

*Digital Media on the
Sun Ray™ 1 Enterprise Appliance*

Technical White Paper



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Printed in the United States of America.
901 San Antonio Road, Palo Alto, California 94303 U.S.A

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Multimedia in the Sun Ray Hot Desk Architecture



Once only the province of high-end workstations, displaying and manipulating digital video and audio on today's desktop systems is now common practice. Whether viewing a Web-based news broadcast, listening to a recorded speech, or viewing video as a part of on-line training, multimedia capabilities have become a basic requirement for today's desktop computing environments.

Previous thin client architectures such as X-terminals and 3270 devices provided no mechanism for multimedia applications, or at best required a specialized application development effort. In contrast, the Sun Ray™ 1 enterprise appliance tightly integrates audio and video support, enabling most multimedia applications to run with little or no modification. Environments with multimedia requirements can now take advantage of the stateless, zero-administration Sun Ray 1 enterprise appliance and the enhanced user mobility, performance, and cost-effective centralized administration model it provides.

This document details the multimedia capabilities of the Sun Ray 1 enterprise appliance and provides guidance for configuring multimedia applications in a Hot Desk environment.

Sun Ray 1 Multimedia Hardware Interfaces

The Sun Ray 1 enterprise appliance provides a full compliment of interfaces for a variety of different media. Connectors are provided both on the front and back of the appliance for convenience and ease of access. As shown in

Figure 1-1, a mono microphone input connector and a stereo headphone output connector are provided on the front of the appliance. The appliance also includes an internal speaker.

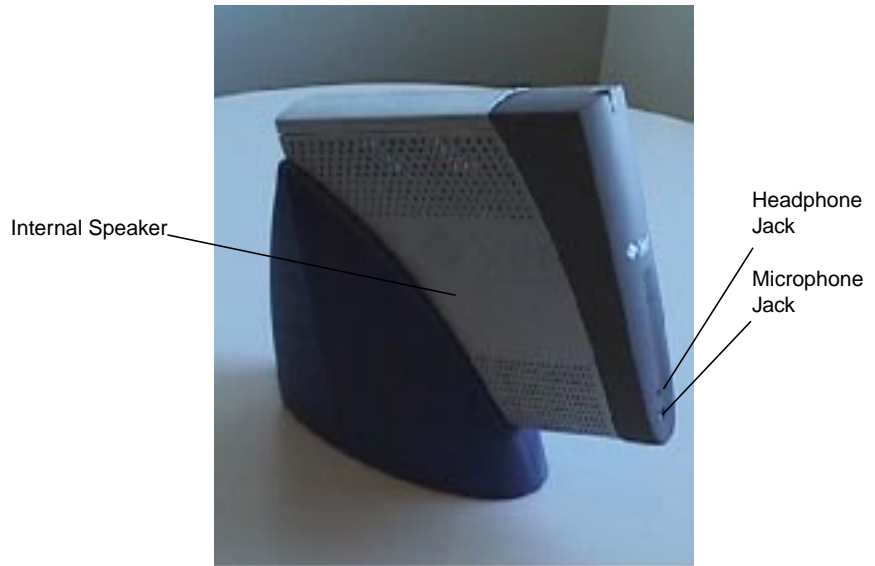


Figure 1-1 Microphone and headphone connectors on the Sun Ray 1 enterprise appliance

Figure 1-2 illustrates the audio and video connections available on the back of the appliance. Both stereo line-in and line-out connectors are provided along with a composite video (NTSC/PAL) input connector.

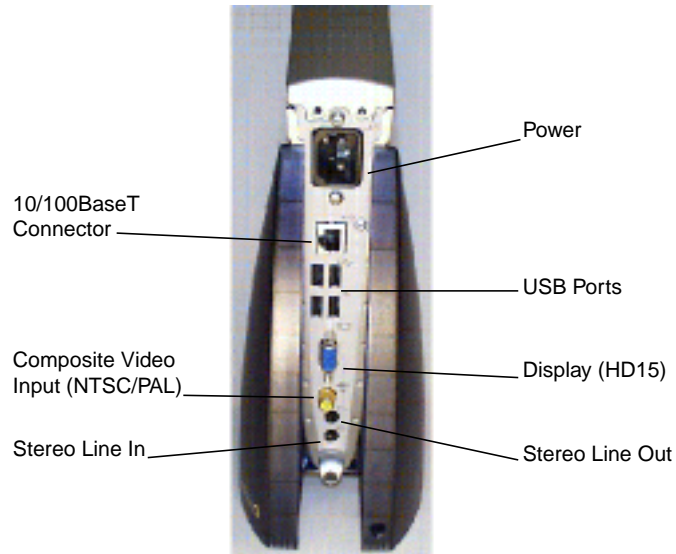


Figure 1-2 Back-panel media connectors on the Sun Ray 1 enterprise appliance

Multimedia Capabilities

The Sun Ray 1 enterprise appliance is capable of recording and playing audio signals and can display digitized and/or broadcast video through a variety of media players. Media players are discussed in detail in chapter 3. Table 1-1 lists the initial media capabilities of the Sun Ray 1 enterprise appliance. Video capture capabilities will be provided through a future version of the Java Media Framework (JMF).

Media Type	Play/Display From Internal Digital Source	Play/Display From External Analog Source	Record/Capture from External Source
Audio	Yes	Yes	Yes
Video	Yes	No	No

Table 1-1 Initial multimedia capabilities of the Sun Ray 1 enterprise appliance

Audio Features

The Sun Ray 1 enterprise appliance provides extensive audio capabilities, comparable with full-featured workstations and PCs.

- *Record and Playback*

The audio input and output interfaces of the Sun Ray 1 enterprise appliance support both recording and playback. μ -law, A-law, and linear encodings are supported.

- *Mixed Audio Streams*

The Sun Ray 1 enterprise appliance supports mixing of audio streams so that audio from multiple sources and protocols can be heard together through either the headphone or line-out interfaces. For example, a user could play audio sent as a multimedia e-mail attachment while viewing a video broadcast — the audio signals from both sources would be audible.

- *Autosensing Interfaces*

The appliance automatically senses the presence of headphone, microphone, and line-in audio jacks and provides this information to the appropriate API. Applications can re-route audio signals or enable user interface components for selection. The headphone and line-out interfaces can be selected automatically or manually through a user interface.

- *Audio Sample Rates*

The Sun Ray 1 enterprise appliance audio subsystem records and plays audio data sampled at a constant rate of 48 kHz — equivalent to that of DAT (Digital Audio Tape) and DVD (Digital Versatile Disk). To enable compatibility with a wide range of different audio formats, the Sun Ray enterprise server automatically converts between other sampling rates as needed. For instance, the Sun Ray enterprise server will automatically convert an external audio signal from 48 kHz to 8kHz when recording a Sun .au file. A CD-quality audio file would be automatically converted from 44.1 kHz to 48 kHz when played through the appliance's audio interface. (Note that mere conversion from a lower to higher sampling rate does not provide an increase in quality.)

Integrated Audio Controls

Convenient menu interfaces are integrated into each appliance for selecting and adjusting different media interfaces. Figure 1-3 illustrates the audio controls GUI which is available by simultaneously pressing the *<shift>* and *<props>* keys on the Sun Ray 1 enterprise appliance keyboard. The audio controls menu can also be run from the command line by executing */opt/SUNWut/bin/utsettings*. In addition, volume and mute can be adjusted directly using the pre-defined audio keys on the appliance keyboard.

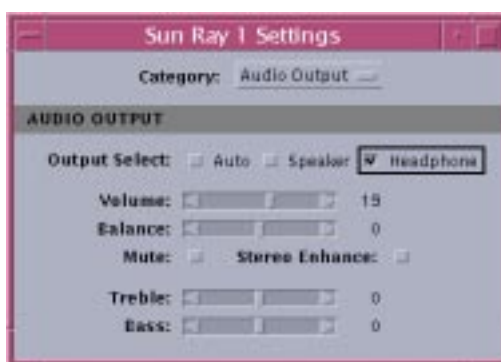


Figure 1-3 Integrated audio controls GUI for audio output

The Sun Ray 1 enterprise appliance offers a complete set of integrated audio controls as shown in Table 1-2.

Input Settings	Output Settings
Input select (microphone or line-in)	Output select (headphones or speakers)
Microphone gain	Volume and mute (on/off)
Line-in gain (left and right)	Stereo enhance (on/off)
Monitor volume	Treble, bass, and balance controls

Table 1-2 Features available through the integrated audio control GUI

Note that the line output is always enabled. It is not affected by any of the output settings, including volume and muting. It is similar to the “record out” jacks provided on consumer audio equipment.

Multimedia in the Hot Desk Technology Architecture

An appreciation of the Hot Desk Technology architecture is helpful in understanding the multimedia capabilities of the Sun Ray 1 enterprise appliance. The Sun Ray Hot Desk architecture succeeds by combining key advantages of existing architectures with today's inexpensive hardware components and high-speed networking technology. As shown in Figure 1-4, the architecture is comprised of three components: the *Sun Ray 1 enterprise appliance*, a *dedicated interconnect*, and a *Sun server* running the *Solaris™ Operating Environment* and *Sun Ray enterprise server software*.

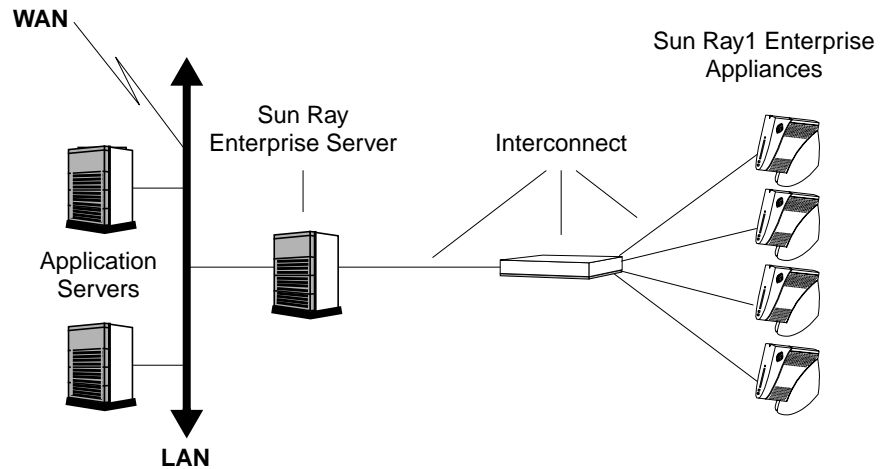


Figure 1-4 High-level perspective of the Hot Desk technology architecture

No client software is stored or executed on the appliance, unlike X-terminals and similar devices. Instead, all user applications run on one or more centralized server systems. The X11 server and GUI along with most desktop applications run on the Sun Ray enterprise server. The enterprise appliance contains only the resources necessary for the *human interface* — input devices such as microphone, keyboard and mouse, and output devices such as the display and audio.

All user input (keystrokes, mouse clicks, audio, etc.) is transmitted from the appliance through the interconnect and to the appropriate client application. 2D pixels and audio output travel back to the appliance across the interconnect. The user sees a fully-functional desktop environment and window system along with all of their active applications.

Virtual Device Drivers

All input and output to the Sun Ray 1 enterprise appliance is accomplished through the use of virtual device drivers on the Sun Ray enterprise server. For example, the X11 server displays to a virtual device driver that translates between the higher-level X11 protocol and the native Hot Desk protocol as shown in Figure 1-5. For each appliance, a *virtual display device driver* maintains a copy of the currently active desktop session in a memory-based *virtual framebuffer* on the Sun Ray enterprise server. All display rendering is performed on the server, and pixels are sent by the virtual device driver to the appliance only when they need to be updated.

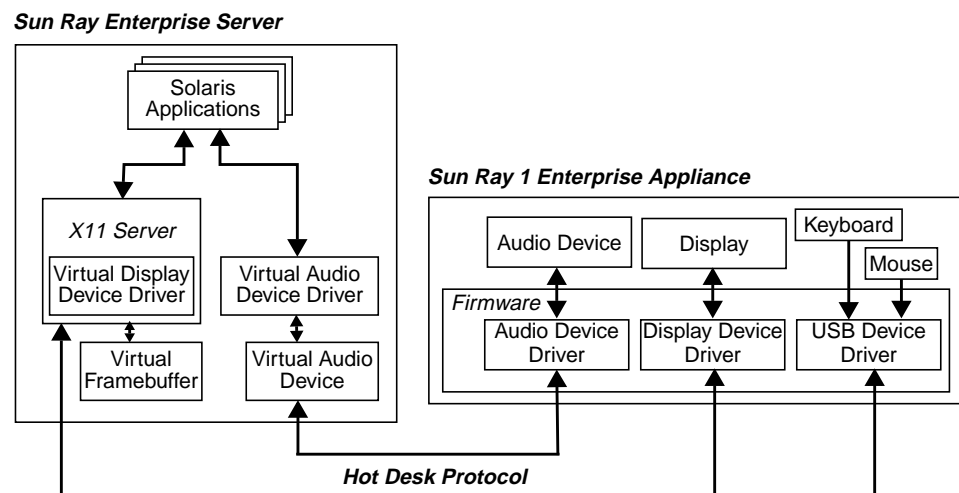


Figure 1-5 Virtual and real device drivers in the Hot Desk technology architecture

Virtual device drivers also exist for the appliance's audio interface and USB keyboard and mouse. Future Sun Ray enterprise server software releases will add support for the NTSC video input and more USB peripherals. Keyboard and mouse events are sent from the desktop back to the server, converted into X11 events, and then sent on to applications. Audio data coming from the appliance is encoded and sent to a virtual audio device driver. The Sun Ray enterprise server software maintains the `AUDIODEV` environment variable for each user session so that audio input and output is directed to the correct appliance.

Applications in the Hot Desk architecture operate independently of the location of their associated input and output devices. A *virtual session* is created for the user because input and output for the session can be redirected to any appliance on the interconnect. The Hot Desk architecture does this transparently for well-behaved Solaris and Java applications.

Even multimedia data and applications are a part of the virtual session. For instance, if a user is playing the video and audio from a video broadcast, those applications and data automatically resume playing when the user moves their smart card to a new appliance.

Media Players for the Sun Ray 1 Enterprise Appliance



A variety of media players are available which perform decompression and playback of digitized audio or video data. Several media players work well with the Sun Ray 1 enterprise appliance to provide access to media files, intranet broadcasts, and Internet-based audio and video sources. Table 2-1 lists three recommended media players for use with the Sun Ray 1 enterprise appliance along with their particular specialization.

Media Player	Recommended Usage
ShowMe TV 1.3	General-purpose intranet media
RealNetworks' RealPlayer 5.0 and G2 ¹	Low bit-rate Internet streaming video (RealNetworks proprietary protocols)
Java Media Player (Java Media Framework 2.0)	Integrating video into Web pages, Java technology application development

1. As of this writing, RealPlayer G2 for the Solaris Operating Environment is undergoing BETA testing. Engineering has found an audio bug that affects the RealPlayer G2 media player. This bug is being fixed and a patch will be out shortly. The 1.1 release will also incorporate this bug fix.

Table 2-1 Recommended media players for the Sun Ray 1 enterprise appliance

This section describes ShowMe TV 1.3 and the RealPlayer 5.0/G2 media players and provides information for configuring them to work together. More information on the Java Media Player can be found in chapter 3 in the section on the Java Media Framework 2.0.

ShowMe TV 1.3

The ShowMe TV 1.3 product set brings high-quality audio and video to the Sun Ray 1 enterprise appliance from a wide variety of sources and formats. ShowMe TV is comprised of two primary components: the ShowMe TV Receiver, and the ShowMe TV Transmitter. ShowMe TV Receiver can be used individually to display media files or it can receive audio and video broadcasts from the ShowMe TV Transmitter across a corporate LAN. ShowMe TV 1.3 is available free of charge and can be downloaded from Sun's Web site at: <http://www.sun.com/desktop/products/software/ShowMeTV/index.html>.

In the Hot Desk environment, a copy of the ShowMe TV Receiver runs on the Sun Ray enterprise server for each appliance user viewing audio or video data. The Sun Ray enterprise server must be sized appropriately to support the load generated by the anticipated number of simultaneous video users. Chapter 3 provides information on sizing Sun Ray enterprise servers for multimedia.

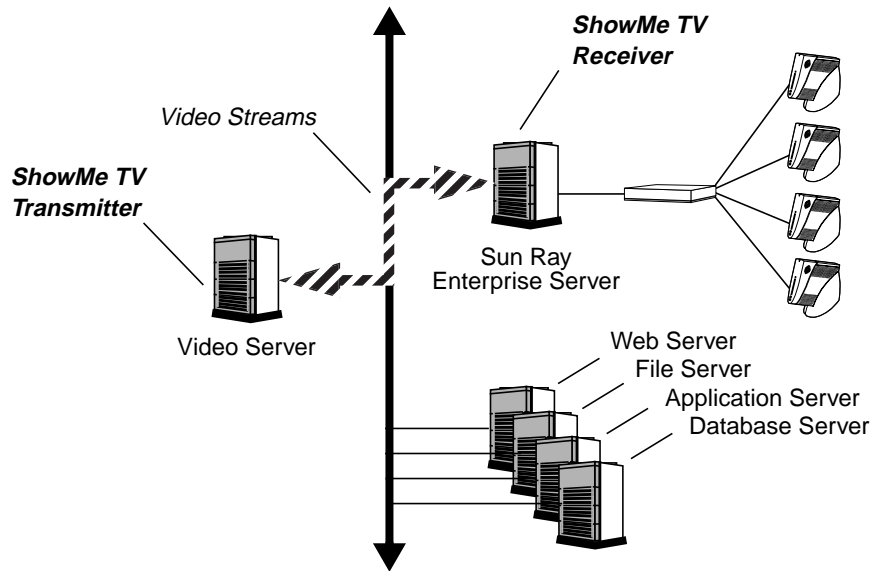


Figure 2-1 ShowMe TV Receiver and Transmitter in the Hot Desk environment

ShowMe TV Transmitter typically runs elsewhere on the LAN and serves to broadcast video input from a file or from a SunVideo or SunVideo Plus board as shown in Figure 2-1.

ShowMe TV Receiver

ShowMe TV Receiver acts as both a television by viewing video data and a VCR by enabling users to record video data either manually or on a scheduled basis. The ShowMe TV GUI (Figure 2-2) affords the user customization options.

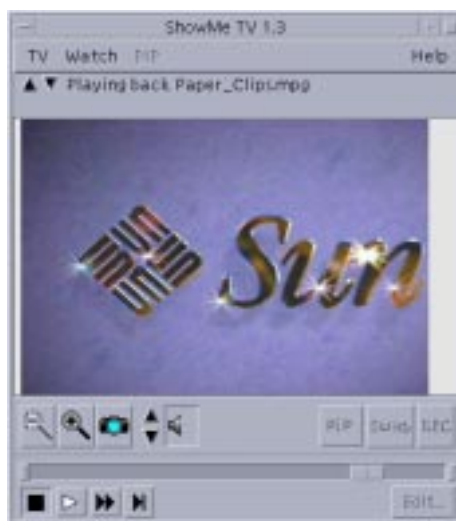


Figure 2-2 ShowMe TV Receiver GUI

ShowMe TV Receiver uses the processing power of the Sun Ray enterprise server to perform software decompression and display content from a number of sources, including:

- *Media Files*

ShowMe TV Receiver enables playback of media files stored in any file systems accessible by the Solaris Operating Environment. ShowMe TV Receiver can also be configured as the default media player for browsers like Netscape Navigator, enabling the download and display of video files accessed through Web pages.

- *Direct Video Sources*
 ShowMe TV Receiver can also directly control a SunVideo (SBus) or SunVideo Plus (PCI) card. Any video source that can be plugged into the SunVideo or SunVideo Plus card can be viewed through ShowMe TV including optional video cam-corders, VCRs, antennas, or satellite receivers.
- *Broadcast Video Streams*
 ShowMe TV Receiver can also receive broadcasts of audio and video streams from other systems on a LAN or corporate network running ShowMe TV Transmitter. ShowMe TV Receiver can monitor broadcasts in progress or can also view upcoming program information. Figure 2-3 shows ShowMe TV Receiver displaying a “watch list” of available broadcasts from ShowMe TV Transmitters on the local LAN.



Figure 2-3 ShowMe TV Receiver communicating with ShowMe TV Transmitter

ShowMe TV Receiver can also record broadcast video to disk for later playback or editing. Recording can be done manually or settings can be entered for automatic recording of future broadcasts.

Supported Formats

ShowMe TV supports a video variety of file formats and video CODECs as shown in Table 2-2.

Video CODEC	File Format
MPEG-1	MPEG-1
MPEG-2	MPEG-2
Cell B	QuickTime, AVI
JPEG	QuickTime, AVI
H.261	QuickTime, AVI
Cinepak	QuickTime
RLE	QuickTime
NA (audio)	Sun .au, WAV, MP3

Table 2-2 CODECs and file formats supported by ShowMe TV Receiver

The MPEG-1 and MPEG-2 CODECs are optimized to run on the Sun Ray 1 enterprise appliance. Though the non-MPEG CODECS will run on the appliance, their performance results will vary significantly depending on the CODEC and installation/configuration.

ShowMe TV Transmitter

The ShowMe TV Transmitter broadcasts audio and video from either a file or from input that comes from a standard tuner, camera, or VCR through a SunVideo (SBus) or SunVideo Plus (PCI) video capture card. Audio input alone can also be captured by using either the microphone or line-in ports on a Sun workstation. ShowMe TV Transmitter is typically run on a system distinct from the Sun Ray enterprise server as was shown in Figure 2-1.

The ShowMe TV Transmitter uses the hardware compression capabilities of the SunVideo Plus (or SunVideo) board to compress the raw NTSC or PAL video input, decreasing the impact of video streaming on network traffic.

ShowMe TV Transmitter broadcasts are either open to everyone on the network or can be closed to a specified viewing audience. Figure 2-4 illustrates the main ShowMe TV Transmitter GUI.



Figure 2-4 ShowMe TV Transmitter window

In addition to using a SunVideo or SunVideo Plus card as a video source, ShowMe TV Transmitter can also obtain its compressed video stream from a pre-recorded media file. Supported CODECs and file formats are listed in Table 2-3.

Video CODEC	File Format
Cell B	QuickTime, AVI
JPEG	QuickTime, AVI
H.261	QuickTime, AVI
N/A (audio)	Sun .au, WAV

Table 2-3 CODECs and file formats supported by ShowMe TV Transmitter

RealPlayer 5.0 and G2

RealNetworks, Inc. provides a number of tools that work with their proprietary RealAudio/RealVideo formats. The RealNetworks solutions are ideal for providing low frame-rate streaming audio and video over the Internet where bandwidth restrictions prohibit other solutions. Many news and information Web sites and other information providers now provide RealAudio and RealVideo broadcasts available for playing on demand. The RealPlayer 5.0 GUI is shown in Figure 2-5.

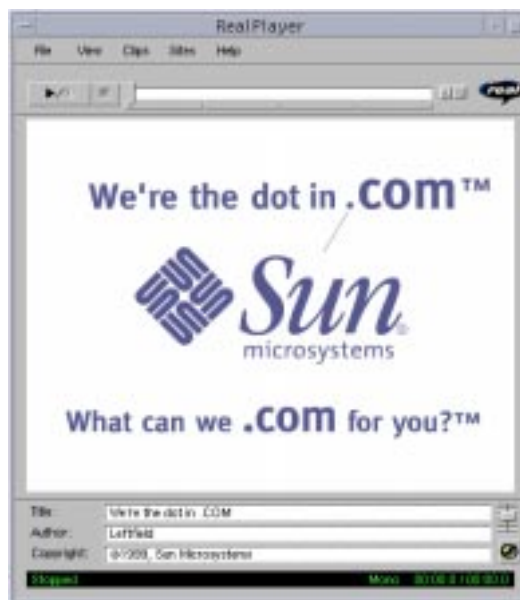


Figure 2-5 The RealPlayer 5.0 GUI

For Sun Ray 1 enterprise appliance deployments, the RealPlayer 5.0 or G2 client is installed on the Sun Ray enterprise server as shown in Figure 2-6. A separate copy of the RealPlayer client runs on behalf of each appliance user displaying video or listening to audio.

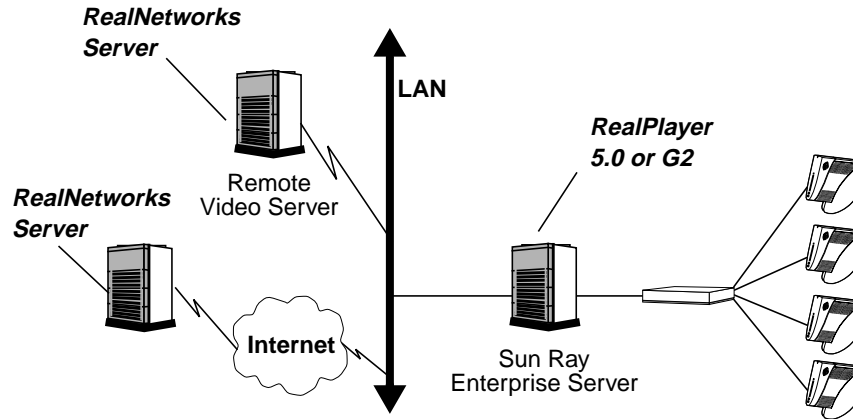


Figure 2-6 Playing low bit-rate video over a low-bandwidth connection

Recommended Media Player Configuration

Sun recommends the ShowMe TV Receiver as the primary media player on the Sun Ray 1 enterprise appliance because of the wide range of media types that it supports. In addition to ShowMe TV Receiver, the RealNetworks Real Player 5.0 or G2 for Solaris can be configured to handle the proprietary RealNetworks streaming protocol for low-bitrate Internet streaming video.

Configuring ShowMe TV

The version of ShowMe TV 1.3 currently available from Sun's web page has been optimized to display full frame-rate MPEG video on the Sun Ray 1 enterprise appliance. Earlier versions of ShowMe TV 1.3 (obtained prior to September 15, 1999) may exhibit slower frame-rates for MPEG video when displaying to the Sun Ray 1 enterprise appliance. The latest version of patch number 108127 should be applied to all earlier versions of ShowMe TV 1.3 (Copies of ShowMe TV 1.3 downloaded after September 15, 1999 contain the required patch).

Of course, video display performance is ultimately subject to having sufficient computational resources on the Sun Ray enterprise server. More information on server sizing is provided in chapter 3 under *Sizing Sun Ray Enterprise Servers for Multimedia*.

Using ShowMe TV

To play a movie file with ShowMe TV, the user specifies the file to load either by using the graphical user interface or by providing a path to the file as a command line argument. The command line option allows the Receiver to be used in conjunction with Web browsers, shell scripts, and file browsers. For instance, the command would bring up ShowMe TV Receiver and load the content contained in the *democlip.mpeg* file.

```
% showmetv -fileonly democlip.mpeg
```

A variety of command-line options are provided that alter the appearance and behavior of ShowMe TV. For example, using the *-fileonly* option eliminates all but the GUI controls needed to playback a file and the *-nocontrol* option eliminates all GUI controls. More information on ShowMe TV GUI options can be found in Sun's ShowMe TV white paper.

Integrating ShowMe TV with a Web Browser or Mail Reader

Setting ShowMe TV to be the default media player for a Web browser or MIME-based mail reader is typically a matter of adding the appropriate ShowMe TV command lines to a configuration file. For example, to configure Netscape Navigator to use the ShowMe TV Receiver as the default player for MPEG, QuickTime, and AVI media files, the following lines should be added to the user's *\$HOME/.mailcap* file:

```
video/mpeg; showmetv -fileonly %s  
video/quicktime; showmetv -fileonly %s  
video/x-msvideo; showmetv -fileonly %s
```

Alternately, most users will want to customize Netscape Navigator through its *applications preferences* GUI. Once these changes are made, Netscape Navigator will automatically start ShowMe TV Receiver whenever MPEG, QuickTime, or AVI media files are downloaded.

Configuring ShowMe TV with CDE

ShowMe TV Receiver can also be configured as the MPEG, QuickTime, or AVI file player for a user's appliance desktop environment (CDE). This approach enables users to view local file system-based media files located in a consistent manner with those accessed through the Web. The Solaris Application Manager offers a convenient *Create Action* GUI which can be used to specify ShowMe TV for key media types.

Alternately, the databases can be edited by hand in the user's *\$HOME/.dt/types/my.dt* and *\$HOME/.dt/types/actionname.dt* configuration files. System-wide definitions are kept in the */usr/dt/appconfig/types/C/datatypes.dt* file. Users need to log off and re-enter CDE in order for the changes to take effect.

An example data type definition follows for QuickTime files. First, the attributes for the datatype "QT" are established, and then recognized file extensions for QuickTime files (.qt and .QT) are assigned:

```
DATA_ATTRIBUTES QT
{
    ACTIONS          Open
    ICON             Dtqt
    NAME_TEMPLATE    %s.qt
    MIME_TYPE        video/quicktime
    DESCRIPTION      This file contains a graphics image movie \
                    in QuickTime Interchange File Format. Its data \
                    type is named QuickTime. QuickTime files have \
                    names ending with .QT, .qt.
    TYPE_LABEL       QT
}
DATA_CRITERIA QT1
{
    DATA_ATTRIBUTES_NAME QT
    MODE              f
    NAME_PATTERN      *.QT
}
DATA_CRITERIA QT2
{
    DATA_ATTRIBUTES_NAME QT
    MODE              f
    NAME_PATTERN      *.qt
}
```

Next, an action is defined which assigns ShowMe TV Receiver as the application registered to operate on the defined “QT” data type:

```
Action Open
{
    LABEL           Open
    ARG_TYPE        QT
    TYPE            COMMAND
    WINDOW_TYPE     NO_STDIO
    EXEC_STRING     showmetv -fileonly "%Arg_1%"
    DESCRIPTION     Use ShowMe TV to play QuickTime movies.
}
```

Similar definitions can be generated for MPEG and AVI files using those names as identifiers.

Configuring RealPlayer 5.0/G2

In addition to the ShowMe TV receiver, The RealNetworks RealPlayer 5.0 or RealPlayer G2 can be configured with a browser to enable automatic viewing of RealAudio/Video files. The following procedure outlines configuring RealPlayer 5.0 or G2 for use with the Sun Ray 1 enterprise appliance:

1. Download and extract RealPlayer software

Download the RealPlayer tar file from the RealNetworks web site at <http://www.real.com>, then decompress and extract the RealPlayer distribution into the desired directory. Sample UNIX commands follow:

```
% cd /home/user/realplayer
% gunzip rv50_sol25ultra.tar.gz
% tar xvf rv50_sol25ultra.tar
```

2. Setting environment variables

Environment variables need to be set depending on which version of RealPlayer is being installed. For RealPlayer 5.0, set the `LD_LIBRARY_PATH` environment variable to point to the directory where the RealPlayer distribution was loaded. At a UNIX command line, enter:

```
% setenv LD_LIBRARY_PATH /home/user/rvplayer
```

To work around an audio bug in RealPlayer 5.0, audio-preload software needs to be used. For SunRay1 release 1.0 software, enter the following:

```
% unsetenv AUDIODEV
```

For RealPlayer G2, the `LD_LIBRARY_PATH` environment variables does not need to be set. Instead, set the `REALPLAYER_HOME` environment variable to the location of the RealPlayer installation as follows:

```
% setenv REALPLAYER_HOME /home/user/rvplayer
```

3. Configuring RealPlayer to work with a browser

Test RealPlayer manually by entering the following at the command line:

```
% cd /home/user/rvplayer
```

```
% ./rvplayer welcome.rm
```

RealPlayer can then be configured to play automatically by editing the browser's application preferences (Figure 2-7) and restarting the browser.

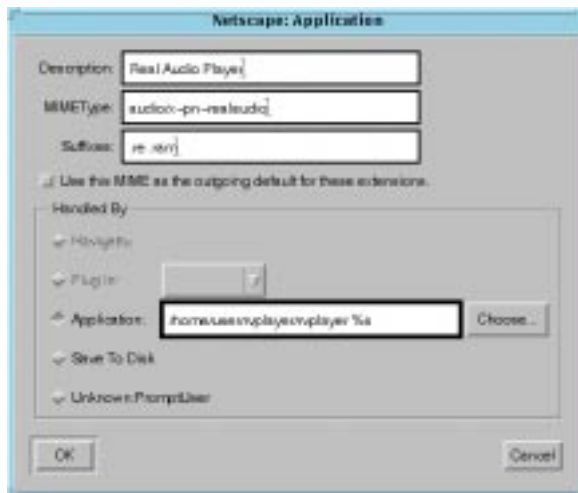


Figure 2-7 Configuring Netscape's application preferences for RealPlayer

Deploying Multimedia in a Hot Desk Environment



In the Hot Desk environment, local application processing for all of the workgroup's appliances takes place on the Sun Ray enterprise server — including execution of multimedia applications. Sun Ray enterprise servers must be sized correctly to enable high performance multimedia applications without compromising interactive performance for other appliance users.

Multimedia applications can be both processor-, memory-, and bandwidth-intensive since they generate a large quantity of data and perform computationally intensive operations like software decompression of video. In addition, some multimedia applications assume a single-user desktop environment and may need modification to operate in a multi-user environment.

This section provides information for sizing and managing servers to enable good performance for appliance users. Information is also provided for developing multimedia applications for the Sun Ray 1 enterprise appliance.

Sizing Sun Ray Enterprise Servers for Multimedia

Sun Ray enterprise server sizing is dependent on the impact of the workgroup's applications (both multimedia and otherwise) on CPU, memory, and interconnect resources along with an understanding of both workgroup and individual activity levels. The actual multimedia applications and the degree of their usage must be taken into account. For instance, a workgroup deployed in faculty offices on a college campus might only see occasional use of multimedia whereas a financial services company running a video feed on

every appliance would have very different needs. Workgroups with significant multimedia needs will need to consider Sun Ray enterprise server resources for multimedia applications above those needed to run the workgroup's desktop applications and environment.

Understanding the processing needs of a Sun Ray enterprise server that will run video applications such as ShowMe TV™ Receiver is entirely dependent on the demands placed on it by appliance users. Unless resource needs are very clearly understood and provided for, Sun recommends limiting each appliance to one media application at a time. More information on sizing Sun Ray enterprise servers for specific applications and mixed workgroup environments can be found in the Sun white paper *Sizing Sun Ray Enterprise Servers*.

Configuring CPUs

The CPU resources needed to decode and display video vary widely with the type and quality of the video sources being decoded. For instance, MPEG files can be encoded at widely differing rates. Decoding a 1.5 Mbps MPEG-1 file typically requires one third of the resources of a 300 MHz UltraSPARC processor. Decoding a 6 Mbps MPEG-2 file at twenty four frames per second typically requires the resources of an entire 300 MHz processor!

As a real-world example, assume that a maximum of eight appliances in a given workgroup were expected to be decoding and displaying 1.5 Mbps MPEG-1 video files simultaneously. Since each MPEG-1 stream is expected to require one third of a CPU, three additional 300 Mhz UltraSPARC processors should be added to the base configuration needed to support basic appliance functionality and applications. If the eight appliance users were viewing 6 Mbps MPEG-2 video files, as many as eight additional 300 Mhz processors would be required. These numbers are offset by the degree to which the server is under- or over-configured for the other workgroup services it provides.

Multicast Video CPU Resources

When sizing Sun Ray enterprise servers for multimedia, it is also important to understand the ramifications of multicast video in a Hot Desk environment. Multicasting is a technique used by applications like the ShowMe TV Transmitter to send network video streams only to the

workstations that either request a signal or are permitted to see it. Multicasting saves on network bandwidth since only the interested stations receive the streaming video traffic.

In the Hot Desk environment, the Sun Ray enterprise server still receives a single multicast stream independent of the number of appliance users viewing a given stream. However, a separate viewer/decoder client application runs on the Sun Ray enterprise server on behalf of each appliance user who wishes to view the video or audio stream. For example, eight appliance users signed up for the same scheduled ShowMe TV Transmitter multicast video presentation will cause eight video decode processes (ShowMe TV Receivers) to run on the Sun Ray enterprise server — all working to decode the same video signal.

Memory Resources

Memory is probably the most important resource in a Sun Ray enterprise server. A server which has run out of CPU resources will typically degrade gracefully whereas a system that is memory starved and has begun thrashing can significantly effect performance. The shared-memory capabilities of the Solaris Operating Environment help greatly to reduce overall memory requirements in a multi-user environment such as that provided by the Sun Ray enterprise server.

The minimum rule-of-thumb for configuring memory on Sun Ray enterprise servers is to provide an additional 40 MB of server memory for each *active* appliance user — yielding a memory environment roughly equivalent to a dedicated workstation with 64 MB of memory. Providing 40 MB per user enables the user's main active application to reside in physical memory but user's inactive applications may still be swapped out. To approximate the memory resources of a dedicated workstation equipped with 128 MB of memory, the Sun Ray enterprise server should be equipped with an extra 100 MB of memory for each active user.

ShowMe TV Receiver Memory Calculation

Beyond basic guidelines, memory requirements for individual multimedia applications can be easily calculated. For example, the ShowMe TV 1.3 Receiver requires approximately 30 MB of virtual memory in order to run and presents a resident set size of 12 MB. Of the resident set, 8 MB is required in private memory and 4 MB is shared. The first instance of ShowMe TV 1.3

Receiver allocates 12 MB of memory. Each additional instance only needs to allocate its own 8 MB private memory segment. If other appliance user application demands are low, 40 MB per active user would be a reasonable configuration. However, if appliance users were already exhausting existing memory resources, the addition of eight *active* ShowMe TV users would require the addition of at least 68 MB of additional memory in the Sun Ray enterprise server.

Interconnect Requirements for Multimedia

Bandwidth requirements for the interconnect must also be taken into account for multimedia applications. The Hot Desk protocol works by sending only pixels that change over the interconnect to the appliance. Because displaying video causes a large number of pixels to change, significant interconnect resources are needed.

Displaying a 320x240 MPEG-1 video window typically generates 10 to 12 Mbps of interconnect traffic yielding a recommended ratio of eight active video clients per 100 Mbps of interconnect bandwidth (allowing for other application bandwidth needs). For instance, ten simultaneous video users would easily saturate a server's 100 Mbps interconnect connection, potentially causing interactivity problems for other users. A Gigabit Ethernet interface in the server would be required to serve this number of video users and allow for future expandability. Gigabit Ethernet would also be required to serve appliance users who wish to display MPEG-2 video — a single 640x240 MPEG-2 window generates approximately 45 Mbps of interconnect traffic.

In addition to configuring enough bandwidth to support each appliance in the server interface, sufficient bandwidth must also be provided through the switch back-planes and the trunk connection to the Sun Ray enterprise server. For more information on interconnect configuration, see the Sun white paper *Deploying the Hot Desk Architecture*.

Solaris Resource Manager[™]

Sun's Solaris Resource Manager can be an extremely effective tool for deploying properly-configured shared server environments — such as those where multimedia applications run on the Sun Ray enterprise server. Beyond simple time-sharing schemes, Sun's Solaris Resource Manager provides fine-grained, hierarchical control of system resources for users, groups, and

applications, allowing an equitable distribution of computational resources within a given system. Solaris Resource Manager is particularly effective for use in Sun Ray enterprise servers which run multimedia applications since it can prevent server resources from being usurped by rogue processes, abusive users, and large computational loads.

Solaris Resource Manager is recommended for Sun Ray enterprise servers because of its ability to provide minimum levels of interactive performance for users sitting at desktop appliances. Solaris Resource Manager can help ensure that the computational load produced by media players doesn't compromise interactive performance for all appliance users in the workgroup.

- *CPU Resources*

Solaris Resource Manager employs a fair-share scheduling system to allocate CPU resources. Better than a simple percentage-based system, it allows administrators to assign "shares" of the system to users or groups of users. Because of its hierarchical design, individual users within a group can receive larger or smaller numbers of shares depending on their needs. For example, multimedia users might receive a larger number of shares to reflect their greater computational requirements. The assigned shares represent a minimum computational resource which is available to a given user or group of users.

Because Solaris Resource Manager implements a minimum allocation scheme, unused system capacity is free to be reallocated to other users and applications. When applications are idle or are consuming less than their designated CPU allotment, excess computational capacity is automatically available for use by other applications — computing resources aren't wasted, increasing resource utilization on Sun Ray enterprise servers.

- *Virtual Memory*

On Sun Ray enterprise servers, Solaris Resource Manager is useful for intercepting unforeseen or runaway applications which place excessive demands on the server's virtual memory resources. Solaris Resource Manager calculates and limits the amount of virtual memory used by all processes and can also impose limits on per-process virtual memory. For example, an application with a memory leak that constantly requests memory without freeing it would be prevented from starving other processes and users.

- *Number of Processes*
Solaris Resource Manager can also be used to impose limits on the number of processes that an individual user may run — protecting the Sun Ray enterprise server against intentionally or accidentally abusive users. Process limits can be applied to groups of users or can be set for individual users by the system administrator. Users with a justifiable need for more resources can be accommodated while the system remains in a balanced state.
- *Accounting*
Solaris Resource Manager tracks CPU, virtual memory, numbers of processes, and numbers of logins. This level of accounting allows system administrators to monitor and fine-tune the Sun Ray enterprise server based on actual usage levels. Tuning might include adding more memory or additional processors based on increased application usage on the system.

Developing Multimedia Applications

The Java Media Framework (JMF) version 2.0 is the recommended API for multimedia applications that will be used on the Sun Ray 1 enterprise appliance. As of this writing, JMF 2.0 is currently in BETA-release and is expected to support the Sun Ray 1 enterprise appliance by the end of calendar year 1999.

For applications which require audio-only support, developers can also use the standard Solaris *libaudio* API as described below.

Java Media Framework 2.0

In the past, multimedia programming has required low-level coding in order to take advantage of unique multimedia interfaces. The Java Media Framework enables developers to target a wide range of devices such as desktop computers, appliances, set-top boxes, and hand-held devices without writing “throw-away” code that uses proprietary interfaces.

JMF 2.0 enables Web-based multi-media solutions that offer both capture and playback in any Java Compatible™ environment, independent of platform. JMF 2.0 is protocol and content-neutral and supports a wide range of file formats, popular streaming media protocols, and video on demand.

This protocol-neutral stance, allows new technology to move quickly into the JMF. For example, Sun has recently entered into a licensing agreement with RealNetworks to provide a Java Media wrapper library on top of RealNetworks *G2 Toolkit*. Figure 3-1 shows how JMF 2.0 enables platform-independent Java technology applications that avoid the details of native, platform-specific code.

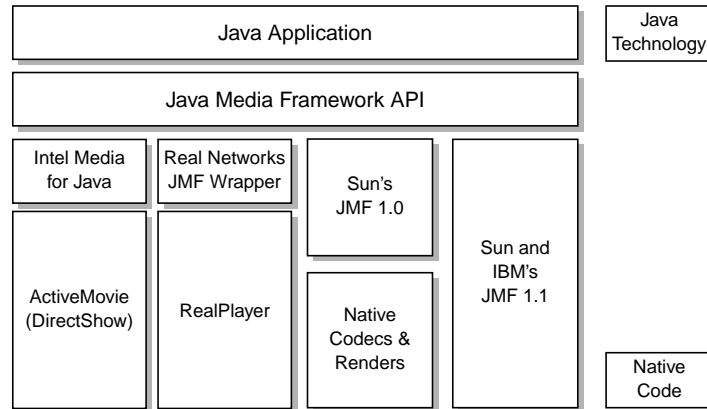


Figure 3-1 The JMF 2.0 API isolates programmers from platform-specific issues

JMF 2.0 opens up the “black box” of media processing and playback and allows considerable flexibility. For example, developers can use the Media Processor API to plug in customized optimizations, CODECs, renderers, or other effects. Figure 3-2 illustrates the basic object components of JMF 2.0.

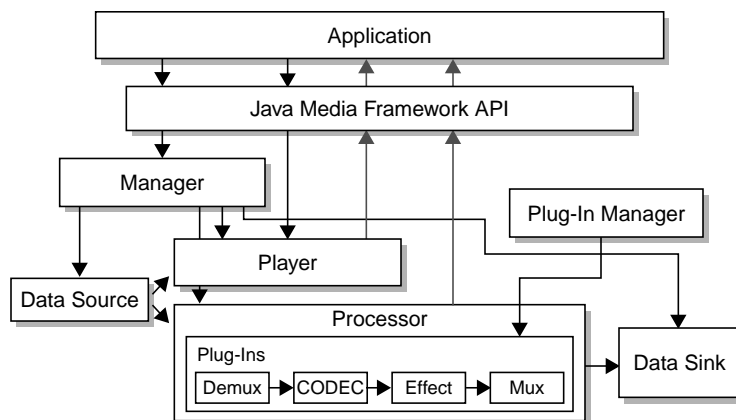


Figure 3-2 JMF 2.0 objects allow for considerable customization

Java Media Player

The Java Media Player API is a component of JMF 2.0 that provides a versatile, platform-neutral framework for building media players that can be integrated into Web pages or Java technology applications. Media sources can range from local or Web-based file storage to Video on Demand (VOD) servers. Many media content types are supported including MPEG-1, MPEG-2, QuickTime, AVI, WAV, AU, and MIDI (see <http://www.java.sun.com> for a complete listing)

Figure 3-3 illustrates two instances of a Java Media Player, one playing audio, and the other playing a video file.



Figure 3-3 Java Media Player GUIs for video and audio playback

Solaris libaudio

Applications which only need audio support can be written using the existing Solaris *libaudio* API. Developers should remember that applications running on behalf of Sun Ray 1 enterprise appliance users operate in a multi-user environment on the Sun Ray enterprise server. As a result, audio applications should avoid referring to the system-specific */dev/audio* interface but should instead use the session-specific *AUDIODEV* environment variable.

Sun Ray enterprise server software automatically sets the *AUDIODEV* environment variable to point to the virtual device driver representing the audio interface on the Sun Ray 1 enterprise appliance where the user's session is displayed. Sun Ray enterprise server software simply follows the session when the user moves his active session from one Sun Ray appliance to another using the smart card mobility feature.



References

Sun Microsystems posts product information in the form of data sheets, specifications, and white papers on its Internet World Wide Web page at: <http://www.sun.com>.

Look for abstracts on these and other Sun technology white papers:

Sun Ray 1 Enterprise Appliance Overview and Technical Brief, White Paper, Sun Microsystems.

Assessing Scalability of the Sun Ray 1 Enterprise Appliance, White Paper, Sun Microsystems.

Deploying the Sun Ray Hot Desk Architecture, White Paper, Sun Microsystems.

Sizing Sun Ray Enterprise Servers, White Paper, Sun Microsystems.

Integrating Hot Desk Technology with Windows NT, White Paper, Sun Microsystems.

ShowMe TV, White Paper, Sun Microsystems.



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