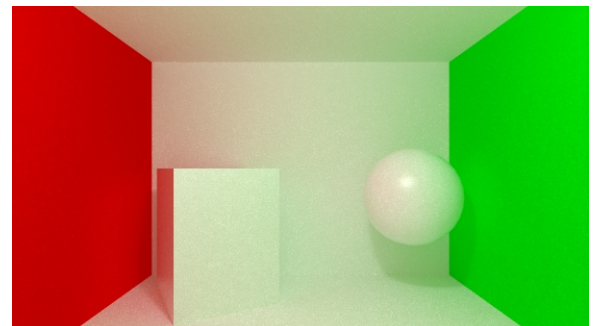
View specific, Irradiance Maps places samples on a surface and calculates the amount of light and direction the light is coming. It then interpolates between sample points. Irradiance mapping tends to be a bit faster and tends to give a softer look and doesn't do as well for bump maps and high detail. Irradiance Mapping in renderers like V-Ray are a primary bounce only and must be used in conjunction with other secondary bounce engines. Irradiance Map is effective, flexible and pretty easy to use.



*IRRADIANCE MAP*

### Light Cache

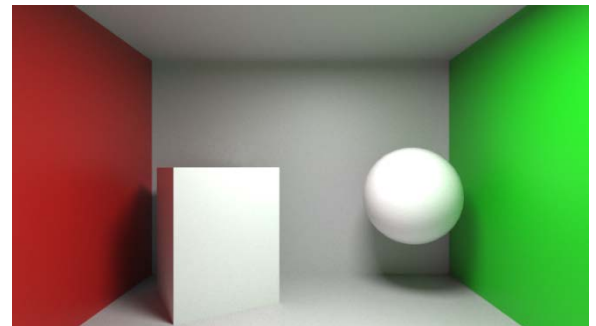
Another View dependent technique, the light map is created by tracking multiple paths from the camera view. Each of the bounces in the path stores the illumination from the rest of the path, very similar to the photon map. Great for both interior and exterior applications, the light cache map is better formulated for secondary bounces.



*LIGHT CACHE*

### Brute Force

Brute force is the easiest to understand. Like nature, rays are traced directly from bounce point in a hemispherical direction. This represents the most number of calculations and tends to be slower than other examples above. Brute force allows for the highest level of accuracy and detail retention.

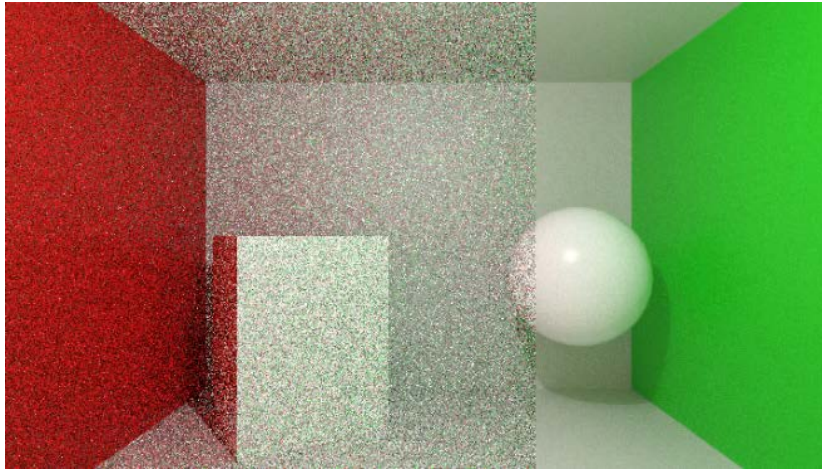


*BRUTE FORCE*



## Progressive Rendering

Progressive Renderers calculate the entire image and continuously improve the quality of the rendering until user input has been achieved like total time or number of iterations calculated.



*PROGRESSIVE RENDERING AFTER 1 SECOND*

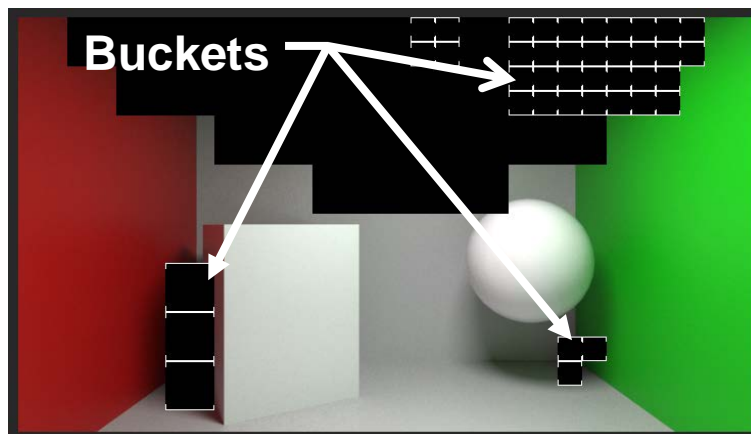
*AFTER 60 SECONDS*

Most progressive renderers determine how long they work on the image based on 2 or 3 of the following criteria.

- **Time** – Given the horsepower of the system, 2 minutes on one machine may produce different results than a different machine.
- **Iterations** – number of “passes” used to calculate the image. Different systems may take different amounts of time to calculate the designated passes, but the results will be almost identical machine to machine.
- **Unlimited** – Some progressive renderers allow Unlimited number of passes. User intervention is required to stop and capture the quality process.

## Buckets

During this rendering process, the image is divided into a number of tiles or “buckets”. As each bucket is being worked on, a processor, CPU or GPU, is assigned to process the information inside the bucket. The more processors, the more buckets that are being worked on simultaneously. For these renderers, the user can often see what the renderer is “working on” as squares in the render frame window.



## Unbiased vs. Biased

The terms Biased and Unbiased apply to raytrace renderers and define how much control the renderer gives an artist to adjusting the interpolation of the scene.

**Unbiased** – The artist does not make adjustment to the interpolation, thus the results are “unbiased” or unaffected by artistic intervention. An unbiased rendering is never complete; it continues to refine. Since samples are assigned to all pixels, it is considered the most accurate. The cost is speed.

**Biased** – Biased renderers give the artist options as to how the image is interpolated between samples thus needing fewer. Since the artist can control how the areas between samples are averaged, it provides controls to increase performance over accuracy. Since biased renders can be set to use less samples, it may produce less accurate and lower detailed images.

## Rendering Technologies

### GPU vs CPU

**CPU** – Central Processing Unit – the computer chip that is the heart of the computer. All of the direct calculations the computer does is done by the cpu.

**GPU** – Graphics Processing Unit – the computer chip, usually located on the graphics card, that processes the display to the monitor.

Initially, the GPU's only function for 3ds Max was to display the user interface, the models within, and the animation playback as smoothly as possible. Strong GPU's made the experience of doing work in 3ds Max more enjoyable. All rendering functions were computed by the CPU's.

Recently, rendering technologies have been written for and optimized to take advantage of the power available in the GPU. As GPUs are created mostly for converting data to images, they share many of the same functions as a rendering application. GPUs can contain thousands of cores where CPUs may have tens or hundreds cores. It easy to add additional video cards with additional cores to a machine for rendering purposes only. Some GPU's use proprietary technology specific to the manufacturer, rendering applications that leverage these GPUs loose benefit when not matched to the manufacturer for the specific hardware. Other GPUs may support OpenCL technology. An OpenCL-compliant renderer (like V-RayRT or ProRender, for example) can render on both NVIDIA or AMD cards so they might be considered agnostic GPU options.

Most renders were originally written for and still rely on the computers CPU to calculate the rendered images. This makes them agnostic to the hardware and makes the function of distributing buckets across multiple computers easily. Doubling cores proportionately reduces rendering times in half. CPU rendering also uses the system memory which depending on the system can be expanded to 128 gigabytes for a relatively reasonable price. Professional video cards are currently top out at 32gig and are in the \$3,000 range. This will limit the total size of the scene you can load into the renderer. Models, textures, caches and more need to be put into memory at rendering time. Some manufacturers have already announced new card coming with over 1 terabyte of addressable memory. This will allow much larger datasets to take direct advantage of GPU renderers.

### Rendering Hardware

A number of hardware manufactures create hardware specific to or perfectly suited to the needs of a renderer. Here are a few examples.

**NVIDIA Tesla cards** – While not created specifically for rendering, the Tesla card bring numerous GPU cores together for “supercomputing”. For renderers that can take advantage of multiple GPU, these can have a dramatic impact.

**NVIDIA® Quadro® Visual Computing Appliance (VCA)** – Developed for GPU renderers, the Quadro VCA makes multiple GPUs network accessible. Bringing as many as 24,576 GPU cores together with as many as 20 CPU cores, rendering can approach interactive.

**AMD XConnect™** - Connects an additional AMD graphics card to any Desktop or Laptop using a Thunderbolt 3 connection. This brings more GPUs for rendering or gaming.

**Boxx Technologies** – RenderPro1, RenderPro2 and RenderBoxx are purposely built deskside or rack mounted rendering computers. Stripped down to the functions of rendering, they pack as many cpu cores into a small form factor.

### **Render farms**

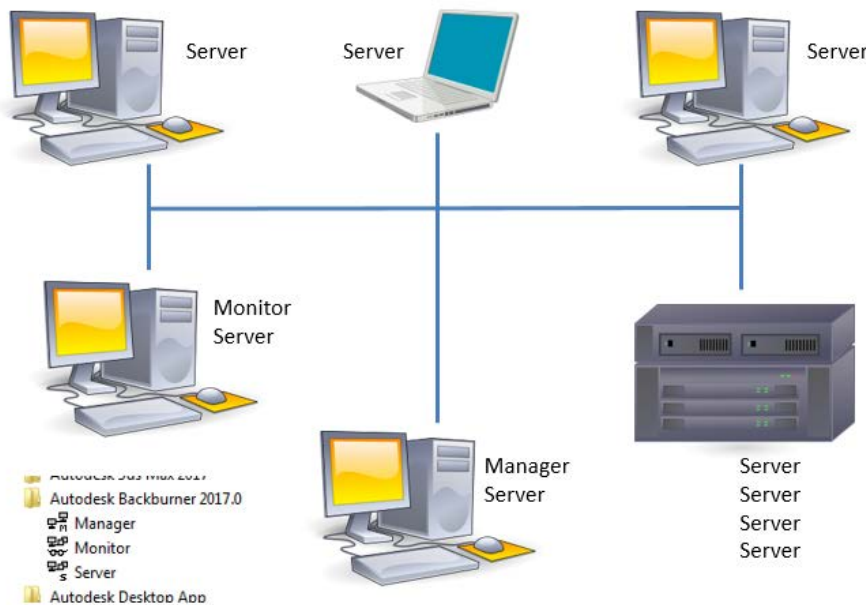
Network rendering uses multiple computers, connected over a network, to perform a rendering task; sometimes called rendering farms. Typically, the rendering of an animation involves hundreds or thousands of frames. Even a small network of three or four PCs can save substantial rendering time and help you meet deadlines.

### **How Network Rendering Works**

Rendering networks are sometimes called “render farms.” Using Autodesk Backburner to manage the assignments of frame to render to computer, one computer is set up as the network Manager. The Manager “farms out” or distributes the work to rendering Servers. Computers running the Server application in Backburner identify themselves as “available” for submissions to the Manager. Once a “Server” receives its frame assignment, 3ds Max is started, the files are loaded, the timeline is moved to the frame number and the image is rendered. Because 3ds Max relies on multiple files outside of the .max file, all need to be sent with the file to be successfully rendered or, the files need to be shared to a common location that all Servers can access.

The same is true for the render output location. While Autodesk Backburner provides the basics of render farm management, other third party render managers provide additional functionality to the process.

- The Manager does not need to be installed with 3ds Max
- The Manager and Server applications can both be running simultaneously with the Manager assigning jobs to itself.
- Render Farm managers do not need a 3ds Max license to submit jobs but, depending on the license agreement of the rendering application, the servers calculating the rendering do.



*RENDERING FARM USING BACKBURNER*

In the above diagram above, 9 images are being calculated at the same time. With 3ds Max installed on each of the servers, the manager starts the software and sends the file to be rendered. Settings allow for sending all of the required auxiliary files or, with a little planning, required files could be loaded on a network server for simultaneous access and storage. Some artists opt to purchase a render server which takes numerous computer systems, motherboards, memory, gpu's, etc. and puts them into one box. Often, these render systems are configured and optimized solely for the purpose of rendering and dramatically speed up the process.

### Split Scan Lines

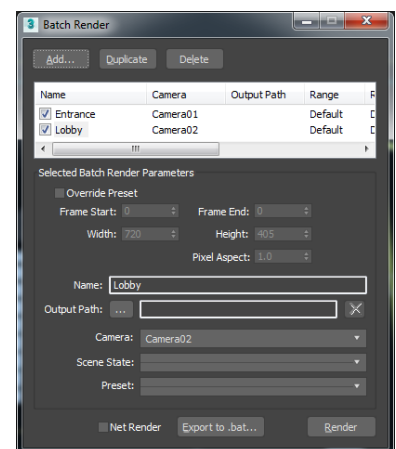
It is apparent how network rendering can help with animation rendering. What may be less apparent is how networking rendering can help with large format still images. In the Options area of the Network Job Assignment box check On Split Scan Lines. Despite the renderer assigned, it will divide the height into strips and assign each strip to each server. This utility will also stitch the strips together to form the final image.

### Batch Rendering

Network rendering can be equally useful if you have only a single PC and need to render a number of images. You can assign the jobs that need to be rendered and Backburner can manage the rendering of each job while you're away from the computer. Commonly, jobs are assigned submitted just before you leave the office. When you arrive the next morning, all your renderings are waiting for you to review.

The Batch Rendering dialog is for rendering different aspects of the same scene, such as views from different cameras. To batch-render a number of different scenes, use Backburner or command-line rendering.

Many service providers provide rendering farms to those that do not have the resources or the consistent need to maintain



a local rendering farm. Rendering Services can provide, for a fee, the multiple machines to shorten time to delivery.

### Cloud Rendering

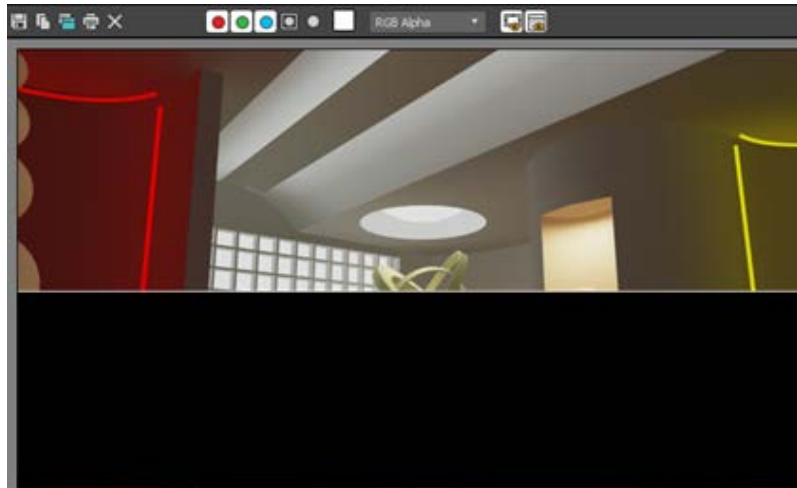
Cloud Rendering is in many ways the same as creating a local render farm. The only difference is that the CPUs and GPUs are located outside of the users physical control. Very attractive in that cloud rendering can be scaled to include hundreds of CPUs. The only limitation will be the rendering budget. Unfortunately, creating your own cloud rendering farm is not currently allowed within the End User License Agreement (EULA), Autodesk is working on making this accessible to 3ds Max users.

## Renders

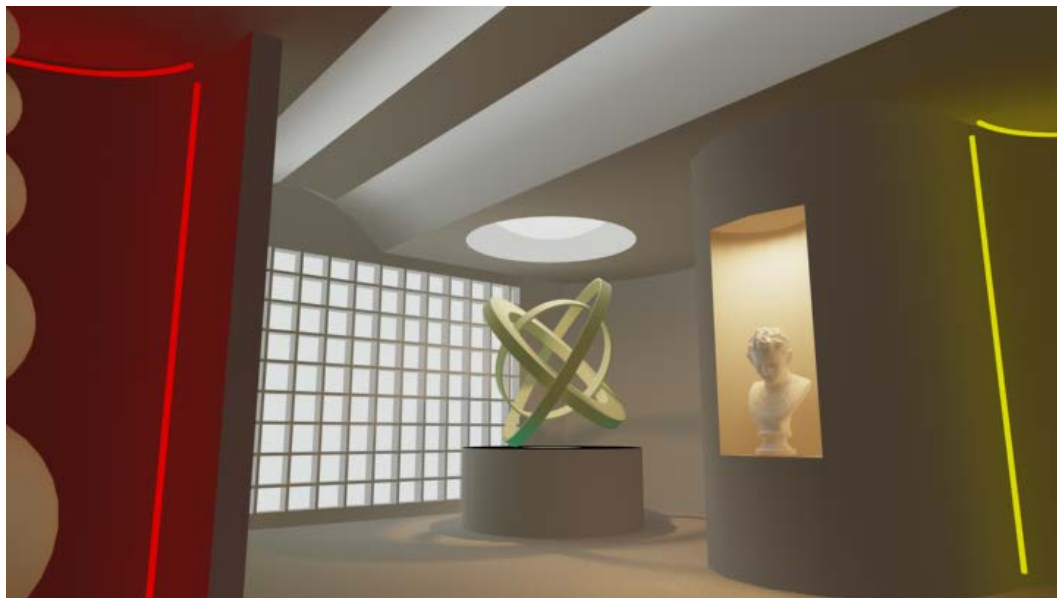
### 3ds Max Renderers

#### Scanline

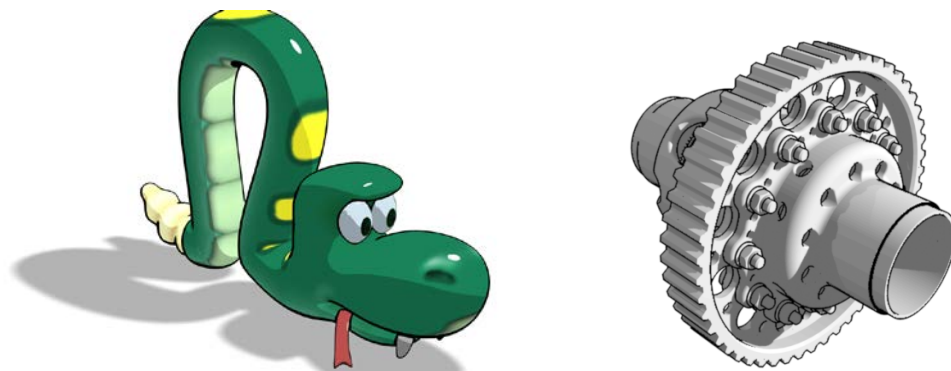
3ds Max's original renderer and still going strong. Scanline processes its image line by line.



*SCANLINE RENDERING MID- RENDERING*



*SCANLINE RENDERING WITH RADIOSITY PRE-CALCULATED*



EXAMPLES OF CEL SHADED

#### Scanline Pro's

- Can be lightning fast
- Decades of content
- Ink and Paint for Cel Animation
- Standard Materials and Lights
- Unlimited rendering on your network via Backburner

#### Scanline Con's

- Radiosity needed for Indirect Illumination
- Realistic results require considerable preplanning and might need post production

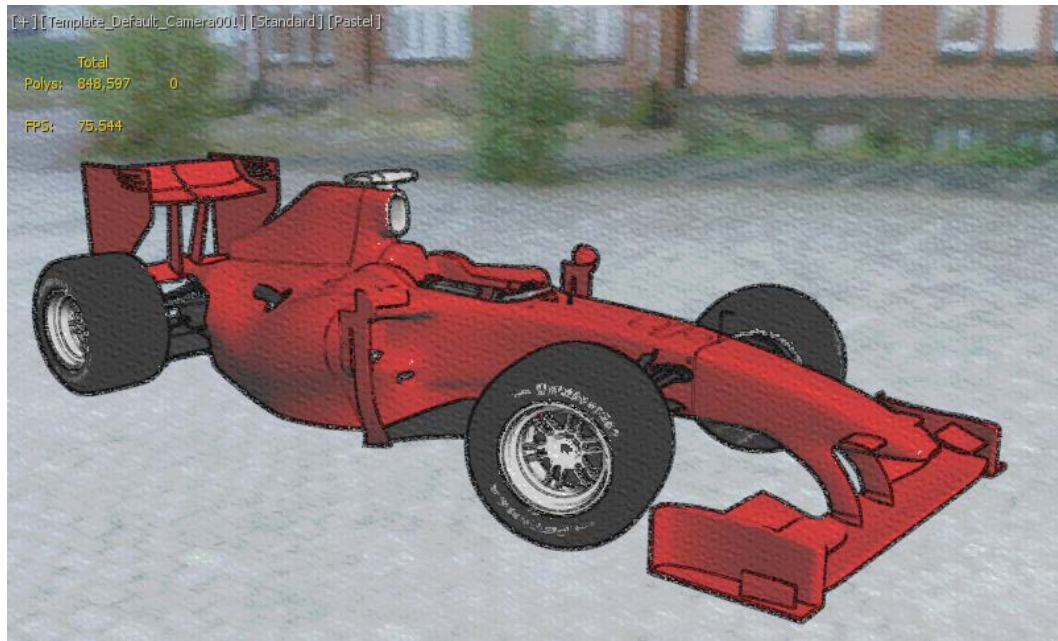
#### QuickSilver

GPU based (hardware) renderer, incorporates Realistic and numerous NPR settings. Quicksilver settings can be assigned to a viewport or at render time. The first time you render with Quicksilver the scene and shaders must be compiled for the specific rendering card you are using. Once compiled, the rendering takes place with GPUs. The more you use the Quicksilver renderer, the fast it becomes.



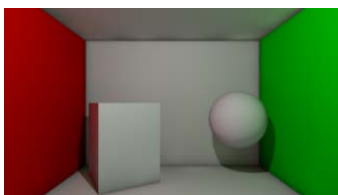
QUICKSILVER RENDERING USING TECH SETTINGS



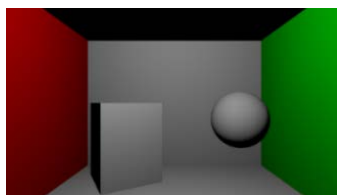


*VIEWPORT SET TO STYLIZED (COLOR PENCIL)*

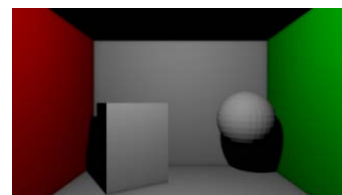
Some examples of the different styles of the quicksilver renderer



*REALISTIC*



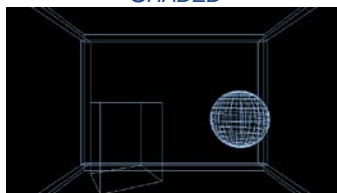
*SHADED*



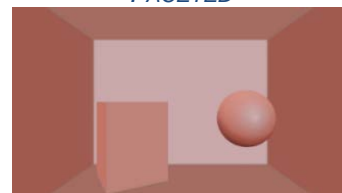
*FACETED*



*HIDDEN LINE*



*WIREFRAME*



*CLAY*



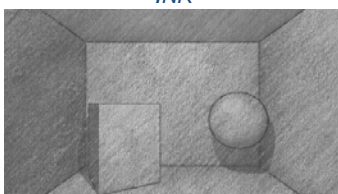
*INK*



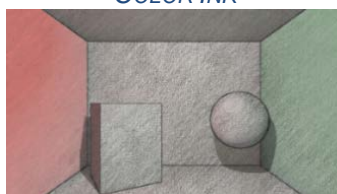
*COLOR INK*



*TECH*



*GRAPHITE*



*COLOR PENCIL*



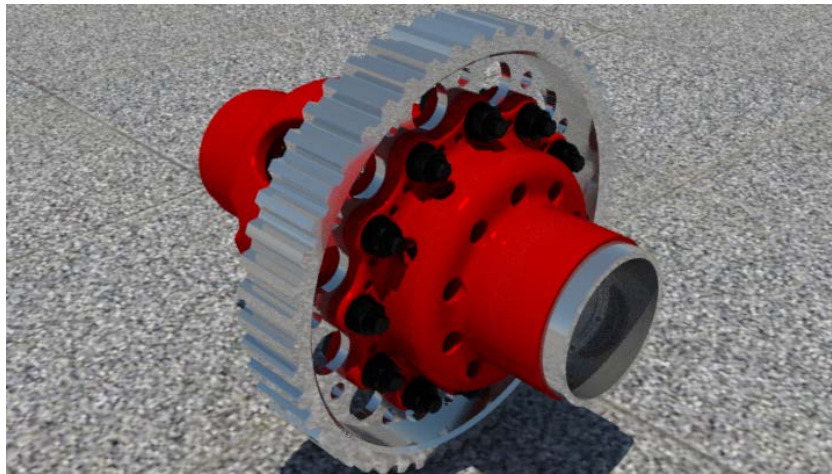
*PASTEL*

Quicksilver Pro's	Quicksilver Con's
<ul style="list-style-type: none"> <li>• Non Photorealistic modes</li> <li>• Hardware Based for fast renderings.</li> <li>• The more you use it, the faster it becomes per session.</li> <li>• Supports multiple Material type.</li> <li>• Unlimited rendering on your network via Backburner</li> </ul>	<ul style="list-style-type: none"> <li>• Does not take advantage of all hardware configurations, it uses only DirectX</li> <li>• Not all shaders are supported,</li> </ul>

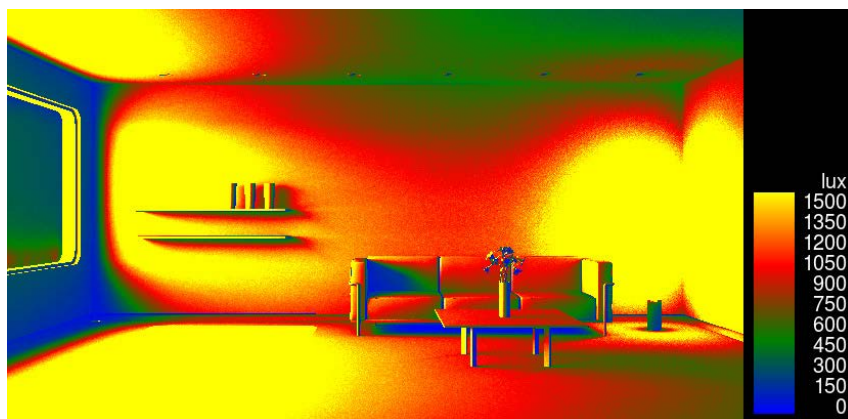
Note: Quicksilver users will benefit from installing the NitrousGraphicsManager sample available in the maxscript help files.

### A360 Cloud Rendering

Autodesk's cloud rendering solution. Using Autodesk cloud credits for high resolutions, A360 allows you to move the rendering calculations away from your PC. During the setup, you can set multiple cameras and multiple outputs types. Choose between Still Images (The default.), Interactive Panorama, Solar Study and Illuminance outputs. Once complete, renderings are available in your A360 Image Gallery. Once on the Gallery, exposure adjustments can be made without resubmitting. Because the A360 Cloud Renderer uses different algorithms to render, plan on using different techniques to get the desired results.



A360 CLOUD RENDERING

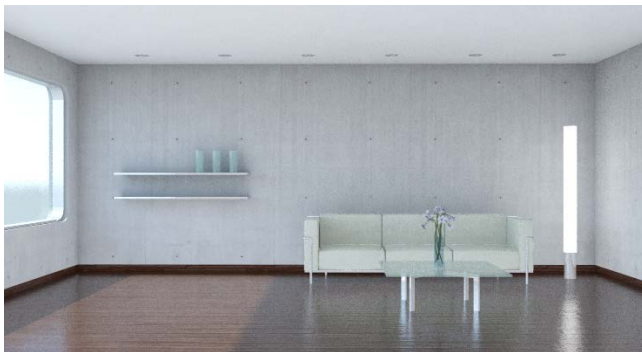


A360 CLOUD RENDERING -ILLUMINANCE

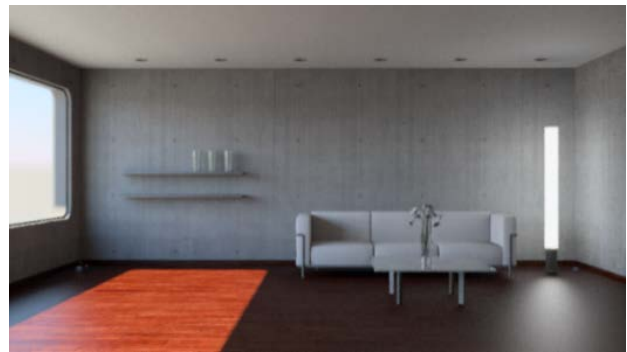




*PANORAMIC OUTPUT*



*ROOM RENDERED WITH MENTAL RAY*



*SAME ROOM RENDERED WITH A360*

#### Pro's

- Cloud rendering
- Panorama renderings
- Lighting analysis (illuminance rendering)
- Frees up your PC while rendering

#### Con's

- Conversion does not always match local rendering (See Above).
- Hi-Res Images cost credits
- Animations not supported.

### ART

The Autodesk Raytracer (ART) is an easy-to-use, high-performance, CPU-only, physically-based renderer. It is ideal for interactive rendering via ActiveShade, and for the production of high-end renderings for design visualization.

The ART renderer has simple controls that make rendering physically-plausible images easy, and is ideal for any user (beginner to advanced) looking for a fast, straightforward renderer.



AUTODESK RAYTRACER (ART)

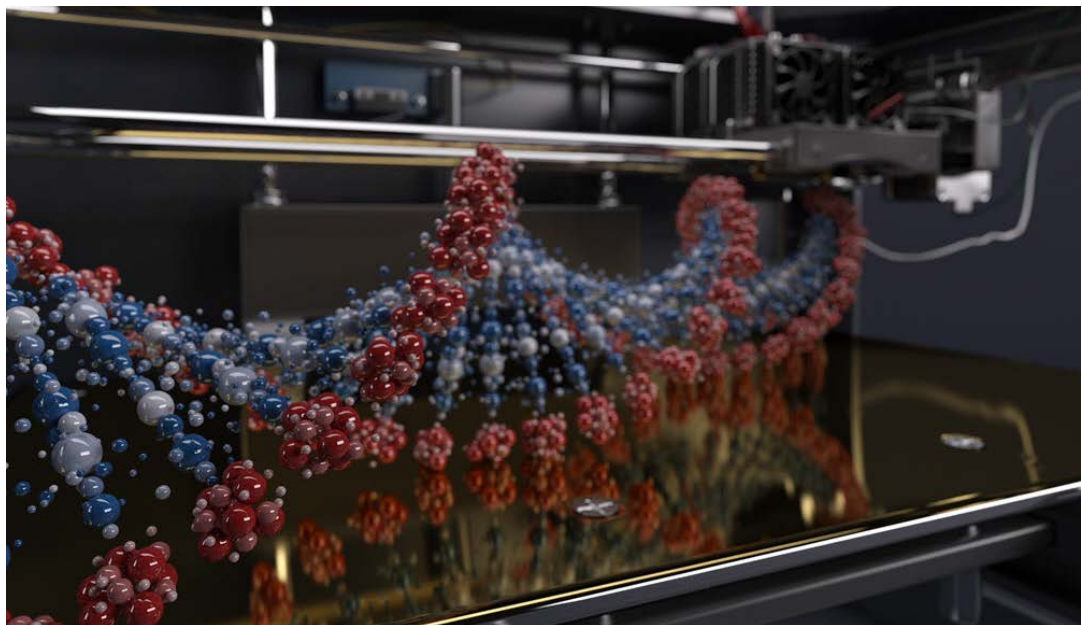


IMAGE COURTESY ADRIAN WISE

Pro's	Con's
<ul style="list-style-type: none"> <li>• Straight forward controls</li> <li>• Physically Based</li> <li>• Ideal for Active Shade iterations</li> <li>• Supports Photometric lights, Autodesk materials, Arch &amp; Design, and the new Physical material.</li> <li>• Unlimited rendering on your network via Backburner</li> </ul>	<ul style="list-style-type: none"> <li>• Use Iterations to avoid noisy animation</li> <li>• Does not have all the bells and whistles of other renderers</li> <li>• Lack of awareness.</li> </ul>

## Shipping 3<sup>rd</sup> Party renders

### mental ray

Developed by NVIDIA's Mental Images division, this Academy Award winning technology has shipped with 3ds Max since version 5. This full feature renderer allows for satellite and distributed bucket rendering.



*PRODUCT RENDERING USING AUTODESK MATERIALS AND 3DS MAX TEMPLATE*



*INTERIOR RENDERING DONE IN MENTAL RAY*

Pro's	Con's
<ul style="list-style-type: none"><li>• Long standing heritage with 3ds Max</li><li>• Autodesk Material Library is based on mental ray</li><li>• Achieve amazing results</li><li>• Physically Accurate.</li><li>• Unlimited rendering on your network via Backburner</li><li>• Standalone version for mixed pipelines</li></ul>	<ul style="list-style-type: none"><li>• Documentation</li><li>• Perception problems</li><li>• Speed</li></ul>



## Iray

NVIDIA's newest rendering technology, this is a GPU optimized progressive renderer.



*COURTESY OF MENTAL IMAGES: IRAY RENDERER*



*INTERIOR USING THE IRAY RENDERER*

Pro's	Con's
<ul style="list-style-type: none"><li>• Uses all mental ray shaders</li><li>• GPU and CPU capable</li><li>• Optimized for NVIDIA technologies (See above)</li><li>• Impressive results quickly.</li><li>• Unlimited rendering on your network via Backburner</li></ul>	<ul style="list-style-type: none"><li>• Can create noisy animation</li><li>• Optimized for NVIDIA technology</li><li>• All of the capabilities are not in 3ds Max</li><li>• Lack of awareness.</li></ul>

Note: Iray+ is a plugin created by Lightworks that includes 2 renderers; Iray+ and Iray+ Interactive. The Iray+ renderer is built using the same Iray technology found in 3ds Max with enhanced functionality and improvements. Iray+ Interactive renderer allows you to navigate models in near real-time with similar results compared to the Iray+ renderer.

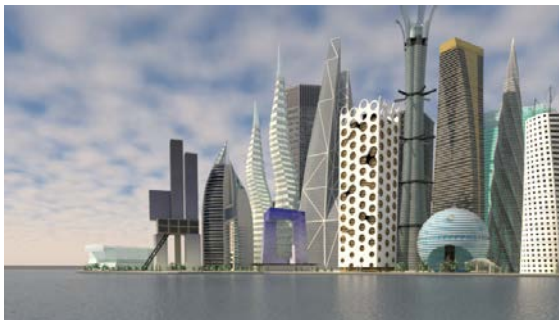
### 3<sup>rd</sup> Party Plugins

#### VRay

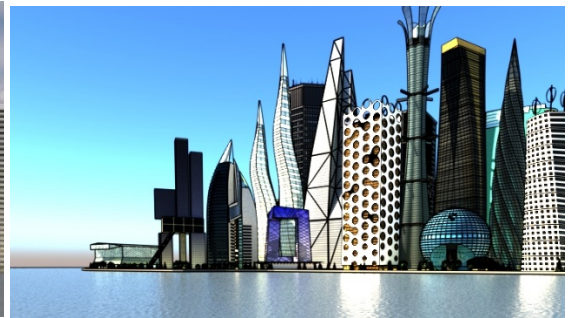
Created by Chaosgroup, V-Ray is 3ds Max's most often used renderer. The renderer of choice for all industries (film, games and design visualization).



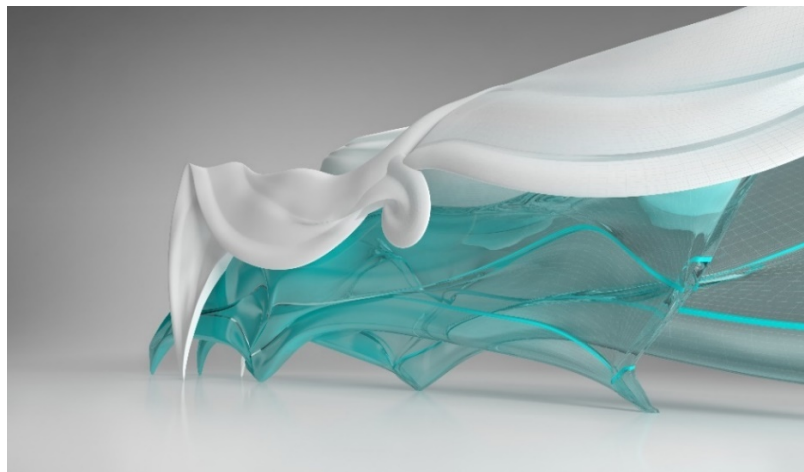
*IMAGE COURTESY OF CHAOSGROUP WEBSITE: BERTRAND-BENOIT*



*USING VRAY ENVIRONMENTAL FOG TO GENERATE CLOUDS*



*USING VRAYTOON FOR AN NPR LOOK*



*AUTODESK BRANDING DONE IN 3DS MAX AND VRAY*



### Pro's

- Amazing results
- Amazing feature set
- Get decent results using 3ds Max elements (Materials, Lights, Cameras, etc.
- Huge community
- Rendering Standard for all 3ds Max industries (Design Visualization/ Film/Games)
- Well documented
- Nightly builds

### Con's

- With great capability comes great amount of learning.
- Price, costlier than some cheaper than others. Considering the capability, cost does equal value.
- Hardware dongle

## Corona

Corona Renderer is a new high-performance photorealistic renderer, available for 3ds Max and as a standalone application.



IMAGE PROVIDED BY RENDER LEGION S.R.O.



IMAGE PROVIDED BY RENDER LEGION S.R.O.

### Pro's

- Provides the speed of biased render engines but maintains the ease of use and simplicity of unbiased render engines
- UHD Cache to help remove animation flickering
- Rental and permanent licensing
- Some truly innovative features

### Con's

- Small team.
- Pixel for pixel, a bit slower than other renderers.
- Some of the basics are still in development.

## Maxwell

Maxwell Render, created by Next Limit Technologies, is a physically correct, unbiased rendering engine. By calculating complex light interactions, Maxwell Render is capable of simulating light exactly as in the real world.



*CREATED USING SAMPLE SCENE PROVIDED BY NEXT LIMIT TECHNOLOGIES*

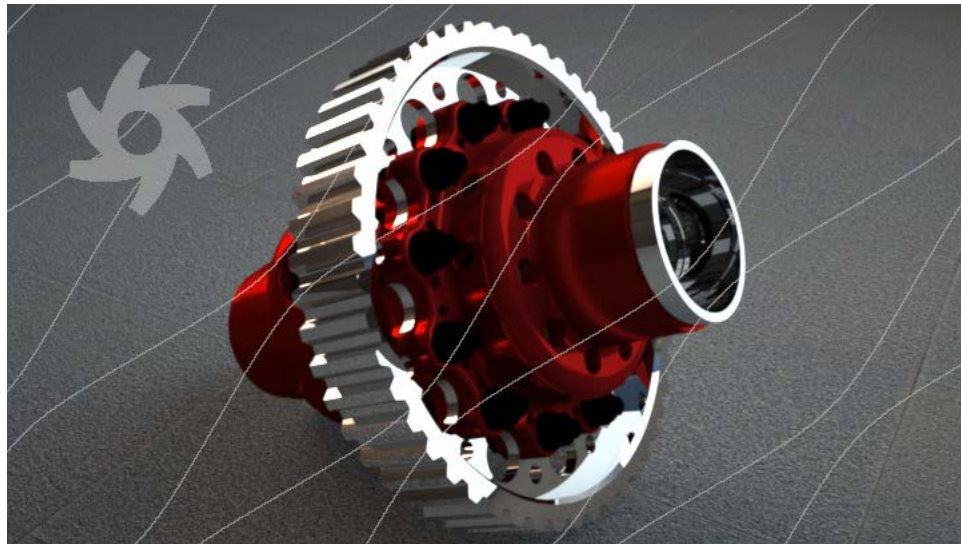


*ADJUSTED POST RENDERING*

Pro's	Con's
<ul style="list-style-type: none"> <li>• Achieve Hyperrealism</li> <li>• Adjustments can be made during and after rendering</li> <li>• Simple rendering settings</li> <li>• Maxwell render engine interface gives multiple adjustment capabilities</li> <li>• Most of the techniques are based on photographic principles.</li> </ul>	<ul style="list-style-type: none"> <li>• Maxwell render engine interface is another window to manage</li> <li>• Accurate equals longer render times</li> <li>• If you don't already know it, you need to learn photography also. Most of the techniques are based on photographic principles.</li> </ul>

## Octane

Developed by OTOY, Octane is a GPU rendering engine with both a standalone and 3ds Max plugin. One of the fastest growing renderers for 3ds Max, Octane can be used for real time look development and scene refinement as well as final frame rendering.



RENDERED IN OCTANE



STANFORD DRAGON



Pro's	Con's
<ul style="list-style-type: none"> <li>• GPU fast</li> <li>• Material Converter</li> <li>• Distributed GPU rendering</li> <li>• With enough horsepower, this can feel interactive or close to realtime.</li> </ul>	<ul style="list-style-type: none"> <li>• Licensing is wonky (Have to purchase a standalone and plugin license.</li> <li>• Hardware specific</li> <li>• Must learn Octane Materials/Lights/Cameras, etc.</li> </ul>

## New Kids on the Block

### Radeon ProRender

Radeon ProRender is AMD's free, Open Source offering. OpenCL makes it hardware agnostic, so in GPU mode, it works with any major hardware developer. Users of Radeon ProRender can also take advantage of the supplemental material library that predefines numerous commonly used materials as starting points to success and learning.



*SAMPLE SCENE PROVIDED BY AMD*



*IMAGE COURTESY OF AMD*

### Pro's

- GPU brand agnostic
- GPU or CPU option
- Ships with a large material library
- Easy to learn
- Utilizes many native 3ds Max object (materials, photometric lights, etc.)
- VR output
- Free

### Con's

- Early in development.
- Some features didn't work as expected (Exposure, Physical camera, etc.)
- Requires OpenCL 1.2 higher hardware.
- Awareness

## Redshift

Redshift, produced by Redshift Rendering Technologies, has been known in the entertainment industry for years as a fast renderer that takes advantage of all of the compatible GPUs in your machine. Redshift released the 3ds Max version earlier this year.



IMAGE COURTESY OF REDSHIFT USER GALLERY



BENCHMARK FILE COURTESY OF REDSHIFT



Pro's	Con's
<ul style="list-style-type: none"> <li>• Fast – GPU accelerated</li> <li>• Production Proven</li> <li>• Updated often</li> <li>• Affordable</li> <li>• Awarded 5-star review and 'best in class' in 3D World magazine</li> </ul>	<ul style="list-style-type: none"> <li>• New to 3ds Max</li> <li>• Opportunity to improve active shade integration.</li> <li>• Requires specific hardware.</li> </ul>

## Arnold

Recently acquired by Autodesk, Arnold is created and developed by Solid Angle. Arnold is an advanced ray-tracing image renderer used to create high quality 3D animation and visual effects. Arnold is used at over 300 film studios worldwide as the primary renderer on for films like Monster House, Pacific Rim and Gravity. For 3ds Max 2017, Arnold is available as a separate download available on the Solid Angle website.



RENDERED IN ARNOLD FOR 3DS MAX 0.8



IMAGE COURTESY OF FRAMESTORE – THE MARTIAN (C) 2015 TWENTIETH CENTURY FOX

Pro's	Con's
<ul style="list-style-type: none"> <li>• Production Proven</li> <li>• Memory Efficient for large datasets</li> <li>• Artist Friendly</li> <li>• Easy to get better than good results fast</li> <li>• Uses many of the 3ds Max material shaders</li> <li>• Easy to adapt</li> </ul>	<ul style="list-style-type: none"> <li>• Development for 3ds Max is not yet complete. Some features are not yet available.</li> <li>• Very good results are easy, amazing may take some tweaking.</li> <li>• Arnold has Arbitrary Output Variables (AOVs) instead of Render Elements.</li> <li>• Pricey</li> </ul>

### Realtime Rendering

Realtime rendering utilizes game engine technology like Unity, Unreal, Stingray or Autodesk Live to generate images. Once in a game engine, users can walk through the scene and “capture” images or animations in the process.

## Best Practices

### Before

Before starting your project, you can dramatically impact which renderer you use, what you need to model and create and what render times will be. Here are a few simple tools to use before you open 3ds Max.

### Storyboarding

Storyboarding has been a part of the creation of films from the birth of the industry, yet seems to be the first overlooked component of most Design Visualization projects. A storyboard organizes each step you’re going to tell in visual form or as a visual script. By taking the time to work out the key visual moments and flows, you will be dictating the required tasks, level of detail and giving you a great preconstruction tool to get customer buy off. The storyboards can be used as part of the contract agreement and will prevent surprises and last minute changes from the customer. Often appearing like a comic book, consider the frames of a storyboard to be similar to the Details of a Construction Document set. Here, the artist can work out creative content and will always help keep the project on track and focused.

The storyboard template features a header section with the title "Storyboard" and fields for "Names", "Date", "Period", and "Topic". Below the header is a grid of drawing frames. The first row contains three large rectangular frames, each with a small square icon in the top right corner. Below each of these frames are four horizontal lines for text. The second row also contains three large rectangular frames with similar icons, followed by four horizontal lines for text. At the bottom of the page, the text "STORYBOARD TEMPLATE" is written in blue.

Storyboards help focus what needs to be modeled, enhanced and purchased. Countless hours can be saved by first knowing what is needed to accomplish the script.

### Know your renderer

As we have seen above, each of the renderers we've looked at and those not mentioned have features and benefits that drive you to choose it. There may be considerable learning involved to get the most out of the renderer chosen. The time to learn new material workflows, render time impacts and new capabilities are not hours before you need to deliver. I am as guilty of this as anyone.

For example, V-Ray has the functionality of using fog atmospheric effects for very compelling clouds. This feature can change rendering times from minutes to hours per frame. For me, it was worth it and planned in the rendering time needed. Other special effects like reflections, volumetric lights, ambient occlusion and others can start to compound to dramatically influence delivery. (See Blinn's Law above).

## During

### Modeling

It is said that "Good materials can make a bad model look good and bad materials can make a good model look bad". Find the balance.

### Lights

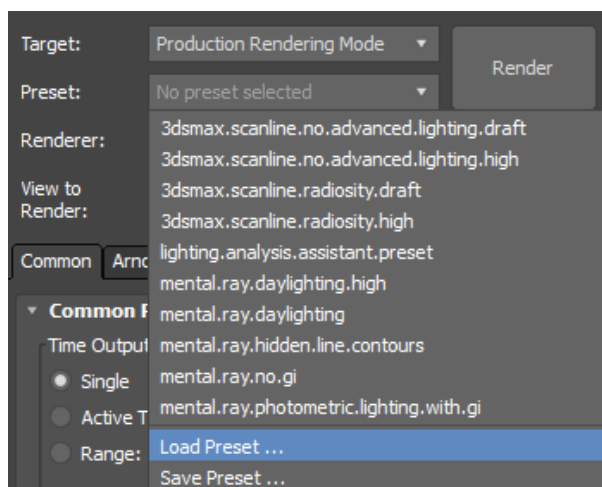
Knowing the settings of lights can improve render times. Rather than use 20 lights in your scene, can the same look be achieved with one? Does setting attenuation shorten render time without changing the look?

### Animation

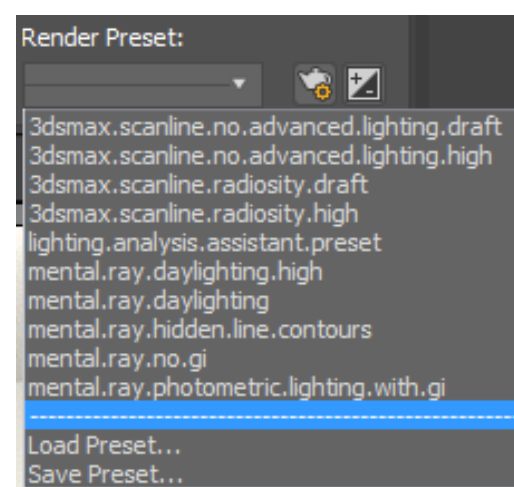
Effects like motion blur can dramatically improve realism but comes at a significant cost to render times. Does the camera stay motionless and objects move through the scene? Could a background be rendered as a still and use matte/shadow techniques to render animations?

### Preset Rendering Options

Rendering Presets allow you to capture a majority of rendering settings and apply them to quickly using the Presets pulldown in the Render Settings dialog box or in the Render Frame Window.



RENDER SETTINGS DIALOG



RENDER FRAME WINDOW

## Rendering Mode

In 3ds Max, there are two different types of renderings:

**Production rendering** (active by default) is typically the one you use for finished renderings.

Production rendering can use any renderer installed with 3ds Max.

**Iterative rendering** uses the Production renderer, but omits file output, network rendering, rendering of multiple frames, export to MI files, and email notification. This can be a useful option when you want to do quick repeated tests of a rendering. Iterative rendering works well with the Area To Render Selected or Region options.

**ActiveShade** rendering creates a preview rendering that can help you see the effects of changing lighting or materials; the rendering updates interactively as you change your scene. Rendering with ActiveShade is, in general, less precise than production rendering.

ActiveShade rendering can use either the scanline, ART, mental ray, iray renderer or Arnold or if installed. For those that are using V-Ray, V-Ray RT (Real-Time) is Chaos Group's interactive rendering engine.

To choose between production and ActiveShade rendering, use the Target drop-down list on the Render Setup dialog, or the main toolbar Render flyout. To change the renderer assigned to production or ActiveShade rendering, use the Renderer drop-down list or the Assign Renderer rollout.

ActiveShade can also be assigned to a viewport.

There are also 2 more options available in the target pulldown.

A360 Cloud Rendering Mode Opens the controls for A360 Cloud rendering.

Submit to Network Rendering Submits the current scene to network rendering.

When you choose this option, 3ds Max opens the Network Job Assignment dialog.

After

## Compositing

Nothing gives you more power to iterate and enhance faster than learning the techniques and abilities of compositing. Rather than trying to adjust elements in 3D space and having to re-render, a compositing workflow can make those adjustments in a 2D space for quick updates.

The key to this workflow is isolating different layers of an image and recompiling them in a photo or animation editor. To get the different components or layers into individual images, we use render elements.

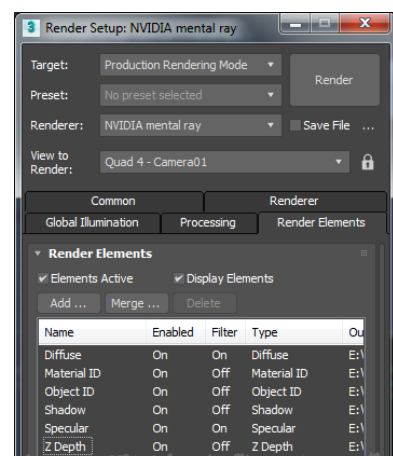
## Render Elements

Rendering to elements lets you separate various types of information in the rendered output into individual image files. This can be useful when you work with some image-processing, compositing, and special-effects software.

Very often making adjustments to specular highlights or replacing images is faster and easier in 2d space rather than re-rendering.

In the following example, we'll take a good rendering and move it into a photo editing software to make it great.

We'll also use 2D photo editing techniques to change the color of the floor and add richness to the furniture fabric.





*ORIGINAL RENDERING*

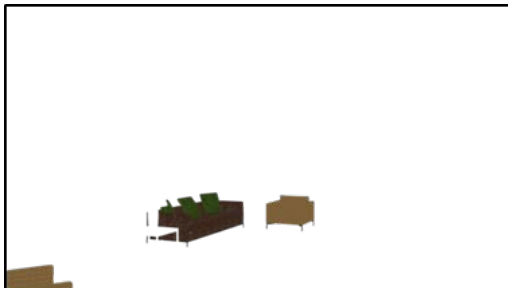
Some of the Rendered elements



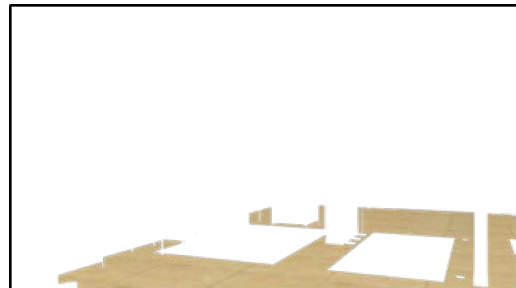
*AMBIENT OCCLUSION RENDER ELEMENTS  
MULTIPLY BLEND LAYER*



*OBJECT ID 1 RENDER ELEMENTS  
SOFT LIGHT LAYER 40% OPACITY*



*OBJECT ID 2 RENDER ELEMENT  
GAMMA CORRECTED NORMAL LAYER*



*MATERIAL ID RENDER ELEMENT  
USED AS A MASK TO CHANGE THE COLOR*





*Z-DEPTH RENDER ELEMENT  
USED AS A MASK FOR DEPTH OF FIELD BLUR*



*ROUNDED CORNERS (PHOTOSHOP LAYER)*

### Composite in Photoshop

#### Notice:

1. The Color of the floor is enhanced
2. The glow around light fixtures is added
3. The fabric on the furniture and floor is richer
4. Ambient Occlusion is darker
5. Background is blurred



*ORIGINAL RENDERING*



*ENHANCED*





*FINAL RESULTS*

## **Conclusion**

Without question, this does not represent the entire list of renderers available for 3ds Max 2017. In the short time we had in today's session, we have looked at the different types of renderers, how they differ, examples of the types of imagery they produce and some best practices to get the most out of them.

By now, you've come to the conclusion that there is no perfect renderer, nor an easy way to identify which best suits a specific job. Each has their own strengths and weakness. Many 3ds Max users are turning to multiple renderers to get they are looking for. It really boils down to what you are comfortable with and what you've taken the time to learn. With new renderers becoming available for 3ds Max all the time, there is a good chance that this list will grow.