The Visual Web Computing Platform

RealityServer® 3.0 White Paper

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About This Document

This document provides a brief introduction to the business and workflow aspects of 3D web application service solutions using RealityServer®. It includes a high-level introduction to its functionality and the underlying technology in the following sections:

- Introduction
- Solution Areas
- Technical Overview
- More Information

Related Information

For more detailed information about RealityServer, you can also read:

- Solution Areas Paper
- Technical Overview Paper
Introducing RealityServer

RealityServer® is a universal software platform for the development and deployment of 3D Web Services and 3D applications on scalable computer platforms that can be deployed on the server side of the Internet using Cloud computing services or on-site for use in and across the enterprise. RealityServer makes limitless forms of interaction with 3D data a ubiquitous experience for anyone accessing the Web with a browser-capable device from anywhere in the world. Applications range from collaborative product design to on-line virtual stores, from simulation and medical data visualization to geospatial navigation, augmented reality and entertainment solutions.

With RealityServer it is possible to reach the widest possible audience thanks to extremely lightweight client demands. Collaboration, annotations and configuration are fast to implement and integrate. RealityServer can display CAD models as beautiful images or, for example, simulate real-world environments in different lighting situations and show how newly designed products or buildings interact with them.

Photorealistic video streams that show the 3D objects and phenomena and the results of remote user interactions are generated in real-time by RealityServer for each user individually and sent to their computer or mobile device continuously during the use of the application or Web service.

Numerous professional and consumer applications require the interactive creation of highest-quality, physically correct images. Such images are generated with iray®, the world's first interactive physically correct raytracing software. iray is an integral component of RealityServer.

In combination with NVIDIA® Tesla™ server technology, RealityServer is the fundamental visual computing technology for creating and operating the 3D Web.

Figure 1 below provides a high-level overview of the RealityServer architecture and workflows:
Why RealityServer?

- A wide range of applications and web services require remote (and often collaborative) interaction with large 3D data sets on the Web from anywhere on any (mobile) device
- Many of these applications do not necessarily require real-time interaction - but they do require immediate random access to the original 3D data
- 3D data complexity often measures in Gigabytes today - and may soon exceed Petabytes for certain applications, making their storage and handling on client devices, including workstations impossible.
- Most of these 3D data are valuable proprietary assets and must remain protected which can only be achieved by keeping the data on secure servers.
- The widespread deployment of fixed-line and mobile (wireless) broadband networks, and the deployment of hundreds of millions of netbooks as well as of billions of smartphone devices allow for effortless mobile access to server based applications
- Mobile client devices such as netbooks and smartphones cannot handle such 3D data nor do they have the processing power to provide photorealistic rendering of such 3D data at interactive frame rates or even in real-time.

3D Cloud Computing = RealityServer + Applications

RealityServer permits

- Remote interaction regardless of 3D data complexity
- Use of very light clients (including mobile devices)
- Collaboration among users
- Integration of 3D applications into enterprise software and Web service environments
- Data security
- Combination with the client/file based approach: Documents become the UI for 3D applications (an example is the PDF format, the 3D representation elements of which are supported by RealityServer)

We call it 3D Cloud Computing.

Scalability and Reduced Cost of Ownership by Optimized Hardware Use

With RealityServer, the provider of a Web or application service can upgrade the server capabilities as demand grows. Servers can be utilized 24/7. It is no longer necessary to demand from end-users to upgrade their computers, use specific operating systems, or download plugins.

3D Data Re-use

3D data created with mainstream Computer-Aided-Design (CAD) and Digital Content Creation (DCC) software tools is often too large to download to many client systems, especially mobile ones, but it is easily manageable on a server. Using RealityServer, it can be redeployed for a variety of additional uses by Web-based applications.
Secure Data: Confidential Data Stays Confidential

RealityServer ensures that users never have access to the original 3D data, while still being able to interact dynamically with it.

Server-based Collaboration

RealityServer allows a virtual 3D environment to be shared among multiple users for purposes of collaborative design, design review, or in developing assets for multi-player games, etc.

Optimized Performance and Dynamic Load Balancing

RealityServer efficiently distributes workloads across a heterogeneous network of computers, including multiple operating systems and computer architectures. This includes optionally-supported graphics processors (GPUs) using the CUDA™ architecture for the built-in iray rendering mode.

Reliability

Data is stored in a redundant, distributed way in scalable, massively parallel server hardware. Redundancy can be configured by users in accordance with their priorities, resources and policies.

Solution Areas

RealityServer’s scalable architecture makes it ideal for hosting even the largest and most complex 3D models. There are countless applications and limitless areas to explore with RealityServer. RealityServer is already being used by companies wanting to offer their customers a unique online experience.

Some key RealityServer solution areas are:

- Automotive styling/design review, marketing visualization and product configuration
- Aerospace styling/design review, marketing visualization and product configuration
- Architectural design and marketing visualization
- Home and office furnishings
- Consumer products, apparel and footwear
- Geospatial: Navigation, location-based services
- Entertainment: Virtual worlds and social games
- Oil & Gas: Interactive visualization of extremely large datasets
- Medical Imaging: Interactive visualization of large datasets
The following figure provides an overview of key RealityServer application areas in relation to the relative processing power per user and typical number of simultaneous users per installation.

Figure 2: Major RealityServer application areas, their relative processing power requirements per user and number of simultaneous users per installation.

**A Selection of Scenarios**

**Architecture and Engineering**

RealityServer is ideal for creating applications that centrally store and visualize architectural or engineering data for all the stakeholders during the entire life cycle of a project. Each phase of the project can be based on a single consistent platform encompassing all areas of a workflow such as design, maintenance requirements and product marketing.

**Consumer Design Visualization**

Whether configuring a car, a kitchen, or an entire family home, RealityServer enables the development of a whole new generation of online customization and marketing tools. For example, in addition to supporting fully-online transaction systems, it is possible to follow up an online visit with a customized brochure featuring a high-resolution rendering of a configured product.
Figure 3: mydeco.com, the London-based interior design website, has successfully implemented RealityServer and is able to provide interior decorators with an online “Complete Room Planner” that uses a library of drag-and-drop décor to create environments for real-world purchase and use.

Social Media Content Creation

RealityServer supports the creation of user-generated 3D content for social media sites. As the example of SceneCaster® demonstrates, this provides much-enhanced user experiences and product marketing opportunities.

Figure 4: SceneCaster, a leading provider of 3D social media applications, uses RealityServer to let their users customize their own fun environments for easy integration within their social networking profiles.

Engineering Collaboration

With RealityServer it is possible to create collaborative frameworks. Users can attach annotations, measurements and meta-data to interactively ray-traced scene elements, and even embed a RealityServer window inside a PDF document. An example of such a solution is ProjectHub™ by Luminova, a solution for global architectural collaboration:
Technical Overview

The scalable, server-based RealityServer architecture allows the creation of multi-user 3D applications and 3D application services without client processing restrictions.

RealityServer Architecture

![RealityServer Architecture Diagram](image)

Instead of putting the resource burden on the client, the application state and rendering are managed by the server. Only a sequence of rendered and suitably compressed images is delivered to the client. These images are displayable in browser-based or client-server applications even on lightweight wireless mobile devices such as PDAs and smart phones. The bandwidth requirements for transmitting an image remain bounded by a constant that is independent of the complexity of the 3D data the user is interacting with.

RealityServer provides solution for some fundamental challenges of 3D visualization, including the support of a potentially large numbers of simultaneous users, collaboration among users in sessions, data complexity, response time, image quality and the support of different bandwidth environments. To
address these challenges, RealityServer 3.0 was developed to support the following features and characteristics:

- Minimize management overhead in massively parallel clusters (of clusters)
- Self-organizing node management and optimization
- Efficient dynamic job distribution
- Very low latency solution for highest possible compute performance
- High performance, scalable rendering algorithms
- Use of GPUs for real-time interaction and interactive simulation
- Video streaming compression

**RealityServer Application Architecture**

RealityServer 3.0 features a highly modular architecture, the main modules of which are described below.

**Figure 7: Major components of the RealityServer application architecture.**

- HTTP Server
- RTMP Server (Streaming)
- Web Services Framework
- DiCE™
HTTP Server

RealityServer applications use HTTP to communicate between the server and its clients. SHTTP can be used by adding a standard reverse proxy server in front of RealityServer.

RTMP Server (Streaming)

In addition to a standard HTTP server, RealityServer also includes a RTMP (Real-Time Messaging Protocol) server to provide video streaming and bidirectional communication between Adobe Flash based clients or custom clients implementing the RTMP standard.

Additionally, RTMP provides a bi-directional stream that allows persistent server communication in a simple manner. This is extremely difficult to achieve with conventional HTTP methodologies.

Web Services Framework

RealityServer’s Web Services Framework provides a mechanism that enables developers to work with their programming language of choice, using their pre-existing development tools and workflows, while building 3D Web Services and applications.

In addition, the Web Services Framework is delivered with a comprehensive documentation system, reusable client libraries and example applications for both Microsoft® Silverlight™ and Adobe® Flash®, all of which are specifically designed to aid developers using RealityServer software for the first time.

DiCE™

mental images’s Distributed Computing Environment (DiCE) is responsible for distributing the computational tasks of RealityServer, including rendering, across all available resources, both locally and over a network.

Scene Database

The RealityServer scene database is designed to support the efficient storage of data required by applications that support multiple and potentially collaborating users.
JavaScript Interpreter

JavaScript offers a familiar and concise way to encode application logic. The JavaScript Interpreter provides a uniform development framework for RealityServer applications and customised Web Services, as it is able to execute a compatible dialect of JavaScript on the client side.

C++ Plugin API

The C++ plugin API enables extending RealityServer with additional custom functionality to make it available to server-side JavaScript and Web Services.

Visualization Solutions

The following table is an overview of the visualization modes provided by RealityServer’s renderers.

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<tr>
<td>MetaSL Raytracer</td>
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iray

The iray technology, available with RealityServer 3.0, generates photo-real imagery without introducing rendering algorithm-specific artifacts and without requiring the use of renderer-specific parameterizations. Users do not need to use complex shaders to “approximate” real, physical lighting effects. iray is a true “push-button” solution. When coupled with highly parallel processing platforms such as NVIDIA GPUs, iray can deliver results in a progressive manner, providing a single process which smoothly combines interactive pre-visualization and final frame rendering.

MetaSL Raytracer Renderer

The MetaSL Raytracer Renderer uses smart, versatile algorithms to support progressive, photorealistic rendering of large and dynamic scenes. This raytracer provides Global Illumination, Image-Based Lighting, and Ambient Occlusion shading effects. MetaSL® 1.1, surface, light, and environment shaders are supported.

MetaSL Rasterizer Renderer

MetaSL Rasterizer is a fast renderer that uses the most advanced hardware graphic acceleration technologies to render production-quality images. It is particularly notable for supporting the rendering of images of unlimited size. The Rasterizer supports very high sampling per pixel, soft shadow maps and

¹ Fallback
² GPU CUDA-based acceleration for Ambient Occlusion, Image Based Lighting and soft shadows.
sample filters, high dynamic range imaging, and production-level shaders, including reflection based on environment shaders. MetaSL 1.1 surface, light, and environment shaders are supported.

Sketch Renderer

The Sketch Renderer is a special-purpose rasterizer renderer for technical and architectural designs. It uses sophisticated algorithms to enhance object assemblies by rendering only the perceptually important edges of objects such as the silhouette, border, and crease edges. The RealityServer architecture allows the support of additional, application-specific renderers.

Video Compression Plugin API

Developers can add support for their own video formats to RealityServer utilizing the Video Compression Plugin API. Frames output from RealityServer may be encoded to any format and either passed to the RTMP module for streaming or handled directly by the plugin (e.g., for writing to disk).

RealityServer provides you with a simple video codec, which is supported by Flash clients. However, more sophisticated codecs, such as H.264, can be added by recompiling the video compression plugin with new libraries. The source code for this plugin is provided. By using the streaming infrastructure and video compression plugins, RealityServer is able to provide full streaming video to RTMP-enabled clients such as Adobe Flash Player 10.

Importer Plugins

RealityServer provides you with COLLADA Importer, DWF Importer, and Obj Importer plugins, which add native support for these file formats.

Persistence Plugin

The Persistence plugin enables you to connect to external databases using RealityServer JavaScript API as well as utilize an efficient in-memory database for less demanding requirements. Additionally the plugin provides File I/O capabilities for accessing other on-disk resources which may be required by your RealityServer application.

Tone Mapping Framework Plugin

The Tone Mapping Framework plugin adds tone mapping capabilities to RealityServer. The most popular standard tone mapping algorithms such as Photographic Tone Mapping are fully supported, including automatic exposure control.

RealityServer 3.0

The key new features of RealityServer 3.0 include

- CUDA-based iray® ray tracing
- Hybrid OpenGL / ray traced rendering
- Video streaming compression
- Full MetaSL support
- Compatible with standard CAD/DCC formats
- Multi OS cluster support
- Self-configuring installation

**More Information**

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