

Executive Overview

HP Remote Graphics efficiently transmits complex 2D and 3D images in real-time across standard computer networks to remote users. The remote users are able to interact with the desktop and its applications as if they were using the local workstation. This ability to work with 3D graphics across a regular network in real-time is revolutionary, and has the potential to change the way we work. It allows the user to work with 3D graphics remotely; for example on the road with a laptop, from home in the evening, or to access a Linux desktop as if it were the native desktop while using a Microsoft Windows system. It enables you to display complex 3D graphics on a system that only has a 2D graphics card. It allows multiple users to interact with the same model in real-time. It is a new paradigm.

There are many uses of such technology, including support, classroom training, collaboration on design and animation projects, resource centralization and consolidation.

HP Remote Graphics Software employs several technologies developed by HP. Components such as a patented compression/decompression module and HP-developed software stacks 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, Remote Graphics Software may be used in conjunction with any software application.

The result is a cost-effective mechanism for providing a collaborative, shared environment of complex graphics among a (perhaps geographically dispersed) group of users in 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 Remote Graphics Software include increased convenience for designers and animators, reduced management costs, increased productivity and more effective training programs.

Introduction

This paper describes a product from Hewlett-Packard that allows sharing of complex graphics images across a standard network, with unmodified off-the-shelf applications, giving the remote viewer(s) a “just like local¹” experience.

Designers and engineers in today’s environments are working with increasingly complex models and simulations. Whether it’s 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 is 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 computations that take powerful compute farms days to complete, it is impractical to take the data to the users—it’s easier to send the images instead.

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

- Remotely accessing a workstation—work remotely from anywhere, anytime
- Remote demonstrations—show 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 workstations²
- Support—provide user application support
- 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 while providing results to any workstation

¹ Performance is subject to network speed.

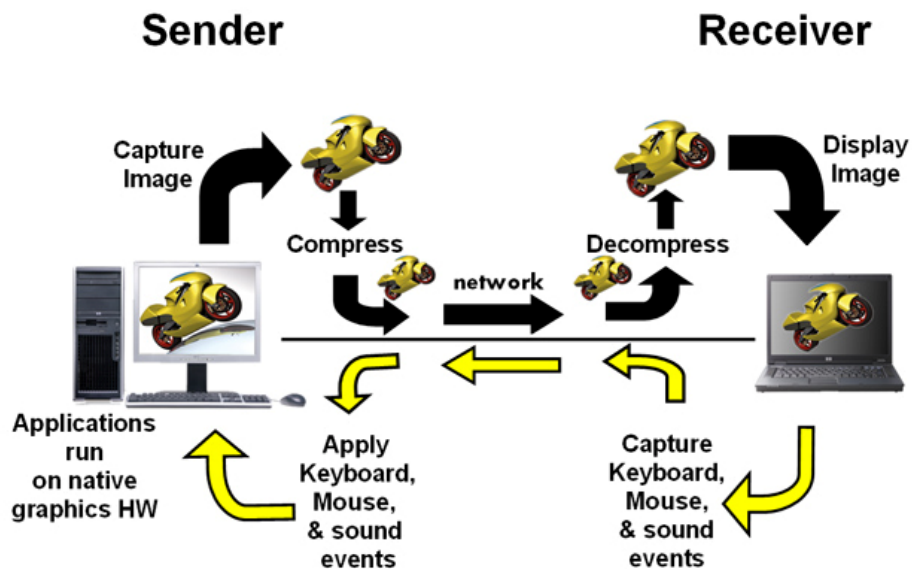
² Subject to license restrictions, be sure to check with your application software vendor.

HP Remote Graphics Software

Overview

As shown in Figure 1, HP Remote Graphics Software (Remote Graphics) 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 interacts with applications just as if he or she were interacting with the sender desktop.

Figure 1. An overview of 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, and compresses and sends that information to the receiver(s) as required. The receiver then decompresses the information and updates the local display appropriately. The receiver also sends keyboard and mouse events to the sender, which are then 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:

- Full utilization of graphics accelerator hardware on the sender system. Remote Graphics makes full use of graphics hardware on the sender system – the receiver system need only display 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.

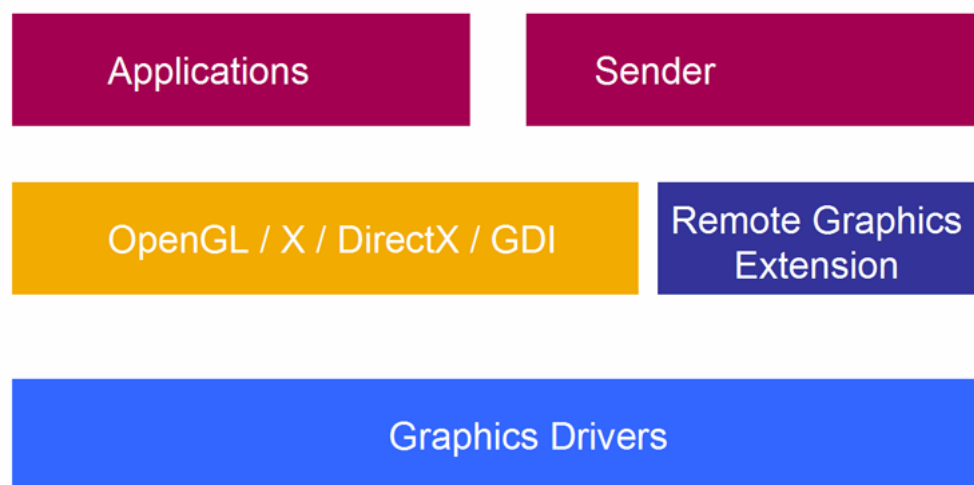
- High quality, high performance compression/decompression technology. HP's patented compression/decompression technology provides both high quality and high performance. The high compression ratio reduces bandwidth requirements and permits communication across standard networking hardware.
- On the 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 Remote Graphics 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 (HP-UX, 32-bit or 64-bit Linux or Microsoft Windows).

Figure 2. Conceptual diagram of the HP Remote Graphics Software sender.



Application calls to the graphics API on the sender may be monitored (in the case of OpenGL), and/or the Remote Graphics reads the device's frame buffer to track operations that modify the appearance of windows on the sender's screen. The Remote Graphics

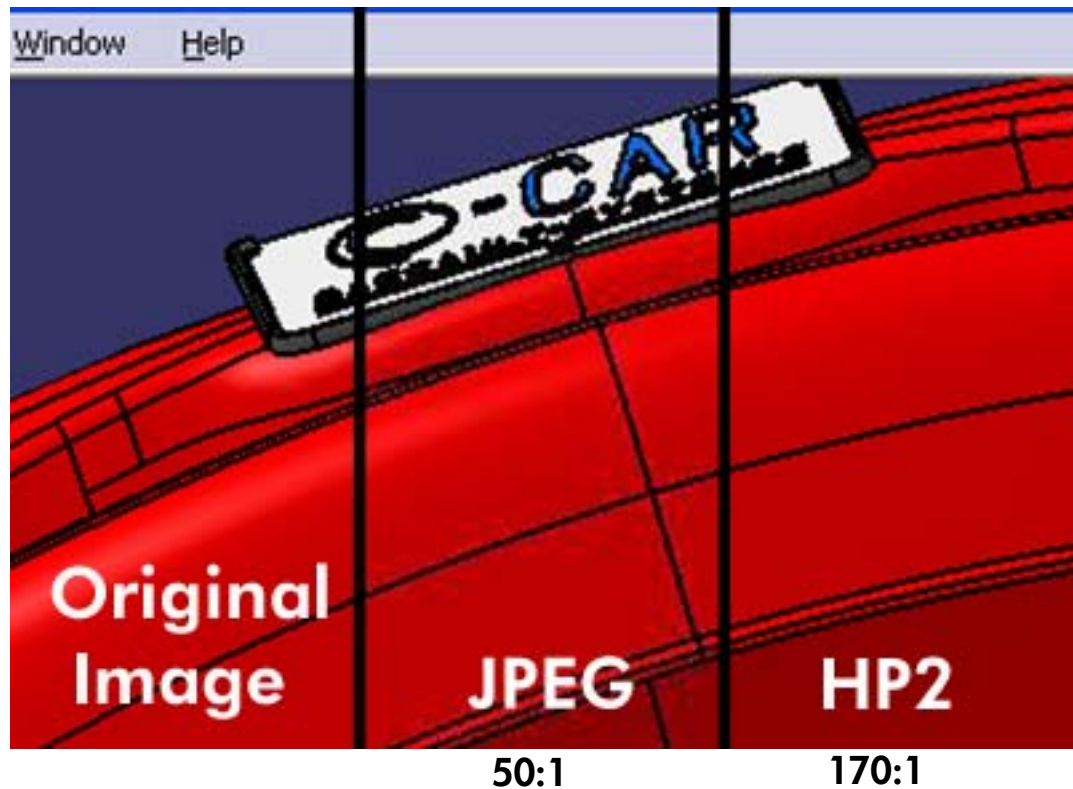
extension communicates with a sender module that manages the communications traffic to/from the receiver. The sender module contains multiple software packages, including display management, input management (handling returned mouse and keyboard commands) security, remote audio output, and compression/decompression.

CODEC

One of the most important components of Remote Graphics is the compression/decompression (CODEC) package. Remote Graphics uses an HP-patented technology developed specifically for rich images. It is a hybrid of “lossless” and “lossy” compression—text, lines, and single color blocks use lossless compression, and photos and complex images use lossy compression. The result is a variable-quality compression across the image that retains high image quality where differences would be most noticed, with higher compression in other places (e.g., white space).

Figure 3 illustrates the quality of the HP CODEC (called “HP2”) compared to standard JPEG on a high resolution engineering data set. The original image quality is shown on the left, the middle section of the image shows JPEG compression and the resulting artifacts, and the right hand part of the image shows HP2 compression. 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 a smaller file which places less load on network resources and enables faster frame rates.

Figure 3. Image quality comparison of JPEG with HP CODEC (HP2).



Security

HP Remote Graphics has multiple levels of security, including authorization and authentication. Workstation users are assigned and administered from a central security

database. Connections are authenticated by Microsoft password authentication protocol NTLM and Kerberos. 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.

Audio

New with HP Remote Graphics Software V3 is the ability for a Microsoft Windows sender system to broadcast audio remotely over the network to a Microsoft Windows or Red Hat Enterprise Linux receiver.

Conclusions

The HP Remote Graphics Software provides an inexpensive and flexible method of remotely managing the complex images produced by applications on a centrally located workstation. Applications range from digital content creation (DCC) to computer-aided design in manufacturing to classroom instruction on sophisticated applications.

Benefits of the HP Remote Graphics include:

- Convenience and time savings—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 installed³.
- Increased resource utilization—remote receivers can be lower spec platforms (for example, a desktop or notebook system with 2D graphics only) while still displaying workstation-class 2D and 3D graphics. This reduces acquisition costs and extends legacy equipment usage life.

The HP Remote Graphics Software 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.

³Subject 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.

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