# Advantages and Implementation of HP Remote Graphics Software

HP Remote Graphics Software enables 2D and 3D real-time interactive graphics and collaboration from a distance.


**Executive Overview** ..... **2**

**Introduction** ..... **3**

**HP Remote Graphics Software** ..... **4**

Overview ..... 4

Features ..... 4

Components ..... 5

Typical Deployments ..... 9

**Conclusions** ..... **10**

**For more information** ..... **11**

# Executive Overview

HP Remote Graphics Software (HP RGS) efficiently transmits complex 2D and 3D images from a sender system across standard computer networks to remote users. The remote users interact with a host sender system and its applications as if they were using a local workstation. HP RGS allows users to work with applications and data remotely—for example on the road with a laptop. It enables display of 2D/3D graphics, full motion video, and multi-display on a system that only has 2D graphics card(s), and allows multiple users to interact with the same model in real-time.

There are many uses of such technology, including enhancing security, providing support, classroom training, collaboration on design and animation projects, and infrastructure consolidation.

HP RGS employs several innovative technologies developed by HP. Components such as a patented compression/decompression algorithms and HP-developed software form a modularized software product that can be installed on a wide variety of HP and non-HP systems. Because it requires no application modifications, HP RGS may be used in conjunction with any application software. The receivers are often off-the-shelf thin clients or Microsoft Windows®-based workstations, PCs and notebooks. Senders may be workstations or workstation/PC blades; the HP Blade Workstation and HP Blade PC solutions are especially effective in an HP RGS environment.

The result is a cost-effective mechanism for providing a secure, collaborative environment for sharing complex graphics, text, or video among a (perhaps geographically dispersed) group of users. The HP RGS is applicable to a wide variety of industries, including digital content creation (DCC), computer-aided design (CAD), financial markets, oil and gas, education and general scientific and research labs.

Benefits of HP RGS include increased corporate security; increased convenience and productivity for designers and animators; reduced management costs; and more effective collaborative programs such as training and joint product design.

# Introduction

This paper describes a product from Hewlett-Packard that allows sharing of documents, complex graphics images, and/or real-time video across a standard network, with unmodified off-the-shelf applications, giving the remote viewer(s) a "just like local[1]" experience.

Designers and engineers in today's environments are working with increasingly complex models and simulations. Whether it is increased reality of an animated movie, or an in-depth fly-through of the engine compartment of a prototype vehicle, the need for higher performance, more data, and increased realism in visualization is the order of the day.

Compounding these increases in compute demands are the conflicting goals of increased security (reducing the number of places where proprietary data is exposed outside of a corporation), and the efficient use of geographically dispersed people resources. With the ability to communicate nearly anywhere on the planet, designers need real-time visual access to the results of simulations, and animators need to tightly collaborate on animation details. However, with data sets of gigabytes to terabytes, and the intense desire to keep this data secret, it is impractical (and generally undesirable) to take the data to the users—it is preferable to send images instead.

HP Remote Graphics technology can be employed in a variety of situations, including:

- Remotely accessing a workstation—work remotely and securely from anywhere, anytime, while keeping the data secure on the host workstation
- Remote demonstrations—show (perhaps many) remote users applications running on the workstation without their need to install the application software
- Design review and collaboration—allow multiple users to remotely interact with large models—even without the modeling application and data on their workstations[2]
- Support—provide user application support by allowing support professionals to remotely interact with the target desktop
- Training—distribute complex images of application demonstrations to a number of clients in real-time
- Centralization and consolidation—employ cost-effective centralized compute and file services (e.g., HP ProLiant Blade Workstations and HP Blade PCs) while providing results to a remote thin client, PC, or workstation.

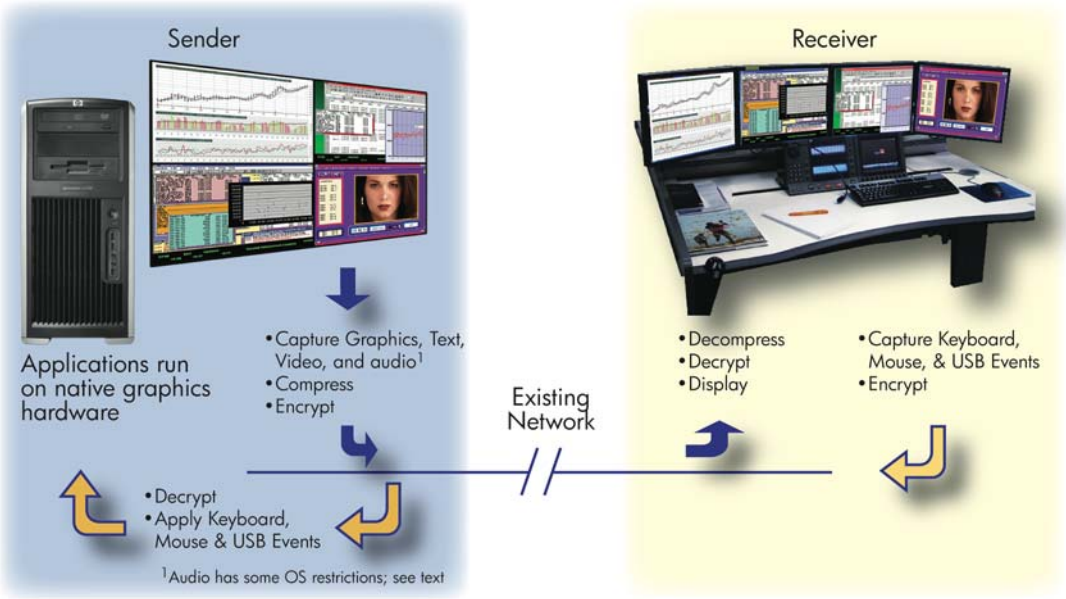
[1] Performance is subject to network speed.
[2] Subject to license restrictions, be sure to check with your application software vendor.

# HP Remote Graphics Software

## Overview

As shown in Figure 1, HP RGS consists of one sender and one or more receivers. As the sender performs typical workstation functions, the receiver sees these actions as if they were happening on the receiver's local workstation. Further, the receiver uses their keyboard, mouse, and USB devices to interact with applications just as if they were physically interacting with the sender system.

**Figure 1.** An overview of the HP Remote Graphics Software




Internally, the sender's workstation is executing an application and interfacing with the graphics drivers using the standard X, OpenGL, DirectX, and/or Graphics Device Interface application program interface (depending upon the operating system). The sender monitors and records any changes in the screen appearance, compresses and encrypts that information, and sends it to the receiver(s) as required. The receiver then decrypts and decompresses the information, then updates the local display appropriately. For selected sender operating environments[3], the sender also sends audio (compressed and encrypted) to the receiver(s).

Similarly, the receiver captures local USB data, keyboard, and mouse events and returns them to the sender, which are then interpreted and executed on the sender's system.

## Features

The modular architecture and patented compression technology permit a comprehensive set of features not found in any other remote workstation technology. These features include:

- **Flexible operating environment support.** The HP RGS supports Microsoft Windows XP Professional, Windows XP Professional x64 Edition, and Red Hat Enterprise Linux 32-bit and 64-bit. In addition, multiple hardware environments are supported, including HP Personal Workstation xw series, HP ProLiant Blade Workstation, HP Compaq Blade Workstation, HP BladeSystem Blade PC, and HP

[3] Audio is only supported on Microsoft Windows-based senders

Compaq Thin Client with Microsoft Windows XP Embedded (as receiver only). Check www.hp.com for specific combinations of sender/receiver hardware platforms and operating environments.

- **Full utilization of graphics accelerator hardware on the sender system.** HP RGS makes full use of graphics hardware on the sender system—since the receiver is dealing only with pixel data, it need only be capable of displaying 2D images. This vastly reduces the graphics card, CPU, and other system requirements on the receiver side and enables a low performance system to display complex real-time 3D images.
- **High quality, high performance compression/decompression technology.** HP's patented compression/decompression (CODEC) technology provides both high quality and high performance. The high compression ratio reduces bandwidth requirements and permits communication across standard networking hardware.
- **USB device mapping to receiver.** Selected USB devices[4] are supported by the receiver, allowing the use of devices such as security keys, flash drives, and printers over the secure connection. A USB Access Control List (ACL) can be used to allow or deny USB devices based on a number of specified USB attributes such as the device class and vendor ID.
- **Highly secure connection.** HP RGS uses multiple security techniques, including encryption of all media streams and all USB, mouse, and keyboard data. (See the section on "Security," below).
- **On the fly compression selection.** Compression technique may be changed on the fly to effectively manage image quality and network bandwidth requirements.
- **Application transparency.** No modifications of applications are necessary.
- **Industry-standard network-based design.** The communication mechanism is industry standard TCP/IP, with no requirements for proprietary networking or cables and no limit on distance. This allows HP RGS to be deployed in an existing network environment.
- **Stateless client.** No information is stored on the receiving side, eliminating data loss because of network disruptions. In addition, there is no need for application executables or application data to reside on the receiver.
- **Access to entire desktop session.** The remote workstation is able to get a convenient and easy-to-use whole-desktop view of the sender's display.
- **Software solution.** The software-only solution allows deployment without physical changes to the compute environment or additional infrastructure investments.

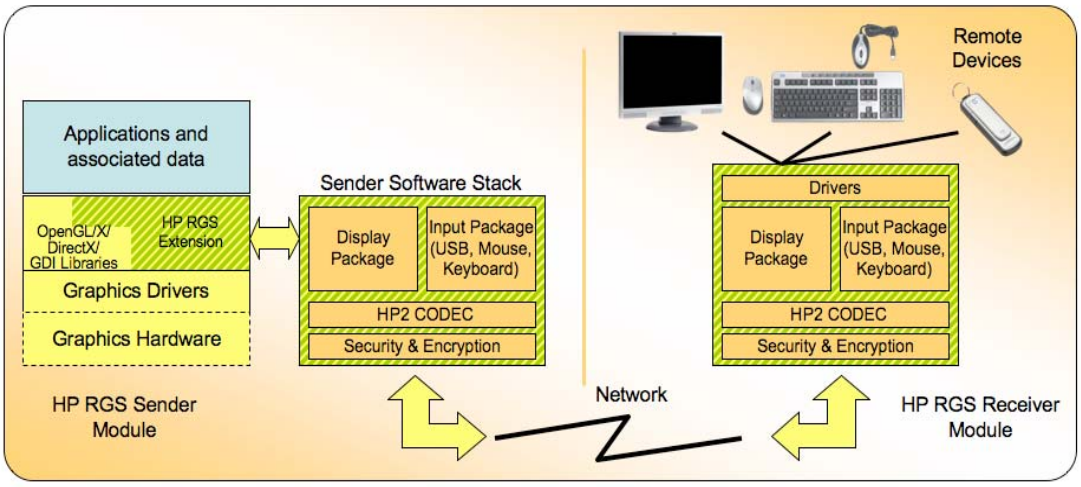
## Components

### The Software Stack

HP Remote Graphics Software is composed of several software layers and various modules that manage the traffic to the receiver. The primary layer is a platform independent module that interacts with the various graphics libraries, depending upon the sender's host operating system (32-bit or 64-bit Linux or Microsoft Windows).

[4] Blade Workstation Client, Microsoft Windows XP/XPE are only supported. See hp.com for a list of supported devices

**Figure 2.** Block diagram of HP RGS software.




Calls to the graphics applications programming interface (API) on the sender may be monitored (in the case of OpenGL and DirectX), and/or HP RGS periodically reads the device's frame buffer to track operations that modify the appearance of windows on the sender's screen. The HP RGS extension communicates with a sender module that manages the communications traffic to/from the receiver. The sender module contains multiple software packages, including display management, input management (handling returned mouse and keyboard commands) security, remote audio output, remote USB, and compression/decompression.

**CODEC**

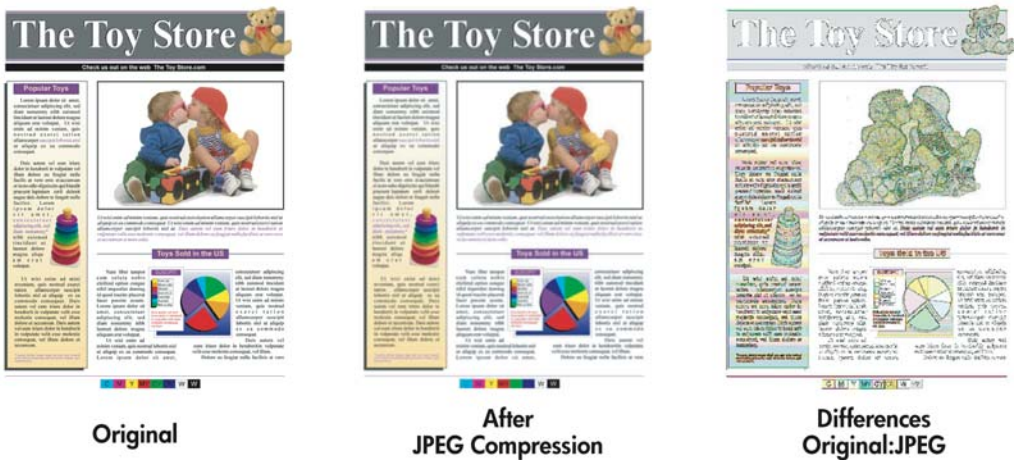
One of the most important components of HP RGS is the compression/decompression (CODEC) algorithm. HP RGS uses an HP-patented CODEC technology, called "HP2," developed specifically for rich digital images and high frame rate video. HP2 is now in its second major revision, with enhanced performance and reduced overhead.

HP2 is a new method for compression of visual content, and is able to efficiently identify different components of a graphic (e.g., text, lines, photos) during compression, and use a different encoding method for each component. Whenever possible, HP2 uses lossless compression for graphics and text, and on natural images it uses lossy compression. The result is a variable-quality compression across the image that retains high image quality where differences would be most noticed (e.g., text), with higher compression in other places (e.g., single-color blocks).

The HP2 CODEC was designed for embedded systems with very limited resources, and thus has a very small footprint (e.g., it can be downloaded with media).

The figures below compare the HP2 CODEC with low-quality (highly compressed) JPEG. In the first case (Figure 3), the compression algorithm JPEG is used as a baseline comparison on a US Letter-sized page of a "Toy Store" advertisement. The original (uncompressed) bitmap graphic is shown on the left, the compressed graphic is shown in the middle, and a "differences" graphic is shown on the right.

**Figure 3.** Image quality analysis of JPEG.

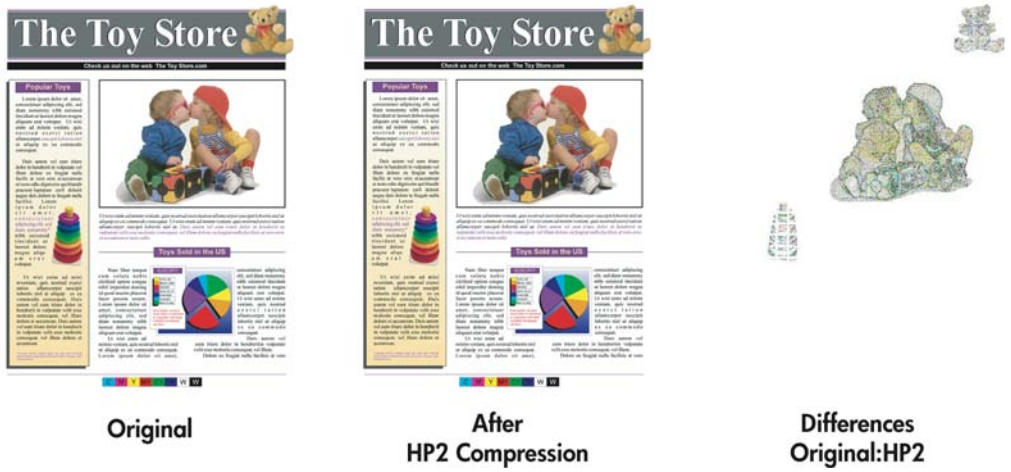



The differences graphic represents, for each pixel, the magnitude of the error (difference from original, white is zero) after compression/decompression; more non-white pixels in the differences graphic represents a poorer reproduction of the original graphic. In this example, the JPEG compression algorithm (at the highest level of compression) tends to do most poorly on text and complex images.

More pixels in the differences graphic also represent increased data transferred to the remote receiver, requiring additional bandwidth. The increased bandwidth requirements may substantially affect performance when video and 3D images are being processed.

Figure 4 illustrates the quality of the HP CODEC. Again, the original image quality is shown on the left, the middle section of the image shows the image after HP2 compression, and the right hand part of the image shows the differences comparison after decompression. Note that the JPEG image is compressed 50:1, while the HP2 CODEC compresses at 170:1, which means that the HP2 compressed image results in less data—placing less load on network resources and enabling higher frame rates.

**Figure 4.** Analysis of HP2 CODEC compression quality.




Also note in Figure 4 the effects of the hybrid lossless and lossy compression techniques; all of the text, lines, and single color blocks are faithfully reproduced, only those sections with complex color mixes, which use lossy compression, show compression artifacts.

**Remote Devices**

The HP RGS client can receive an audio stream from the sender (for selected sender operating systems). In addition, local client USB devices can be attached to the remote system. For example, USB I/O devices such as scanners and printers can be attached to the client system, as can USB disk drives and flash drives. Security devices, such as USB keys and USB fingerprint readers are also supported.

**Session Allocation Manager (SAM)**

In a centralized environment, the SAM software helps support virtualization—the ability of a client to dynamically obtain, use, and release compute resources from a central pool of resources. These resources may be HP Workstations, HP Blade Workstation Solution, or the HP Consolidated Client Infrastructure.

The SAM is a single-point of access utility that manages all of the remote desktop connections to the computing resources. In a high availability configuration, computing resources may be configured to permit failover; the SAM will automatically search for an operational compute node before connecting the user to his/her computing resources.

Since users acquire and release resources only as they are needed, compute resources are much more effectively utilized. Moreover, system administrators have much more freedom in configuring, upgrading, and deploying new hardware into the centralized compute infrastructure, without costly disruption of end users' tasks.

**Security**

HP RGS has multiple levels of security, including authorization and authentication. Users can be assigned and administered from a central service. There is a single sign-on (SSO) for connection/session initiation; if the receiver and sender are within the same domain, the credentials of the current user are used to automatically establish connections between receiver and sender.

Extensive collaboration techniques are used to allow the primary user to control the connection. For example, the keyboard and mouse can be enabled or disable for collaborators. If the primary user connects from another location and that user has a pre-existing connection, the previous connection

will be terminated. This feature adds security and privacy measure for mobile user sessions and prevents the possibility of snooping through the user's non-active client connection elsewhere.

Another security feature is a collaboration notification dialog window that appears once a collaboration user has been authorized to connect to the desktop. A persistent pop-up window appears once a guest user has been authorized to connect to the desktop as reminder that desktop session is being shared—the window contains user information such as username and hostname, and continuously lists all connected users. This serves as both a reminder and a visible indicator of a collaboration session taking place.

All graphics traffic is encrypted using the Anonymous Diffie-Hellman (ADH) cipher suite based on the OpenSSL implementation, including mouse and keyboard data. Encryption is started with an initial key length (used to negotiate the public/private keys) of 1024 bits. After the initial connection the ADH algorithm negotiates a secret key for use in one of the secret key ciphers available in the ADH suite in OpenSSL; 256 bit encryption with a secure hash based on the Secure Hash 1 (SHA1) algorithm will be the highest priority key cipher.

## Typical Deployments

Some typical deployment scenarios are described below.

**High-performance collaboration**

Using HP RGS, multiple remote contributors can access and work on centrally located projects. This leads to faster time-to-completion, improved file consistency, and higher productivity. Because HP RGS can handle 3D images, media-rich content, and streaming video, it is an ideal solution for digital content creation, computer-aided design, oil and gas, life sciences and any industry that depends on complex graphics and 3D content.

**Shared-environment display**

HP RGS allows many receivers to simultaneously receive graphics output from a common sender. This capability fits well in a shared environment, including software training, product demonstrations, project reviews, geographically dispersed teams and telecommuting.

**Data security**

Data security is inherent to HP Remote Graphics Software because no applications or data leave the sender workstation. Only the pixel information necessary to mirror the sender's desktop is sent (with the exception of potential data transfers to USB devices). For example, a parts vendor can remotely view and interact with a manufacturer's product design, yet the manufacturer can rest assured that the product design data files are not exposed for copying and possibly ending up in a competitor’s hands. Additional security is available by disabling multi-user access (collaboration) for situations where a single user interacts with the sender.

**Consolidated compute resources**

In many cases, end users may only occasionally need the power of a high-performance workstation; much of the time a more lightweight client system on their desktop is sufficient. Using HP RGS, and the HP Session Allocation Manager, an organization can create a pool of workstations or workstation blades that users can access dynamically from lower-cost desktops. The end users can still view and manipulate complex 3D images even though their client systems use lower-cost 2D graphics cards. Furthermore, resources are more efficiently used because they are dynamically allocated to users as required, rather than deploying relatively expensive high-performance systems for each individual user.

**Disaster recovery**

The HP RGS software can be used to enable a disaster recovery configuration. If a primary office becomes inaccessible, remote users can resume operations from a secondary location, without moving or recovering the entire infrastructure.

# Conclusions

The HP Remote Graphics Software provides an inexpensive and flexible method of remotely managing the complex images produced by applications on centrally located workstations or PCs. Benefits of the HP Remote Graphics include:

- Increased corporate security—remote users (designers, engineers, vendors) are able to access design information without proprietary data being transferred outside of the corporation; only image pixels are transmitted to the remote users. Of course, access to USB devices must still be properly and securely configured.
- Convenience and timesavings—users may remotely access centrally located applications, remotely leveraging large central compute resources and eliminating the need to transfer huge volumes of data to another site. Further, the remote sites may be mobile, lightweight clients, reducing travel time and expenses.
- Reduced management costs—centralization allows reduction in management costs by consolidation and single-point-of-contact system management.
- Increased productivity—remote document/model reviewing and collaboration increases workers productivity and communication effectiveness. Users may review and interact with complex 3D images worldwide, simultaneously.
- Increased training effectiveness—training with complex applications and complex user sequences is facilitated by allowing multiple users to follow interaction with applications. Costs are lowered because student workstations need not have expensive copies of applications installed[5].
- Increased resource utilization—remote receivers can be lower spec platforms (for example, a thin client or a desktop system with 2D graphics only) while still displaying workstation-class 2D and 3D graphics. This reduces acquisition costs and extends the usage life of legacy equipment. HP RGS also opens up new ways of using remote visualization. The ability to transmit and share graphics in real-time changes the way we are able to work by opening up new collaboration possibilities and enabling new working capabilities.

[5] Subject to license restrictions, be sure to check with your application software vendor.

# For more information

http://www.hp.com/workstations/software/remote/
HP Remote Graphics Software site.

http://www.hp.com/workstations
HP Workstations portal.

http://www.hp.com/go/cci
Information on the HP Consolidated Client Infrastructure with HP Blade PCs



5982-7872EN, May 2007

invent