



**Mac OS X Server
QuickTime
Streaming Server 5.0
Administration**

For Mac OS X Server Version 10.3 or Later



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Welcome to QuickTime Streaming

Learn what's new in this version of QuickTime Streaming Server and about the QuickTime suite of products.

Mac OS X Server version 10.3 ("Panther") includes QuickTime Streaming Server (QTSS) version 5.0 in its suite of services. QTSS comes preinstalled on Apple server hardware.

QTSS is similar in design and configuration to Apache, the popular web server software that is also included in Mac OS X Server. If you have experience working with Apache, QTSS will seem familiar.

If you have previously administered a QuickTime Streaming Server using the web-based application, Web Admin, you can continue to do so. Web Admin is useful for administering a streaming server remotely or from non-Mac computers. (For more information, see "Using the Web-Based Application to Manage QuickTime Streaming" on page 24.) Server Admin for Mac OS X Server version 10.3 includes a user-friendly interface for accomplishing the tasks you performed with Web Admin.

What's New in QuickTime Streaming Server (QTSS) for Mac OS X Server Version 10.3

Built in to Mac OS X Server version 10.3 is QuickTime Streaming Server 5, the next generation of Apple's industrial-strength standards-based streaming server. With a focus on usability and further integration with Mac OS X Server, this version of QTSS delivers a number of enhancements:

- **New server administration** QTSS administration has been redesigned and is now integrated into Mac OS X Server Admin. You can customize streaming server settings—including binding QTSS to a specific IP address, monitoring server activity, setting up relays, and viewing log files—using the same interface as the other Mac OS X Server services. (The web-based application is still available for administering QTSS.)
You can run Server Admin on Mac OS X Server version 10.3 or later, or on any Mac running Mac OS X version 10.3 or later. (See “Mac OS X Server Getting Started for Version 10.3 or Later” for information about installing administrator software on a desktop system.) You can use Mac OS X Server version 10.3 to monitor computers running Mac OS X version 10.2 or later.
- **Home directory streaming** QTSS now supports streaming movies from users' home directories. Users can stream their own movies by placing hinted files in the Sites/Streaming folder in their home directory; viewers can access the movies via a URL similar to `rtsp://myserver/~user/movie.mov`. System administrators no longer have to move user files to the main media directory; movies are ready for streaming as soon as they are copied. With home directory support, you can also implement account-based streaming to specify disk space for local streaming folders (using Workgroup Manager).
- **QuickTime Streaming Server Publisher** Use this new, easy-to-use application to manage all of your QuickTime media, both streaming and progressive download, on Mac OS X Server version 10.3. With the ability to run locally on the server or remotely from any Mac running Mac OS X version 10.2 or later, QTSS Publisher fits the needs of web masters and content creators alike. With QTSS Publisher you can easily:
 - Upload media to Mac OS X Server “Panther.”
 - Prepare content for streaming. QTSS Publisher automatically applies hint tracks to unhinted movies, ensuring the reliability of your streams.
 - Embed media into a webpage. QTSS Publisher generates HTML you can copy and paste into an existing webpage.
 - Annotate movies. Add the appropriate title, credits, and copyright information to your media.
 - Generate webpages. QTSS provides templates you can use to turn your content into attractive webpages.

- Create playlists. Create MP3, MP4, and movie server-side playlists with the ease of drag and drop. The iTunes-like interface makes it easier than ever to turn your streaming server into an Internet radio station or to give your viewers a simulated live experience with prerecorded QuickTime movies.
- Update playlists in real time. Add media to or rearrange items in a playlist without interrupting your audience.

Other features of QTSS include:

- **Native MPEG-4 streaming** Stream ISO-compliant, hinted MPEG-4 files to any ISO-compliant MPEG-4 player, without converting them to .mov files.
- **MP3 audio streaming** Create your own Internet radio station. You can serve standard MP3 files using Icecast-compatible protocols over http. Build a playlist of MP3 files and serve them to MP3 clients such as iTunes, SoundJam, and WinAmp for a simulated live experience.
- **Skip protection** Apple skip-protection technology—a collection of quality-of-service features—takes advantage of excess available bandwidth to buffer ahead data locally to the client.
- **Instant-On** Viewers with a broadband connection watching a streaming video with QuickTime 6 and later will benefit from Instant-On, an advance that provides enhanced overbuffering of data, resulting in dramatically reduced buffer time. With Instant-On, broadband users can also “scrub” forward and back with the time slider through an on-demand media stream and have playback updated instantly.
- **Authentication** Two types of authentication, digest and basic, let you control access to protected media.
- **Server-side playlists** You can stream a set of media files as if it were a live broadcast. This can be ideal for creating and managing a virtual radio or television station.
- **Relay support** You can easily set up several layers of servers to broadcast streams to a virtually unlimited number of clients.

The QuickTime Suite of Products

The QuickTime suite of products is unique in that it provides all the software you need to produce, transmit, and receive streamed media. Each product is designed from start to finish for optimum compatibility with all the other components in the suite.

The QuickTime suite comprises the following products:

- **QuickTime Player** The free QuickTime Player is an easy-to-use application for playing, interacting with, or viewing any video, audio, virtual reality (VR), or graphics file that is compatible with QuickTime.
- **QuickTime Pro** The powerful “pro” version of QuickTime Player provides an abundance of media authoring capabilities. You can create slideshows, encode complex video and audio, edit movie tracks, create hint tracks, create media skins, and assemble hundreds of different media types into one movie file.
- **QuickTime Streaming Server** Included with Mac OS X Server, QuickTime Streaming Server (QTSS) software enables you to deliver media in real time or on demand over the Internet with no per-stream license fee. Users see streamed media as soon as it reaches the computer; they don’t have to wait to download files.
- **Darwin Streaming Server** This free, open-source version of QuickTime Streaming Server supports popular enterprise platforms such as Linux, Solaris, Windows NT/2000, and Windows Server 2003. It is available for download in source or binary form and can be ported to other platforms by modifying a few platform-specific source files.
- **QuickTime Broadcaster** With QuickTime Broadcaster, you can produce a live broadcast event that anyone with an Internet connection can “attend” in real time. Combining the power of QuickTime with legendary Apple ease of use, QuickTime Broadcaster is included with Mac OS X Server (and is also available as a free download from the Apple website). QuickTime Broadcaster supports most codecs supported by QuickTime.

For More Information

Additional QuickTime streaming resources, including classes, mailing lists, and frequently asked questions (FAQs), are available. For more information, visit the QuickTime Streaming Server website at <http://www.apple.com/quicktime/qtss>.

- **The QuickTime Streaming Server products** page provides the latest information on key features, recent downloads, and minimum requirements, with links to additional support pages:
<http://www.apple.com/quicktime/products/qtss/>
- **The Mac OS X Server AppleCare support** page provides links to many useful Knowledge Base articles on all of the services that ship with Mac OS X Server, including QuickTime Streaming Server and Apache. It also provides links to downloadable PDFs of “Getting Started With Mac OS X Server” and “Mac OS X Server Administrator’s Guide”:
<http://www.info.apple.com/usen/macosexserver/>
- **The QuickTime Streaming course** takes an in-depth look at QuickTime Streaming Server by teaching system administrators and QuickTime authors the details behind real-time streaming. For more information, see the Resources section of the QuickTime Streaming Server product page:
<http://www.apple.com/quicktime/products/qtss/>
- **The best-selling book “QuickTime for the Web”** is an excellent hands-on guide. This Apple QuickTime Developer Series book explains how to integrate video, recorded sound, Flash animation, virtual reality, MIDI, text, still images, live streams, games, and user interactivity into a website. The companion CD-ROM includes QuickTime Pro and a full set of development tools for both Windows and Macintosh. Published by Morgan Kaufmann, this award-winning book is featured with other useful titles on the QuickTime instructional website:
http://www.apple.com/quicktime/tools_tips/books.html
- **The Apple Discussions area of the AppleCare support website** provides a location for discussing QuickTime Streaming Server issues. Navigate to the Mac OS X Server section and then to QuickTime Streaming Server. You can post messages and view posts from other registered users:
<http://discussions.info.apple.com/>
- Apple hosts many **mailing lists**, including lists for streaming server users and developers. Actively followed by Apple engineers, these lists are an excellent resource for novice and advanced users alike. To subscribe, click “Lists hosted on this site,” then click “streaming-server users” or “streaming-server developers,” and sign up. You can also search through the archives of both lists:
<http://lists.apple.com>
- **The QuickTime Services website** lists streaming service providers:
http://www.apple.com/quicktime/tools_tips/services/

- If you are an advanced user, you may want to review the Request for Comments (RFC) memorandums on the RTP and RTSP standards by visiting the **Internet Engineering Task Force (IETF) website**:
<http://www.ietf.org/rfc/rfc1889.txt> (RTP)
<http://www.ietf.org/rfc/rfc2326.txt> (RTSP)
- **The public source website** provides access to Darwin Streaming Server source code and developer information. Be sure to read the FAQs linked from this page:
<http://developer.apple.com/darwin/projects/streaming/>

Before you set up your QuickTime Streaming Server, learn what streaming is all about.

What Is Streaming?

“Streaming” is the delivery of media, such as movies and live presentations, over a network in real time. A computer (a streaming server) sends the media to another computer (a client computer), which plays the media as it is delivered. With streaming, no files are downloaded to the viewer’s hard disk. You can stream media at various rates, from modem to broadband.

Just as you need a web server to host a website, to send streams over the Internet or a local network, you need a streaming server, which transmits video and audio streams on request. For small audiences, the same computer can run web server software, mail server software, and streaming server software. For larger audiences, one or more computers are typically dedicated as streaming servers.

When a user requests a stream (using client software such as QuickTime Player), the request is handled using Real-Time Streaming Protocol (RTSP). Streams are sent using Real-Time Transport Protocol (RTP). A streaming server can create streams from QuickTime movies stored on a disk, and can transmit live streams to which it has access.

With QuickTime Streaming Server (QTSS) software, you can deliver:

- Broadcasts of live events in real time
- Video on demand
- Playlists of prerecorded content

Live Versus On-Demand Delivery

Real-time streaming media is delivered in two ways: live and on demand. QuickTime Streaming Server delivers both.

Live events, such as concerts, speeches, and lectures, are commonly streamed over the Internet as they happen, using broadcasting software such as QuickTime Broadcaster. Broadcasting software encodes a live source, such as video from a camera, in real time and delivers the resulting stream to the server. The server then serves, or “reflects,” the live stream to clients. Regardless of when people connect to the stream, everyone sees the same point in the stream at the same time. You can simulate a live experience with recorded content by broadcasting from an archive source such as a tape deck or by creating playlists of media on the server.

With on-demand delivery, such as a movie or an archived lecture, each customer initiates the stream from the beginning, so no one comes in “late” to the stream. No broadcasting software is required for on-demand delivery.

Progressive Download (HTTP) Delivery Versus Streaming (RTP/RTSP) Delivery

Progressive download (sometimes called “Fast Start”) is a method of delivering a movie over the Internet so that it can start playing before its file is fully downloaded. With progressive download, a movie has all the data needed to start playing it at the beginning of the file, so QuickTime can start to play the movie as soon as the first part of the file is transferred. Unlike streaming, where you can watch movies without downloading any files, Fast Start movies are actually downloaded to the viewer’s computer.

A Fast Start movie can be self-contained, so that all the data is stored inside the movie itself, or it can include pointers to data located on the Internet. You can watch progressive download movies in a web browser using the QuickTime plug-in or using QuickTime Player.

You can create progressive download movies for viewers with various connection speeds (called “reference movies”) and a streaming movie for viewers with the fastest connections.

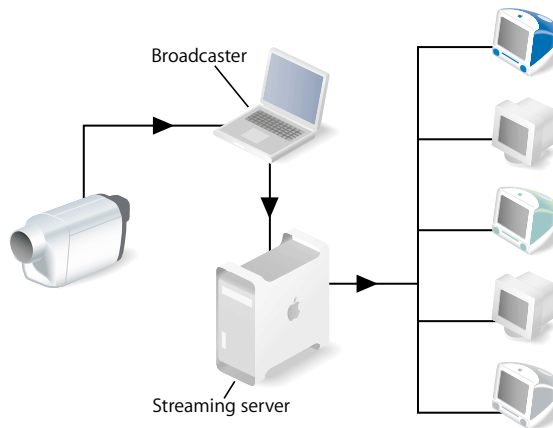
Instant-On Streaming

Viewers watching a streaming video with QuickTime 6 and later will benefit from Instant-On, an advance in Apple skip-protection technology that dramatically reduces buffer, or wait, time for an instantaneous viewing experience. Viewers can click around or scrub video as if it were on their hard disks.

Users must have a broadband connection to experience Instant-On streaming. The responsiveness of Instant-On streaming is affected by available bandwidth and size, or data rate, of the content. Responsiveness can also be affected by the codec used.

Simple Setup for Live Video

The illustration below shows a setup for streaming live video and audio. (Most video cameras have a built-in microphone.) You can stream audio only using a microphone, mixer, and other appropriate audio equipment.



A PowerBook G4 with QuickTime Broadcaster software captures and encodes video and audio. The encoded signal is sent over an Internet Protocol (IP) network to a server computer running QuickTime Streaming Server (QTSS) software. QTSS on the server computer sends the signal over the Internet or a local network to client computers that request the stream using QuickTime Player.

You can also run QuickTime Broadcaster and QTSS on the same computer. If you are broadcasting to a large audience (more than, say, 100), however, Apple recommends that you run QuickTime Broadcaster and QTSS on separate computers.

Ways to Receive Streamed Media

When you watch and listen to cable or over-the-air media transmissions on television or radio, the cable or electromagnetic wavelengths used are dedicated to that transmission. Those transmissions are mostly uncompressed and consume large amounts of transmission bandwidth. It's not a problem, because they don't have to compete with other transmissions within the frequency over which they're broadcast.

When you send that same media over the Internet, the bandwidth used is no longer dedicated to only that transmission stream. The media now has to share extremely limited bandwidth with thousands, potentially millions, of other transmissions traveling back and forth over the Internet. Therefore, before multimedia is sent over the Internet, it is encoded and compressed for transmission. The resulting files are saved in a specific location, and streaming server software such as QuickTime Streaming Server sends the media over the Internet to client computers.

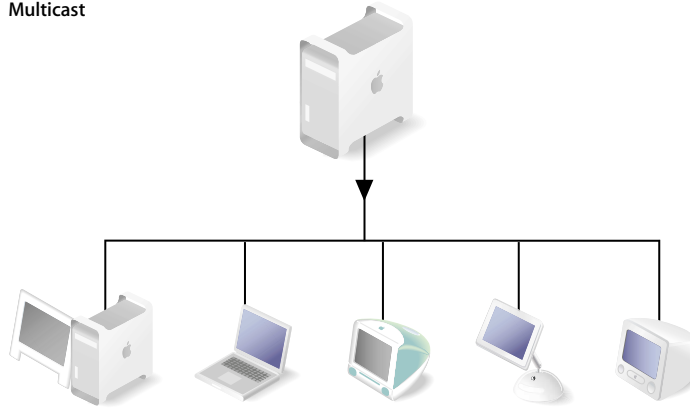
Macintosh and Windows users can view streamed media with QuickTime Player (available free on the Apple website) or any other application that supports QuickTime or standard MPEG-4 files. You can also set up streams that users can view from within a web browser (they must have the QuickTime plug-in installed). When a user starts to play streamed media on a webpage, the QuickTime plug-in sends a request to the streaming server, and the server responds by sending the multimedia content to the client computer. You specify on the webpage what content to send to the client—a QuickTime movie in a specified directory, a live broadcast, or a playlist on the streaming server.

Multicast Versus Unicast

QuickTime Streaming Server supports both multicast and unicast network transport to deliver streaming media.

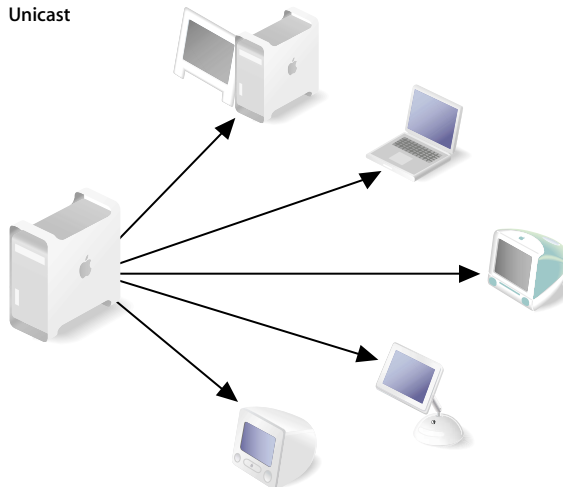
In a multicast, a single stream is shared among the clients (see illustration below). Each client “tunes in” to the stream much as a radio tunes in to an FM broadcast. This technique reduces network congestion, but it requires a network that either has access to the multicast backbone (the “Mbone”) for content distributed over the Internet, or is multicast enabled for content distributed within a contained private network.

Multicast



In a unicast, each client initiates its own stream, resulting in the generation of many one-to-one connections between client and server (see illustration below). Many clients connected via unicast to a stream in a local network can result in heavy network traffic. But this technique is the most reliable for delivery over the Internet since no special transport support is required.

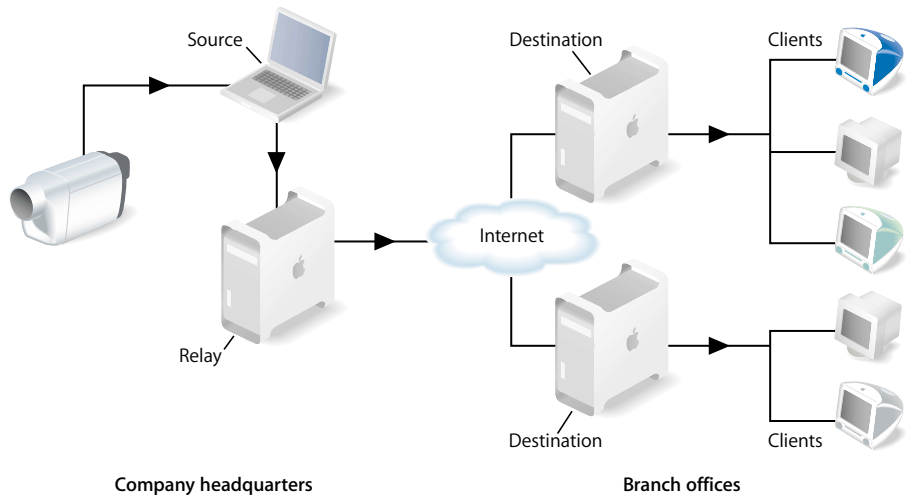
Unicast



Relays

A relay receives an incoming stream and then forwards that stream to one or more streaming servers. Relays can reduce Internet bandwidth consumption and are useful for broadcasts with numerous viewers in different locations.

For example, a company can broadcast a CEO's presentation by relaying it from headquarters to branch offices.



The CEO's presentation is captured live with a video camera. The audio and video from the camera are encoded using QuickTime Broadcaster on a Mac OS X computer. A Mac OS X Server computer with QuickTime Streaming Server software relays the broadcast over the Internet to destination computers, which serve the company's branch offices. Employees use client computers to tune in to the destination computers to watch the CEO's presentation. With QTSS, the destination computers don't need to be set up; they automatically receive the forwarded broadcast from the relay computer.

For detailed information about setting up relays, see "Setting Up Relay Streams" on page 27.

Setting Up Your QuickTime Streaming Server

2

This chapter is designed to help you quickly get your QuickTime Streaming Server up and running.

The instructions in this chapter assume that you have already installed and performed a basic setup of Mac OS X Server “Panther.” For instructions on setting up Mac OS X Server, see “Mac OS X Server Getting Started for Version 10.3 or Later” (included on the Mac OS X Server installation CD and downloadable at www.apple.com/server/documentation/).

Hardware and Software Requirements for QuickTime Streaming

QuickTime Streaming Server requirements are provided in “Mac OS X Server Getting Started.”

Viewer Computer Requirements

Any computer with QuickTime 4 or later installed can view media streamed by the streaming server. For best results, Apple recommends QuickTime 6 or later.

QuickTime 6 and a broadband Internet connection are required to take advantage of Instant-On using QuickTime Streaming Server 4.1 or later.

Any ISO-compliant MPEG-4 player can view MPEG-4 files. Streaming MP3 playlists can be listened to using iTunes or other compatible streaming MP3 player such as WinAmp.

You can download QuickTime Player software from the QuickTime website at <http://www.apple.com/quicktime>.

Live Broadcasting Requirements

If you want to broadcast live content, you can use QuickTime Broadcaster, which is included and installed with Mac OS X Server. For setup and other information, see the Apple QuickTime Broadcaster webpage (<http://www.apple.com/quicktime/products/broadcaster/>) and QuickTime Broadcaster online help.

You need the following equipment to stream live audio or video:

- Source equipment for audio, video, or both, such as a VCR, video camera, and microphone.
- A computer with QuickTime Broadcaster or other broadcast software (PowerPC G4 recommended for MPEG-4 broadcasting) and a video or audio capture card.

Note: QuickTime Broadcaster supports video capture from most FireWire-equipped sources, including digital video (DV) cameras, some webcams, and DV converter boxes for a fast and easy broadcasting process with professional-quality results.

- 128 MB of RAM (256 MB recommended for professional broadcasting)
- QuickTime 6 or later

Bandwidth Considerations

It's generally not a good idea to connect a streaming server to the Internet or local area network by Digital Subscriber Line (DSL) or cable modem. The server will be severely limited by the relatively small bandwidth of DSL and cable modems for uploading data. In some cases, running a server on a DSL connection may break a DSL service agreement. Consult your DSL or cable modem service provider before setting up the server.

When authoring Real-Time Transport Protocol (RTSP) streams, you'll get best performance if the streams don't exceed 75 percent of anticipated client bandwidth. For example, don't use a rate higher than 21 kilobits per second (Kbps) for a 28 Kbps modem connection. For a typical 56K modem connection, don't use a rate higher than 40Kbps. For a T1 (1500 Kbps) client connection, don't use a rate higher than 1125 Kbps.

Setting Up Your Streaming Server

This section tells you how to set up your streaming server, test your setup, and access media streamed from your server.

To set up your streaming server:

- 1 Open Server Admin.
- 2 In the Computers & Services list, select the computer you want to set up as a QuickTime Streaming Server and make sure you can see all of its services (click the triangle next to the computer if you can't see the services).
- 3 In the Computers & Services list, click QuickTime Streaming.
- 4 Click Start Service.

Testing Your Setup

Sample QuickTime movies are included with QTSS in the default movie folder so you can test the server setup. The sample movies can be viewed from a client computer using QuickTime Player.

Note: The included sample .mp3 file is for use in a streaming MP3 playlist only. It is *not* a hinted QuickTime movie and cannot be streamed on demand via RTSP. For information on preparing MP3 and other prerecorded media for simulated live streaming, see “Preparing Prerecorded Media for Streaming” on page 33.

To test your server setup by viewing a sample movie:

- 1 On another computer, open QuickTime Player.
- 2 Choose File > Open URL in New Player.
- 3 Enter the following URL:

```
rtsp://hostname/sample_300kbit.mov
```

where hostname is the host name or IP address of the QuickTime streaming server. Choose the movie with the bit rate appropriate for your bandwidth.

- 4 Click OK.

QuickTime Player connects with the server and plays the movie in a new window.

If you see a “File not found” message:

First make sure the URL was typed correctly, including upper- and lowercase restrictions.

If your streaming server is multihomed (for example, if the computer also hosts a web server), then you may need to specify another IP address for streaming. (A web server automatically uses port 80; with certain QuickTime client configurations, QTSS also uses port 80.) You can choose or add an IP address for the streaming server in the QuickTime Streaming pane of Server Admin. Click Settings, click IP Bindings, and then select the Bind checkbox for the desired IP address.

This concludes the initial setup of your streaming server software. Additional settings depend on your hardware and software, network connections, expected number of viewers, and media you want to stream. For information about determining these settings and operating your streaming server, see Chapter 3, “Managing Your QuickTime Streaming Server,” Chapter 6, “Setup Example,” and the resources listed on page 11.

Accessing Media Streamed From Your Server

To view streaming media, users must have QuickTime 4 or later (or an MP4 player). These are the instructions to provide users who want to view media streamed from your server.

To view streamed media:

- 1 Open QuickTime Player.
- 2 Choose File > Open URL.
- 3 Enter the URL for the media file. For example:

```
rtsp://myserver.com/mymedia
```

where `myserver.com` is the DNS name of the QTSS computer and `mymedia` is the name of the hinted movie or media file.

This URL assumes that the movie or media file is located at the top level of the media directory. For movies in subfolders within the media directory, add the folder to the pathname. For example:

```
rtsp://myserver.com/myfolder/mymedia.mov
```

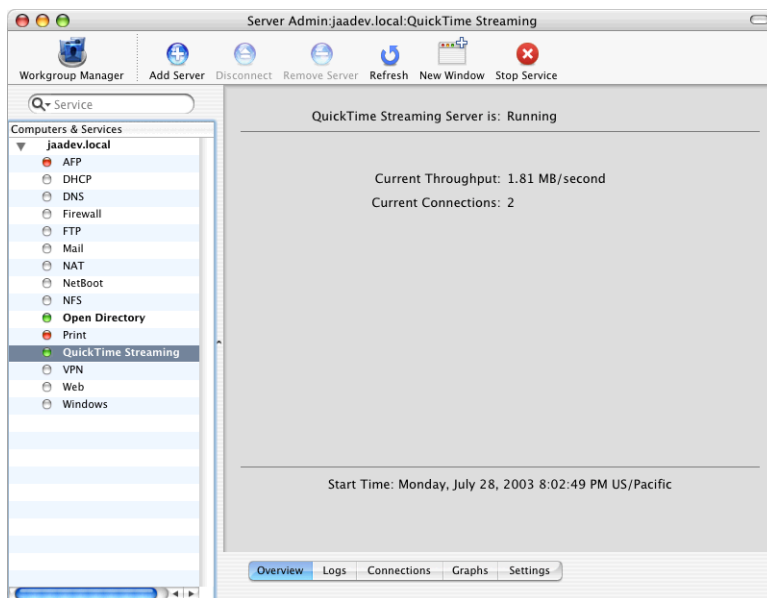
If you want users to view streamed media through a web browser, you must set up a webpage to show the media (see “Turning Content into a Webpage” on page 36) and give users the page’s URL. Typing an RTSP URL directly into the web browser’s address field is not recommended (some web browsers don’t understand “rtsp”).

Managing Your QuickTime Streaming Server

3

This chapter provides information about streaming past firewalls, setting up relays, and administering a QuickTime Streaming Server remotely.

To set up and manage QuickTime Streaming Server (QTSS), you use the Server Admin application, which is installed with Mac OS X Server version 10.3 or later. This application provides a standard graphical user interface for all supported platforms and enables you to administer the streaming server locally or remotely. You use Server Admin to change general settings, monitor connected users, view log files, manage bandwidth usage, and relay streams from one server to another.



Here is a brief description of the five panes in QuickTime Streaming:

- **Overview:** Provides a snapshot of current server activity.
- **Logs:** Displays Error Logs for troubleshooting purposes and Access Logs, which show such information as the number of times a media file has been accessed and when.
- **Connections:** Provides information about connected users and active relays.
- **Graphs:** Displays a graph of the average number of connected users or throughput over time, from hours to days.
- **Settings:** Where you specify server settings, bind QTSS to specific IP addresses (if the server computer is multihomed), enable relays, and change log settings.

Also included with QTSS is QuickTime Streaming Server Publisher, an application that automates the process of preparing and delivering streaming movies. Its user-friendly interface makes it easy to post error-free streaming content on the web. You use QTSS Publisher to create playlists, automatically hint movies, and easily embed movies in a website. For more information about QTSS Publisher, see Chapter 4, “Managing Your Media,” on page 31.

Using the Web-Based Application to Manage QuickTime Streaming

If you have previously administered a QuickTime Streaming Server using the web-based application, Web Admin, you can continue to do so. Web Admin is useful for administering a streaming server remotely or from non-Mac computers.

To use Web Admin:

- 1 In Server Admin, select QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings.
- 3 Click Access.
- 4 Select “Enable web-based administration.”
- 5 Click Save.

For information on using Web Admin, see the QuickTime Streaming Server/Darwin Streaming Server administrator’s guide available at <http://developer.apple.com/darwin>.

Note: If you have been using the web-based application, Web Admin, to administer a QuickTime Streaming Server, you’ll find the administration features in Mac OS X Server Admin. Use QTSS Publisher to create playlists and to prepare and organize media files.

Using Server Admin to Manage QuickTime Streaming

This section provides instructions for tasks such as starting and stopping streaming, setting up a multihomed server, and changing such settings as the maximum number of connections and the maximum throughput allowed.

Starting or Stopping Streaming Service

You start or stop streaming service in the QuickTime Streaming pane of Server Admin.

To start or stop streaming service:

- 1 Open Server Admin.
- 2 In the Computers & Services list, click QuickTime Streaming for the server.
- 3 At the top of the window, click Start Service or Stop Service.

Changing the Maximum Number of Stream Connections

When the specified maximum number of connections is reached, users who try to connect see a message that the server is busy or there is not enough bandwidth (error 453).

To change the maximum number of connections:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings.
- 3 Enter a number in the Maximum Connections text field.
- 4 Click Save.

Changing the Maximum Streaming Throughput

If the maximum throughput is reached, no one else can connect. Users who try to connect see a message that the server is busy (error 453).

To change the maximum throughput:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings.
- 3 Enter a number in the Maximum Throughput text field.
- 4 Click Save.

You can specify megabits per second (Mbps) or kilobits per second (Kbps) with the pop-up menu.

Changing the Streaming Media Directory

QuickTime Streaming Server has one main media directory (/Library/QuickTimeStreaming/Movies). If you have a reason to specify another directory for your streaming media (for example, you might want to switch the directory to another hard disk), you can do so.

To specify another media directory:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings.
- 3 Enter a pathname in the Media Directory text field or click the button next to the field to choose a folder.
- 4 Click Save.

Binding the Streaming Server Admin Computer to an IP Address

If your streaming server admin computer is multihomed (for example, if you're also hosting a web server), you can specify what IP address QTSS should bind to.

To specify an IP address:

- 1 In Server Admin, click QuickTime Streaming.
- 2 Click Settings, then click IP Bindings.
- 3 Select the Bind checkbox for the desired IP address.
- 4 Click Save.

You can specify whether to bind QTSS to all listed IP addresses or to selected addresses only.

Hosting Streams From Multiple User Media Directories

QuickTime Streaming Server can have only one main media directory. By enabling home directory support, however, users can stream on-demand files or playlists from their home directory.

To configure QTSS to stream movies located in users' home directories:

- 1 In Server Admin, click QuickTime Streaming.
- 2 Click Settings, then click Access.
- 3 Select "Enable home directory streaming."
- 4 Click Save.
- 5 Ask users to put their hinted QuickTime movies into the folder that was created in their home directories (/<username>/Sites/Streaming).

To view a movie in a private movie directory, enter the URL:

```
rtsp://hostname.com/~user1/sample.mov
```

Note: To stream a live broadcast from a directory other than the media directory, you need to create a qtaccess file. For more information, see the QuickTime Streaming Server administrator's guide available at <http://developer.apple.com/darwin>.

Setting Up Relay Streams

You use relays to accept a stream from one streaming server and send the stream on, or "relay" it, to another streaming server. Each relay comprises a source and one or more destinations.

To set up a relay:

- 1 In the Settings pane of the QuickTime Streaming service, click Relays.
- 2 Click the Add (+) button next to the Relays list.
- 3 Enter a name for the relay in the Relay Name field.
- 4 Choose an option from the Relay Type pop-up menu.

Request Incoming Stream directs the streaming server to send a request to the source computer for the incoming stream before it gets relayed. You can use this feature to relay a reflected live broadcast (from another server) or to request a stored file and turn it into an outgoing live stream.

Unannounced UDP directs the server to send the stream immediately.

Announced UDP directs the server to wait for the incoming stream and then relay it. Relays set to wait for announced streams can accept only media streams using the RTSP announce protocol.

- 5 In the Source IP field, enter the DNS hostname or IP address of the source computer.
- 6 In the Path text field, enter the pathname to the stream.

- 7 If the source computer requires automatic broadcasts to be authenticated, enter a user name and password.
- 8 Make sure Enable Relay is selected and click the Back button.
- 9 Click the Add (+) button next to the Destinations list.
- 10 Enter the requested information and click the Back button.
- 11 Repeat steps 9 and 10 for each destination, then click Save.

To turn a relay on or off, select or deselect the Enable checkbox next to the relay in the list. To delete a relay, select it and click the Delete (–) button.

Changing QuickTime Streaming Log Settings

You can specify that each log be reset after a certain number of days.

To change log settings:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings.
- 3 Click Logging.

The Access Log is updated only as client connections are disconnected. Any currently connected clients at the time of a power failure or server crash are never logged, and won't appear in the Access Log when the server is restarted.

Log files are stored in `/Library/QuickTimeStreaming/Logs/`.

Security and Access

A certain level of security is inherent in real-time streaming, since content is delivered only as the client needs it and no files remain afterward, but you may need to address some security issues.

For information about creating QTSS user accounts, see the QuickTime Streaming Server/Darwin Streaming Server administrator's guide (available at <http://developer.apple.com/darwin/>) or the command-line administration guide for Mac OS X Server version 10.3 (available at www.apple.com/server/documentation).

Serving Streams Past Firewalls Using Port 80

If you are setting up a streaming server on the Internet and you think some of your clients are behind firewalls that allow only web traffic, enable streaming on port 80. With this option, the streaming server accepts connections on port 80, the default port for web traffic, and QuickTime clients can connect to your streaming server even if they are behind a web-only firewall. If you enable streaming on port 80, make sure you disable any web server with the same IP address to avoid conflicts with your streaming server.

To serve QuickTime streams over HTTP port 80:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings.
- 3 Click IP Bindings.
- 4 Select "Enable streaming on port 80."

Important: If you enable streaming on port 80, make sure that your server is not also running a web server, such as Apache. Running both QTSS and a web server with streaming on port 80 enabled can cause a port conflict that results in one or both of the servers not behaving properly.

Streaming Past Firewalls or Networks With Address Translation

The streaming server sends data using User Datagram Protocol (UDP) packets. Firewalls designed to protect information on a network often block UDP packets. Client computers located behind a firewall that blocks UDP packets can't receive streamed media. However, the streaming server also allows streaming over HTTP connections, which allows streamed media to be viewed through even very tightly configured firewalls.

Some client computers located on networks that use address translation may also be unable to receive UDP packets, but they can receive media that's streamed over HTTP connections.

If users have problems viewing media through a firewall or via a network that uses address translation, they should upgrade their client software to QuickTime 5 or later. If users still have problems, their network administrators should provide them with the appropriate settings for the Streaming Proxy and Streaming Transport settings on their computers.

Network administrators can also set their firewall software to permit RTP and RTSP throughput.

Changing the Password Required to Send an MP3 Broadcast Stream

Broadcasting MP3s to another server requires authentication.

To change the MP3 broadcast password:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings, then click Access.
- 3 Type a new password in the MP3 Broadcast Password box.
- 4 Click Save.

Using Automatic Unicast (Announce) With QTSS on a Separate Computer

You can broadcast from QuickTime Broadcaster to QuickTime Streaming Server (QTSS) running on a separate computer using the Automatic Unicast (Announce) transmission method. To do so, you need to create a broadcast user name and password on the streaming server.

To create a broadcast user name and password on the streaming server:

- 1 In Server Admin, click QuickTime Streaming under the server in the Computers & Services list.
- 2 Click Settings, then click Access.
- 3 Select the “Accept incoming broadcasts” checkbox.
- 4 Click Set Password and enter the name and password.
- 5 Click Save.

This chapter provides information about using the new QuickTime Streaming Server Publisher application to prepare, organize, and upload media for streaming.

The QuickTime Streaming Server Publisher application, which comes with Mac OS X Server version 10.3 (or later), makes it easy to prepare and deliver streaming movies on the Internet.

Users who aren't server administrators can install QTSS Publisher from the administration tools CD that comes with Mac OS X Server, or can simply copy the application from a server. QTSS Publisher is in /Applications/Server.

Important: You can use QTSS Publisher locally on a computer running Mac OS X Server version 10.3 or later, or remotely on a computer running Mac OS X version 10.2 or later. When you open QTSS Publisher, you must enter a user name and password for a Mac OS X Server (version 10.3 or later) user account.

Overview of QTSS Publisher

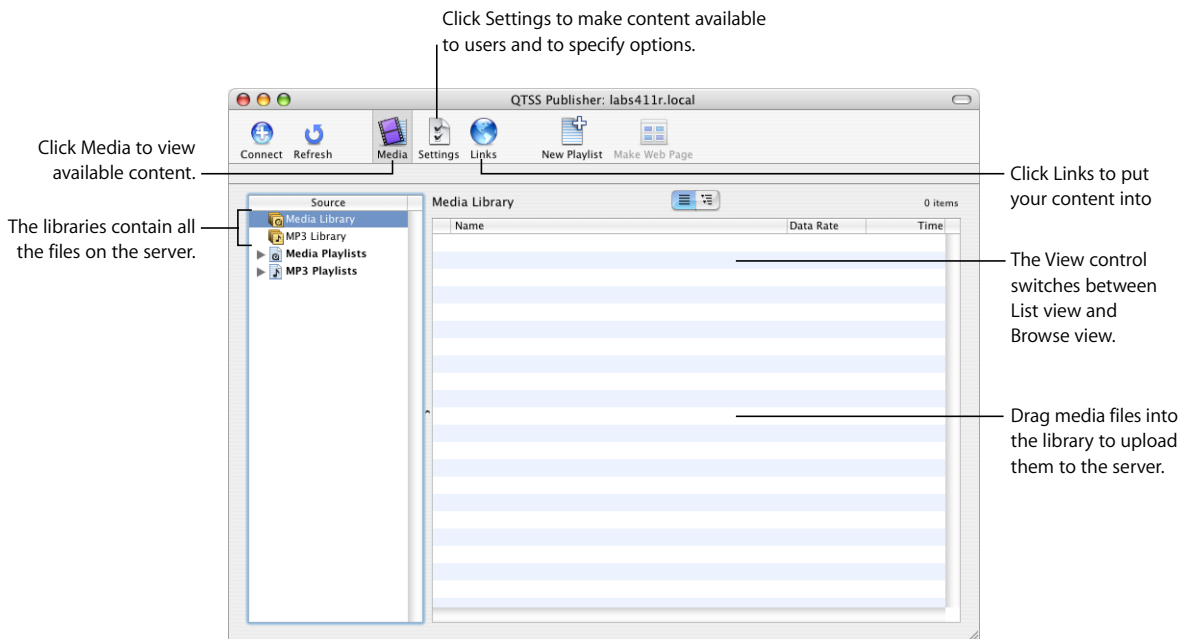
With QTSS Publisher, a new application for use with QuickTime Streaming Server, you can manage all of your QuickTime media on Mac OS X Server, from uploading to streaming. If you previously used the web-based application, Web Admin, to create MP3 and movie playlists, you can now use the more Mac-like interface of QTSS Publisher to create playlists and more. With QTSS Publisher, you can:

- Upload media to the server
- Prepare media for streaming or progressive download
- Create MP3, MP4, and movie playlists
- Create webpages with QuickTime media

About Playlists and Hinting

QTSS Publisher contains a Media Library and an MP3 Library. You can add files to these libraries to prepare them for streaming or to create playlists from them.

A *playlist* is a set of media files (QuickTime movies, MPEG-4 files, or MP3 audio tracks) that you choose and arrange. You can create a virtual “radio station” or a simulated live video broadcast by creating a playlist (or a series of playlists) of prerecorded QuickTime media, MPEG-4, or MP3 files. The playlists broadcast the media to the streaming server, which sends the media to viewers who request it, in the sequence you set up (random or ordered). Although the media is prerecorded, it appears to viewers as a live broadcast; all viewers see the same media when they tune in to the broadcast.



Before you stream a movie (a .mov or .MP4 file), it must be *hinted*. Hint tracks contain information the streaming server needs to stream the media properly; they allow the streaming server to stream QuickTime movies without having to understand QuickTime media types or codecs. QTSS Publisher automatically adds hint tracks to the items in a playlist as needed. (MP3 playlists don't need to be hinted.)

Note: When you use QuickTime Player to export a movie as a hinted movie, QuickTime adds all the necessary hint tracks automatically.

Connecting to Mac OS X Server

When you open QTSS Publisher, you must provide a user name and password for a Mac OS X Server (version 10.3 or later) user account. Local users can log in if home directory streaming has been enabled for them (see “Hosting Streams From Multiple User Media Directories” on page 27).

If the attempt to log in fails, make sure that the server you’re trying to connect to is running. Also make sure that port 311 is not disabled by your firewall.

Uploading Media From QTSS Publisher to a QuickTime Streaming Server

Files you drag into the Media Library in QTSS Publisher are automatically uploaded to the server you’re connected to. The media is not accessible to the public until you make it available (see “Making Content Available for Streaming or Downloading” on page 36). You can use QTSS Publisher as a staging area to prepare your content for web delivery.

Preparing Content for Web Delivery

After your content has been uploaded to the server (by dragging it into the Media Library in QTSS Publisher) and before you make your content available to the public, you may need to prepare your files for delivery over the Internet. This section describes the process.

Preparing Prerecorded Media for Streaming

Prerecorded media can be played back as a simulated live stream in a playlist when prepared properly. MP3 audio files can be played back in an MP3 playlist and listened to using iTunes or another compatible streaming MP3 player.

To prepare prerecorded media for broadcast in a playlist:

- 1 Make sure each movie that will be in the playlist has the same number and types of tracks, and that all the media files contain compatible media types.

For example, all audio tracks should use the same encoding, sampling rate, compression, and bit rate. All video tracks should also use the same encoding, compression, bit rate, and frame size. MP3 files should use the same sample rate.
- 2 Format the media in each file in the same way. For a movie playlist, be sure each media file is a hinted QuickTime movie or a hinted MPEG-4 file. (If you put your files in the QTSS Publisher Media Library, they are hinted for you.) Do not hint MP3 files when preparing an MP3 playlist.
- 3 Open QTSS Publisher (in /Applications/Server), click Media (if it is not already selected), and drag the media files to the QTSS Media Library.

Important: QTSS support of MP3 streams is intended for Shoutcast/Icecast-compatible live streams (such as those created by a streaming playlist) or live streams of other compatible MP3 live encoder broadcasters. To serve an individual MP3 file on demand (not as a live stream), select “Media is available for download” in the URL Settings pane of QTSS Publisher.

Improving the Performance of Hinted Movies Exported From QuickTime Player

When you export a hinted movie from QuickTime Player, you can compress video and sound using either the native RTP payload encoder or the generic QuickTime payload encoder. To select QuickTime, click Options in the QuickTime Player Export dialog, then click Track Hinder Settings.

Generally, native payload encoding is preferred. Check with your codec manufacturer for specific guidelines regarding payload encoding.

Use care and experimentation when choosing between native and QuickTime payload encoders.

Creating and Managing Playlists

With QTSS Publisher, it’s easy to create and manage playlists for video or audio broadcasts.

Creating a Playlist of Media for Streaming

You can create a playlist of QuickTime movies, MPEG-4 files, or MP3 audio tracks.

To create a playlist:

- 1 Make sure your prepared media files are in the appropriate Library folder (MP3 or Movie) in QTSS Publisher. You can move files in QTSS Publisher by dragging them.
- 2 In QTSS Publisher, click New Playlist.
- 3 Select MP3 Playlist or Media Playlist.
- 4 Enter a name for the playlist.

After you enter the name, QTSS Publisher creates a URL name for you (you can change the URL name if you wish). The playlist and URL names must be unique; no two broadcasts can use the same name.

- 5 Click Create Playlist.
- 6 Drag items from the library list (at the top) to the Playlist Contents.

Modifying a Playlist

To change the order of items in a playlist, drag them. To delete an item from a playlist, select it and click Delete. To add items to a playlist, double-click the playlist and click Add Items.

You can also modify settings such as the playlist’s name, genre, and play mode.

To modify a playlist's settings:

- In QTSS Publisher, select a playlist and click Settings (or double-click the playlist).

Note: You can modify the contents of a playlist without stopping and restarting it; it updates automatically. You can change a playlist's settings (for example, whether the playlist plays in random or sequential order) while it is broadcasting, but you must stop and restart the playlist to apply the new settings.

Changing the Weight of a Track in a Playlist

You can "weight" a track to adjust how often it plays. Tracks with higher weights play more often than tracks with lower weights (when Weighted Random is chosen in the Play Mode pop-up menu in the Playlist pane).

To change a track's weight:

- 1 In QTSS Publisher, select the track.
- 2 Drag the Weight slider to a setting from 0 to 10.

Creating and Editing Movie Annotations

You can add annotations to a movie to document information such as its original format, its producer, and performers. For example, if you put a movie's full name in the annotations, it appears as the title in a QuickTime Player window.

To annotate a movie:

- 1 In QTSS Publisher, select a movie and click Settings (or double-click the movie).
- 2 Select the checkbox for the annotation you want to include and type the annotation in the text field.

Changing the Still Image of a Movie Embedded in a Webpage

When you use QTSS Publisher to embed a streaming movie in a webpage, you can choose a custom image to display until the movie starts playing. (That is, you can select another image besides the movie's poster frame.)

To select a still image to represent an embedded movie:

- 1 In QTSS Publisher, select a movie and click Link Settings.
- 2 Drag a file from the Finder to the image well or click Choose.
- 3 Click Apply.

You can also type a caption to appear below the image.

Delivering Your Content

After you prepare and organize your media, QTSS Publisher makes it easy to deliver your content over the Internet, by progressive download or streaming.

Making Content Available for Streaming or Downloading

Content in the QTSS Publisher Media Library is automatically uploaded to the server, but is not available for on-demand streaming until you specify it (unless you are starting a playlist).

To make content publicly available:

- 1 Select the item and click Settings (or double-click the item).
- 2 Click URL (if it is not already selected).
- 3 Select one or both of the User Access checkboxes.

Starting and Stopping Playlists

You start or stop broadcasting playlists in the Settings pane of QTSS Publisher.

To start or stop broadcasting a playlist:

- 1 In QTSS Publisher, select the playlist and click Settings (or double-click the playlist).
- 2 In the Playlist pane, click the Start or Stop button.

Use the Play Mode pop-up menu to specify how you want the playlist to play.

- **Sequential** broadcasts the media in the order in which it appears in the playlist file.
- **Sequential Looped** broadcasts the media in the order in which it appears in the playlist file. When the last media file has ended, the playlist repeats in the same order.
- **Weighted Random** broadcasts the media in random order using the specified weights to determine how often an item plays. The higher the weight, the more often the item is played. You can specify the number of items that must be broadcast before an item repeats.

Turning Content into a Webpage

In QTSS Publisher, you can easily turn a playlist (or any media you make available for streaming or download) into a webpage by selecting it and clicking Make Webpage. Several sample webpage templates are provided (see the sample below).

When QTSS Publisher is done creating the webpage, it opens in Safari. Users can access the webpage by typing the URL into their browser. You can change the URL in the Links pane.

QTSS Publisher also generates HTML you can drag to your webpage editor to create links to media. To access the code, select the items and click Links, highlight the link, and then click HTML.

You can also specify settings such as whether the stream begins to play as soon as the webpage loads or when users click the poster frame, or whether the movie opens in a QuickTime Player window.

To change settings for content embedded in a webpage:

- 1 In QTSS Publisher, select a movie or playlist and click URL.
- 2 Click Link Settings.

Mrs. Smith's 3rd grade class field trip

Recently, Mrs. Smith's 3rd grade class took a field trip down the California coast to learn about the ocean and its inhabitants. The students took videos so that they could share what they learned. Click a picture below to join them on their adventure!



We took the school bus all the way down the California coast where we got to look at the ocean. It was such a beautiful day!

Driving down the coast

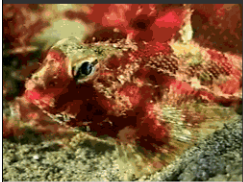
 ocean.mp4
4:10 | 4.7mb



When we got off the bus we saw some otters having lunch in the water. They were diving in and out of the water and flapping their rippers around. Maybe they were trying to wave to us.

Lunch time!

 seal.mp4
3:04 | 4.5mb



The best part of the trip was the aquarium where we got to see some very interesting fish. They were many different colors and sizes, and they were all very beautiful. I hope we get to visit the aquarium again!

Underwater creatures

 fish.mov
5:21 | 7.0mb



For optimal viewing experience, viewers should download QuickTime 6.3



This chapter provides information on what to do if you encounter problems while streaming media.

Using Log Files to Monitor Playlist Broadcasts

If you enable logging, you can use the log file to troubleshoot problems that occur during a broadcast.

- If the media in the playlist is not being broadcast, check Streaming Server Admin to make sure the streaming server is running.
- If the streaming server is running, make sure a process called PlaylistBroadcaster is running on the server computer. If it is running, stop the broadcast, delete the SDP file for the broadcast from the streaming server media directory, then restart the broadcast. A new SDP file is generated when you restart the broadcast.

Media Files Don't Stream Properly

- Try streaming a sample movie to see if the server can stream it. Sample movies are included with the server.

If the server streams the sample movie, the problem may be with the way your movie file is prepared. Re-create the movie.

If the sample movie doesn't stream, the problem may be with the server computer or the network.

- Check streaming server activity and, if necessary, reduce the maximum number of connections or throughput.
- If the problem occurs on a client computer, make sure the user has the appropriate Streaming Proxy and Streaming Transport settings. The administrator for the client computer's network should be able to provide the correct settings.
- Make sure the client software supports the file format being broadcast.
- Check the structure of the URL.
- Check the playlist. If you created a looping playlist containing hinted MPEG-1 QuickTime files, QuickTime clients may have problems viewing the stream.

Users Can't Connect to Your Broadcast

- Make sure the client computer has QuickTime 4 or later installed. If users are connecting using a web browser, make sure the QuickTime 4 Plug-in is installed correctly.
- Make sure users have the correct URL.
- If users are attempting to connect to your broadcast over HTTP, make sure you disable any web server that may be conflicting with your streaming server. Also, make sure streaming on port 80 is enabled in the General Settings pane of Streaming Server Admin.

Users See Error Messages While Streaming Media

Here's what the messages mean:

Error code 401: The user has tried to access a protected file. Users may need to upgrade to QuickTime 5 or later.

Error code 404: The server cannot locate the URL the user entered. Make sure users enter the correct URL for the broadcast. Tell users not to attempt to view media in a web browser by typing an RTSP URL directly into the web browser's location address. RTSP URLs are used only with the Open URL command of QuickTime Player.

Error code 415: The movie file is not hinted or has a compressed movie resource. You need to hint the movie again using the Pro version of QuickTime Player. Alternatively, you may be attempting to natively serve MP3 files on demand (that is, as an HTTP download). QTSS support of MP3 streams is intended for shoutcast/icecast-compatible live streams (such as those created by an MP3 playlist) or live streams of other compatible MP3 live encoder broadcasters. If you wish to serve individual MP3 files on demand (not as live streams), simply host the files on a web server.

Error code 453: The server is too busy for users to view the stream. Users should try again later. You may want to increase the maximum number of connections in the General Settings pane of Streaming Server Admin.

Error code 454: The connection to the server was dropped. Users must start viewing the stream again. Check if the server is behind a firewall or the client is behind Network Address Translation (NAT) software. See "Serving Streams Past Firewalls Using Port 80" on page 28 and "Streaming Past Firewalls or Networks With Address Translation" on page 29.

Error code -5420: The server may not be running. Check the streaming server and restart it if necessary. Check if the server is behind a firewall or the client is behind Network Address Translation (NAT) software. See "Serving Streams Past Firewalls Using Port 80" on page 28 and "Streaming Past Firewalls or Networks With Address Translation" on page 29.

This chapter describes the key components needed for a generic webcasting setup and how they are connected together.

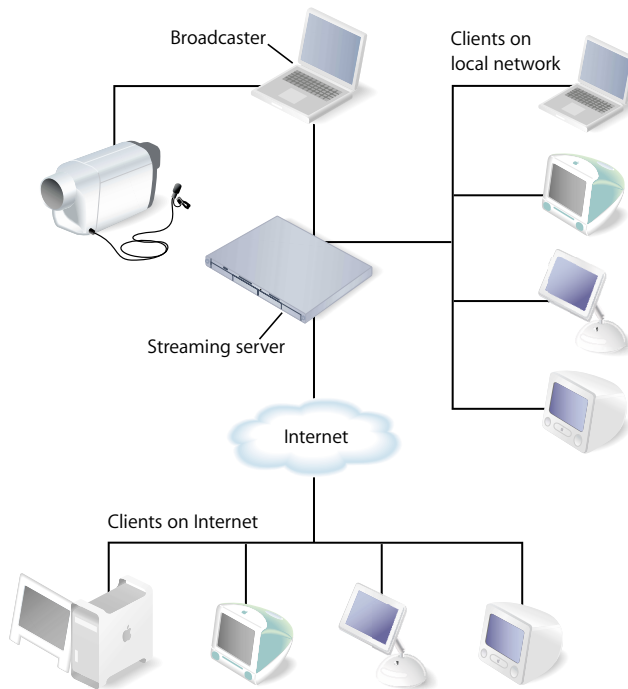
The setup instructions that follow assume an educational setting, such as a university campus. But the example can be easily adapted for many uses including:

- Distance learning classes
- Corporate communications to employees, customers, suppliers, or shareholders
- One-time concert or presentation
- Childcare center broadcasts to parents

Streaming Presentations—Live and On Demand

This example shows how a university network administrator might set up a streaming server and other needed components to stream both live and on-demand classroom presentations to students using client computers connected to the campus network and to the Internet.

Such a setup would make it possible for students who couldn't attend a class in person to view it online. It would also enable students to review parts of the lecture later by playing an archived version on their computers.



The streaming setup in this example, shown above, has these features:

- An already-existing local network with Ethernet connections to classrooms and lecture halls from which live presentations are to be streamed.
- A digital video (DV) camera and microphone set up in a classroom or lecture hall to convert the live presentation to digital form. The camera makes a high-quality DV recording of the presentation and provides the digital signal to be encoded for live streaming.
- The DV camera is connected through a FireWire port to a laptop computer running QuickTime Broadcaster, which encodes the digitized live presentation and transmits the signal via an Ethernet connection to the streaming server on the campus network.
- The streaming server is a rack-mounted Xserve running “headless” (without a monitor and keyboard). The server is running Mac OS X Server with QuickTime Streaming Server (QTSS) configured to reflect the encoded live presentation as a unicast stream to each client computer—on the campus network or on the Internet—that “tunes in” to the broadcast. The Xserve comes with Mac OS X Server and QTSS preinstalled.

- Client computers of various types with QuickTime Player or other MPEG-4 compliant software installed can access the Xserve streaming server via the campus network. Other client computers can access the streaming server via the Internet.
- The broadcaster laptop running iMovie is used to produce high-quality on-demand versions of a live presentation after the presentation is concluded. The recorded digitized presentation is brought into the computer for compression through its FireWire connection using the DV camera.

Note: QuickTime Broadcaster can be set to record the encoded live stream to disk for archival purposes. For best results, however, the footage should be encoded separately.

- The broadcaster laptop is also used to control the Xserve remotely using the Server Admin application (or using Web Admin, the QTSS web-based administration application).

Note: The laptop could also be connected to the local network wirelessly via an AirPort base station for extra portability. The AirPort is 802.11 compliant and works fine with QTSS. Its 11 megabits per second (Mbps) of bandwidth is more than enough for our example setup if other clients don't place heavy demands on the same base station.

Setting It Up

The following steps show how to set up QuickTime Streaming Server and the other components needed for live and on-demand streaming in this hypothetical university setting.

Step 1: Prepare the Location

A typical classroom doesn't provide a broadcasting and recording environment comparable to a professional television or recording studio. The following measures can help ensure reasonably good results:

- Go into the classroom or lecture room you want to use for live streaming, close the doors, and listen for extraneous noise that could interfere with a broadcast. If noise from a nearby break room, video gaming area, street traffic, or other source is noticeable and can't be eliminated, find another room.
- If extraneous noise is not an issue, stand in the center of the room, clap your hands or shout, and listen for an echo. If you hear an echo, the sound quality of a live broadcast can be compromised. You can reduce or eliminate echoes by hanging heavy curtains on bare walls or placing acoustic panels in a checkerboard pattern on each wall.
- Next, examine the floors and furniture. Carpeted floors and padded chairs are best. A lectern should have a cloth on top or other padded surface to protect against noises such as the speaker setting down a glass of water.

- Windows can cause lighting problems. For more control, you should be able to draw the blinds and supplement room lights with a portable lighting kit that can be quickly set up for a live session.

Step 2: Prepare the Network

Check that there is an Ethernet connection to the room where the live broadcast is to take place. Install, repair, or replace cables and connectors as needed, using high-quality materials.

Bear in mind that streaming—especially live streaming—can make heavy demands on network resources, especially available bandwidth. To ensure that the network can handle the extra load, it may be necessary to do some or all of the following:

- Determine the capacity of the existing network and calculate the anticipated additional traffic generated by live and on-demand streaming.
- Draw a map of bandwidth segments on your network, listing the capacity between all points.
- Determine which applications are used in your network, their use patterns, where they are hosted, and the bandwidth they normally use during peak and off-peak times.
- Based on the configuration and capacities of your network, select the appropriate place to install your streaming server, avoiding potential bottlenecks.
- If necessary, add capacity to the network (additional T1 lines, routers, switches, and so on) to handle the anticipated maximum number of concurrent viewers of live broadcasts in addition to other peak network traffic.

Keep in mind that a typical local network provides bandwidth internally of 10–100 Mbps. In contrast, a T1 line, frequently used to connect to the Internet, provides only about 1.5 Mbps of bandwidth.

T1 lines work fine for HTTP and FTP, where the requests are either short-lived or are not time sensitive, but streaming is much more demanding. With streaming you can't slow things down—the data has to be transferred at least as fast as the original content data rate in order to deliver streams.

For this example, we will assume a maximum of 10 concurrent viewers, half on the local network and half on the Internet, and a bit rate for each unicast stream of approximately 256 kilobits per second (Kbps). The peak extra bandwidth needed is then about 3.2–3.3 megabits per second (Mbps). This estimate includes an extra margin of 25–30 percent for unplanned network congestion and peaks in the transmitted streams that can occur for various reasons.

Step 3: Set Up Your Streaming Server

An administrator computer must be set up before you can configure and manage your streaming server if, as in this example, the streaming server is running headless. For information on setting up an administrator computer, see “Mac OS X Server Getting Started for Version 10.3 or Later” (included on the Mac OS X Server CD).

To set up and manage QTSS, you use the Server Admin application, which is installed with Mac OS X Server version 10.3 or later. (After configuring Mac OS X Server, you can also use the web-based administration application, Web Admin, to manage QTSS remotely from any computer connected directly to the local network or to the Internet.) For this example, we assume that the broadcaster laptop in the streaming setup illustration is also used for this purpose.

Although the Xserve comes with Mac OS X Server and QTSS preinstalled, the software must be configured for the particular network to which it is being added and for the specific uses to which it is to be put. For information on setting up Mac OS X Server, see the getting started guide included on the Mac OS X Server CD.

Among the questions to be answered when setting up your streaming server are the following:

Can the server computer be dedicated solely to streaming?

It's best if your streaming server doesn't also have to handle web serving, mail serving, and other server tasks. This example is for a dedicated streaming server.

How much random access memory (RAM) is needed?

The minimum required to run QTSS is 128 megabytes (MB). Estimate about 256 MB of RAM for every 50 MB of throughput you plan to serve. This setup assumes 256 MB of RAM.

How much hard disk storage is needed?

Video files can be large. A hinted one-hour presentation encoded at 300 Kbps (not optimized for a server) takes up approximately 135 MB of hard disk space. A 60 GB hard disk can store more than 400 such presentations.

Note: Here's a formula for calculating streaming file sizes:

$$\text{dataRateInBits} / 8 \text{ bits} * \text{timeInSeconds} = \text{file size}$$

Example for a one-hour 300-Kbps stream:

$$300,000 / 8 \text{ bits} * 3600 = 135,000,000 \text{ bytes} = 135 \text{ MB file size}$$

Many local networks include redundant arrays of independent disks (RAID) storage systems, which provide much larger amounts of hard disk space.

If you store streaming files anywhere other than the QTSS default location (/Library/QuickTimeStreaming/Movies), you'll need to enter the path in the Settings pane of QuickTime Streaming in Server Admin (see "Changing the Streaming Media Directory" on page 26). Place any Session Description Protocol (SDP) files referencing live webcasts in the same location so they can be recognized by QTSS.

In this example, all archived streaming files and SDP reference files reside in the default Movies folder on the streaming server.

Does the streaming server have an adequate network card?

The network card is a critical component of your streaming server, since it provides Ethernet connectivity between the server and your audience. An Ethernet card should provide a minimum of 100 megabytes (about 0.8 gigabit) per second of throughput.

Where will the streaming server be located on the network? What about a firewall?

The streaming server must be located where it will be accessible to users (in our example, students) logging in from both the local network and the Internet. It also should be protected by a firewall against unauthorized access to the server and to archived media files.

Mac OS X Server includes IP Firewall service, which scans incoming IP packets and rejects or accepts these packets based on a set of filters you create. For instructions on setting up this service, see the network services administration guide.

Specific ports need to be opened in the firewall to allow Real-Time Streaming Protocol (RTSP) requests from users, encoded video and audio from the broadcaster, and outbound streams to clients on the local network and the Internet. The table below lists the ports used by QuickTime Streaming Server and for incoming and outgoing requests.

Ports	Requests
Ports used to communicate with client	554, 7070 TCP or 80 TCP
Ports used to send media	6970-6999 UDP, or 80 TCP
Ports used to receive broadcast	10000-65635 UDP
Ports server will stream through	554 RTSP 7070 TCP or 80 TCP
Default port typically used by MP3 broadcasters	8000 TCP
Port used for remotely managing QTSS with Server Admin	687 TCP
Port used for remotely managing QTSS with Web Admin	1220 TCP

In this setup example, we'll assume that the students connecting to the streaming server via the Internet are *not* behind their own firewalls. In that case, we won't enable streaming on port 80, the port typically carrying HTTP Internet traffic and allowed by most firewalls.

If some clients *are* behind firewalls, it may be desirable to enable streaming on port 80 for those clients to access the streams. For instructions, see "Serving Streams Past Firewalls Using Port 80" on page 28.

Will it be necessary to set up a broadcaster user account on the streaming server?

In this setup example, it's necessary to create a broadcaster user name and password because the encoding software and QTSS are on separate computers. Creating a broadcaster user allows a Session Description Protocol (SDP) file, which provides information about the format, timing, and authorship of a live streaming broadcast, to be created on the server. Once specified, the user name and password are entered through QuickTime Broadcaster.

For instructions on creating or changing a broadcaster user name and password, see "Using Automatic Unicast (Announce) With QTSS on a Separate Computer" on page 30. You'll need to use the administrator computer previously set up.

Will users require authentication to access live or archived presentations?

In our example setup, no authentication is necessary. However, if you want to restrict access to your streams, you'll need to set up individual or group streaming user names and passwords. For information on how to set up and manage such accounts, see the appropriate topics under "Security and Access" on page 28.

Step 4: Set Up for a Live Webcast

For the example setup, the following items are needed:

- Good-quality DV camera
- Microphone placed near the speaker, either on a stand or clipped to the speaker's clothing, connected by good-quality audio cable to the DV camera audio input
- Sturdy tripod on which to mount the camera
- Portable lighting kit

The Camera Is the First Link

Since the camera is the first link in the video signal chain, it is very important. Two main things determine a DV camera's picture quality:

- **Lens quality.** The better the lens, the better the image.
- **Image capture mechanism.** DV cameras use charge-coupled devices (CCDs) to convert the picture into electronic signals. The number and size of the CCDs affect the quality of the image.

Optical zoom gives better quality than digital zoom, but zooming should be avoided or kept to a minimum when streaming a live presentation to avoid degrading the stream.

Lower-end DV cameras use a single charge-coupled device (CCD) to capture the complete image, whereas higher-quality cameras use three separate CCDs to scan the red, blue, and green content of the image, giving a better quality scan. CCDs range in size from 1/4 inch to 2/3 inch; bigger CCDs give better resolution.

Here are other desirable features:

- You should be able to override automatic camera settings.
- You'll want to use a separate microphone that can plug in to the camera for optimal sound pick-up. A built-in microphone is unsuitable for most situations.
- The camera should accept professional XLR plugs (as opposed to the 1/8-inch mini-jack connectors). It should also have a headphone jack for monitoring the audio input.
- Finally, a FireWire output enables digital transfers and automated capture, which can save time later.

Keep the Microphone Close

The microphone is the first link in the audio signal chain and so is also very important. Dynamic microphones are a good all-around choice and can be purchased for as little as \$100.

The best way to improve audio if the room has bad acoustics is to place the microphone as close as possible to the person doing the speaking. Use a small lavalier (lapel) microphone clipped to the front of the speaker's clothing immediately under the mouth, or use a handheld microphone.

In the case of a panel discussion, use multiple microphones, preferably on sturdy stands, and a small audio mixer. Connect the mixed stereo output from the mixer into the line input on the DV camera.

If using an external microphone or mixer, make sure that all the connectors are securely plugged in to assure reliable audio. Plug a pair of headphones into the video camera's headphone output to make sure that you can hear the audio and that it's not distorted.

A Tripod Is a Must

It's important to use a camera tripod when shooting a live presentation, and also to avoid pans, tilts, and zooms. If the camera moves just one degree, every pixel in the frame changes, multiplying the difficulty of encoding the stream adequately. What was a simple scene to encode suddenly becomes much more difficult.

The tripod should be lightweight while still providing stable support for the camera's weight.

Get a Simple Lighting Kit

Lighting is a big subject and beyond the scope of this guide, but here are some brief suggestions.

Even a high-quality video camera will produce poor results without proper lighting. It's unlikely that the normal lighting available in a typical classroom will be adequate for shooting a live presentation. At a minimum, you'll probably want to add backlighting to make your subject stand out from the background. A portable lighting kit supporting three-point lighting, plus a reflector or two if you're planning to shoot outside, can greatly improve your results.

Step 5: Set Up Broadcaster

In this example, QuickTime Broadcaster is installed on a laptop computer. This encoding software is included on the Mac OS X Server CD and can also be downloaded free of charge from the QuickTime Broadcaster website at <http://www.apple.com/quicktime/products/broadcaster/>.

To install QuickTime Broadcaster, double-click the installer package (QuickTimeBroadcaster.pkg) and follow the on-screen instructions.

Once the encoder software is installed, plug the camera into the laptop using FireWire, turn the camera on, and see if QuickTime Broadcaster recognizes it.

- 1 Open QuickTime Broadcaster and click Show Details.
- 2 Click Video and choose a video source from the Source pop-up menu.

If the camera is recognized, it appears in the Source menu. Video settings should also be active (not dimmed).

If the camera doesn't appear in the Source menu, quit QuickTime Broadcaster, make sure your camera is connected and turned on, and then open QuickTime Broadcaster again. If your camera still does not appear, check the QuickTime website or the Apple Knowledge Base for information on compatibility and other issues.

When broadcasting to QTSS on a separate computer, as in this example, Automatic Unicast (Announce) is the recommended transmission method. It's easy to set up.

- 1 In QuickTime Broadcaster, click Show Details, click Network, and choose Automatic Unicast (Announce) from the Transmission pop-up menu.
- 2 In the Network pane, enter the IP address or host name of the receiving server (the Xserve in this example), a name for the broadcast file, the user name and password for the broadcaster user created in Step 3, and the buffer delay (or accept the default).

Note: The buffer delay sets the number of seconds QuickTime buffers the broadcast before playback. For broadband connections, QuickTime Player 6 or later fills the buffer more quickly than real time, providing an "Instant-On" viewing experience.

- 3 Click Broadcast and start QTSS (if it's not already running) by selecting the computer in Server Admin, clicking QuickTime Streaming, and clicking Start Service.

To find out if the live stream can be seen from a client, open QuickTime Player on one of the client computers and do the following:

- 1 Choose File > Open URL in New Player.
- 2 Enter the Real-Time Streaming Protocol (RTSP) URL displayed in the Location section of the QuickTime Broadcaster window (for example, `rtsp://myserver.com/mystream.sdp`).

Note: The URL is case-sensitive and must be entered exactly as displayed in the QuickTime Broadcaster window.

The live stream should start playing in QuickTime Player.

Step 6: Test Your Setup

The last step is to test the setup. This should be done as realistically as possible.

- Set up your equipment just as it will be used for the live presentation—in the actual location, if possible.
- Ask a colleague to stand in for the presenter, or better yet, have the presenter take part in the test, making it a “dress rehearsal.”
- Check the video image and the sound.
- Check that clients both on the local network and on the Internet can tune in to the live stream.
- Adjust the camera and microphone positions and lighting as necessary and troubleshoot any other problems.

Creating a Webpage for Easy Access

Enabling access from a webpage eliminates students' having to remember the RTSP URL and names of the streaming server and SDP files.

In our example, the webpage can be added to the existing university website, but it can reside on any web server. Students can access the live presentation (as well as the archives) by clicking links in their browser.

For instructions on creating a webpage with links to streamed media, see “Turning Content into a Webpage” on page 36.

Shooting the Live Presentation

If all the preparatory work has been done as outlined above, and the equipment and connections have been thoroughly tested, shooting the live presentation should be straightforward.

Here are a few tips for avoiding problems during the event:

- On the day of the actual event to be streamed live, set up early so you have time to check once again that all components are working as expected.
- If an audience is to be present, let them know in advance that you will be webcasting the presentation live and ask for their cooperation.
- Tape down any cables along the floor to minimize tripping hazards.
- Check for potential sources of extraneous noise and take abatement measures if possible.

Archiving the Live Presentation

In the example setup, the iMovie application, which comes with Mac OS X, is on the laptop. iMovie is used to import the recorded DV footage from the camera tape and then to encode and archive taped live presentations.

To archive a live presentation, first import the recorded DV footage:

- 1 Connect the DV camera to the laptop using FireWire and turn on the camera.
- 2 Insert the tape with the video footage to be archived and switch to VTR mode.
- 3 On the laptop, open iMovie and set the Mode Switch under the iMovie monitor to Camera mode (drag the round blue slider toward the DV camera icon).
- 4 Use the playback controls to view a portion of the tape in the iMovie monitor. If the tape doesn't play, check the connections and make sure the camera is turned on.
- 5 Rewind the tape to a few seconds before the point where you want to start importing.
- 6 Click Play below the iMovie monitor.
- 7 Click Import when you see the point in the presentation where you want to start importing.
- 8 Click Import again when you want to stop importing.
- 9 If you get some footage that you don't want to include in your archived presentation, you can edit it later using iMovie.

Important: You'll need to monitor hard disk space as you import video and create your iMovie. One minute of DV footage uses about 220 MB of hard disk space, so a one-hour presentation can use up more than 13 gigabytes of disk space. The Free Space status bar, below the clip shelf, shows how much disk space is available at any point in the import process.

Next, use iMovie to compress and encode the DV footage for streaming:

- 1 In iMovie, choose File > Export Movie.
- 2 Choose To QuickTime from the Export Movie pop-up menu.
- 3 Choose a movie format from the Formats pop-up menu.

You can choose one of the QuickTime formats optimized for different uses or choose Expert, which provides custom QuickTime settings such as MPEG-4 Video.

- 4 Click Export.
- 5 Name your movie, select a destination for the file, and click Save.

The time it takes to save the movie depends on the movie's length and the format you chose.

Note: You may want to save more than one archive streaming file, each compressed for a different connection speed. For example, you might choose lower compression settings for clients on the campus network and higher compression settings for clients connecting over the Internet.

- 6 After you have saved the encoded file or files, check to make sure every file streams properly.

This glossary defines terms and spells out abbreviations you may encounter while working with online help or *QTSS Administration*.

access file A text file called *qtaccess* that contains information about users and groups who are authorized to view media in the directory in which the access file is stored.

administrator A user with server or directory domain administration privileges. Administrators are always members of the predefined “admin” group.

administrator computer A Mac OS X computer onto which you have installed the server administration applications from the Mac OS X Server Admin CD.

announced broadcast A method such as Automatic Unicast (Announce) that enables a broadcaster to negotiate with a server to accept a broadcast.

AppleScript A scripting language with English-like syntax, used to write script files that can control your computer. AppleScript is part of the Mac operating system and is included on every Macintosh.

Automatic Unicast (Announce) A method of delivering a broadcast to a streaming server in which an SDP file is automatically copied and kept current on the server. A *broadcast user* name and password must be created before starting such a broadcast.

AVI (Audio Visual Interleave) A Windows video file format.

bandwidth The capacity of a network connection, measured in bits or bytes per second, for carrying data.

bit A single piece of information, with a value of either 0 or 1.

bit rate The speed at which bits are transmitted on a network, usually expressed in bits per second.

broadcast The process of transmitting one copy of a stream over the whole network.

broadcast user A user who has permission to broadcast to the streaming server. The broadcast user name and password are set in the General Settings pane of Streaming Server Admin and are used in conjunction with announced broadcasts. It is not necessary to create a broadcast user for UDP broadcasts.

browser plug-in Software that you attach to a browser to enable it to display specific data formats.

byte Eight bits.

client The user-side software or computer used to display streaming media.

codec Any technology for compressing and decompressing data. Codecs can be implemented in software, hardware, or a combination of both.

data rate The amount of information transmitted per second.

DNS (Domain Name System) A distributed database that maps IP addresses to domain names. A DNS server, also known as a name server, keeps a list of names and the IP addresses associated with each name.

DSL (digital subscriber line) A broadband data transmission technology that operates over telephone lines.

DV (digital video) A digital tape-recording format using approximately 5:1 compression to produce Betacam quality on a very small cassette.

firewall Software that protects the network applications running on your server. IP firewall service, which is part of Mac OS X Server software, scans incoming IP packets and rejects or accepts these packets based on a set of filters you create.

FireWire A hardware technology for exchanging data with peripheral devices, defined by IEEE Standard 1394.

frame A single image in a movie or sequence of images.

frame rate In a movie, the number of frames per second.

FTP (File Transfer Protocol) A protocol that allows computers to transfer files over a network. FTP clients using any operating system that supports FTP can connect to a file server and download files, depending on their access privileges. Most Internet browsers and a number of freeware applications can be used to access an FTP server.

hinting A process that creates a track for each streamable media track in the file that tells QuickTime Streaming Server how and when to deliver each frame of media. The hinting process performs the required calculations in advance, allowing QTSS to serve up a larger number of streams. Hinting also allows new codecs to be used without the need to upgrade the server.

HTML (Hypertext Markup Language) The set of symbols or codes inserted in a file to be displayed on a World Wide Web browser page. The markup tells the web browser how to display a webpage's words and images for the user.

HTTP (Hypertext Transfer Protocol) The client/server protocol for the World Wide Web. The HTTP protocol provides a way for a web browser to access a web server and request hypermedia documents created using HTML.

IEEE (Institute of Electrical and Electronics Engineers, Inc.) An organization dedicated to promoting standards in computing and electrical engineering.

Instant On An advance in Apple's patent-pending Skip Protection technology that dramatically reduces buffer, or wait, time for an instantaneous viewing experience with streaming video on a broadband connection.

IP (Internet Protocol) Also known as IPv4. A method used with Transmission Control Protocol (TCP) to send data between computers over a local network or the Internet. IP delivers packets of data, while TCP keeps track of data packets.

IP address A unique numeric address that identifies a computer on the Internet.

IP subnet A portion of an IP network, which may be a physically independent network segment, that shares a network address with other portions of the network and is identified by a subnet number.

ISP (Internet service provider) A business that sells Internet access and often provides web hosting for ecommerce applications as well as mail services.

JavaScript A scripting language used to add interactivity to webpages.

key frame A sample in a sequence of temporally compressed samples that does not rely on other samples in the sequence for any of its information. Key frames are placed into temporally compressed sequences at a frequency that is determined by the *key* frame rate.

key frame rate The frequency with which key frames are placed into temporally compressed data sequences.

LAN (local area network) A network maintained within a facility, as opposed to a WAN (wide area network) that links geographically separated facilities.

layer A mechanism for prioritizing the tracks in a movie or the overlapping of *sprites*. When QuickTime plays a movie, it displays the movie's images according to their layer—images with lower layer numbers are displayed on top; images with higher layer numbers may be obscured by images with lower layer numbers.

M3U file An audio metafile that is created using a text editor and saved to a web server. The file directs a user's web browser to an MP3 playlist residing on the same web server and opens the user's MP3 player.

Mac OS X The latest version of the Apple operating system. Mac OS X combines the reliability of UNIX with the ease of use of Macintosh.

Mac OS X Server An industrial-strength server platform that supports Mac, Windows, UNIX, and Linux clients out of the box and provides a suite of scalable workgroup and network services plus advanced remote management tools.

Manual Unicast A method for transmitting a live stream to a single QuickTime Player client or to a computer running QTSS. An SDP file is usually created by the broadcaster application and then must be manually sent to the viewer or streaming server.

MBONE (multicast backbone) A virtual network that supports IP multicasting. An MBONE network uses the same physical media as the Internet, but is designed to repackage multicast data packets so they appear to be unicast data packets.

MIDI (Musical Instrument Digital Interface) A standard format for sending instructions to a musical synthesizer.

modifier track A track in a movie that modifies the data or presentation of other tracks. For example, a "tween" track is a modifier track.

mount point A string used to identify a live stream, which can be a relayed movie stream, a nonrelayed movie stream, or an MP3 stream. Mount points that describe live movie streams always end with an .sdp extension.

mov The Apple QuickTime movie file extension used to name both movie redirect files and actual QuickTime media files.

movie A structure of time-based data that is managed by QuickTime. A QuickTime movie may contain sound, video, animation, or a combination of data types. A QuickTime movie contains one or more tracks; each track represents a single data stream in the movie.

MP3 (MPEG layer 3) A popular format for compressing music.

MPEG-4 An ISO standard based on the QuickTime file format that defines multimedia file and compression formats.

multicast An efficient, one-to-many form of streaming. Users can join or leave a multicast but cannot otherwise interact with it.

multihoming The ability to support multiple network connections. When more than one connection is available, Mac OS X selects the best connection according to the order specified in Network preferences.

NAT (Network Address Translation) A method of connecting multiple computers to the Internet (or any other IP network) using one IP address. NAT converts the IP addresses you assign to computers on your private, internal network into one legitimate IP address for Internet communications.

open source A term for the cooperative development of software by the Internet community. The basic principle is to involve as many people as possible in writing and debugging code by publishing the source code and encouraging the formation of a large community of developers who will submit modifications and enhancements.

packet A unit of data information consisting of header, information, error detection, and trailer records. QTSS uses TCP, UDP, and IP packets to communicate with streaming clients.

pixel A single dot in a graphic image with a given color and brightness value.

playlist A set of media files in the QTSS media folder specified to play one after the other or in random sequence.

port A sort of virtual mail slot. A server uses port numbers to determine which application should receive data packets. Firewalls use port numbers to determine whether or not data packets are allowed to traverse a local network. "Port" usually refers to either a TCP or UDP port.

privileges Settings that define the kind of access users have to shared items. You can assign four types of privileges to a share point, folder, or file: read/write, read-only, write-only, and none (no access).

progressive download Movie data that is pushed via HTTP to the client. The movie can be viewed by the user as it is being transferred. This is not a form of media streaming.

protocol A set of rules that determines how data is sent back and forth between two applications.

proxy server A server that sits between a client application, such as a web browser, and a real server. The proxy server intercepts all requests to the real server to see if it can fulfill the requests itself. If not, it forwards the request to the real server.

QTSS (QuickTime Streaming Server) A technology that lets you deliver media over the Internet in real time.

QuickTime A set of Macintosh system extensions or a Windows dynamic-link library that supports the composition and playing of movies.

QuickTime Player An application, included with the QuickTime system software, that plays QuickTime movies.

QuickTime Pro A version of QuickTime Player with advanced features, primarily the addition of editing capabilities.

RAID (Redundant Array of Independent Disks) A hard disk array that either increases the speed of disk input and output or mirrors the data for redundancy, or provides both of these features. Users may access the RAID as if it were one drive, although it may be divided into multiple partitions.

reference movie A .mov file created using a utility program like MakeRefMovie, available at no cost from Apple for Macintosh and Windows. The file contains the location of a streaming media file and can also contain the locations of multiple streaming files. A reference file linked from a webpage, for example, can direct a client player to the on-demand presentation encoded for its particular connection speed.

reflected stream A live broadcast delivered as a unicast stream. Movie and MP4 playlists also generate reflected streams.

relayed stream A stream that is passed from one server to one or more other servers. Relays can also be used to generate a multicast stream. QTSS does not support relaying of MP3 streams.

RTP (Real-Time Transport Protocol) An end-to-end network-transport protocol suitable for applications transmitting real-time data (such as audio, video, or simulation data) over multicast or unicast network services.

RTSP (Real Time Streaming Protocol) An application-level protocol for controlling the delivery of data with real-time properties. RTSP provides an extensible framework to enable controlled, on-demand delivery of real-time data, such as audio and video. Sources of data can include both live data feeds and stored clips.

sample rate The number of samples per second used for audio. Higher sample rates yield higher quality audio than lower sample rates.

SDP (Session Description Protocol) A text file used with QuickTime Streaming Server that provides information about the format, timing, and authorship of a live streaming broadcast and gives the user's computer instructions for tuning in.

SMTP (Simple Mail Transfer Protocol) A protocol used to send and transfer mail. Its ability to queue incoming messages is limited, so SMTP usually is used only to send mail, and POP or IMAP is used to receive mail.

sprite An animated image that is managed by QuickTime. A sprite is defined once and is then animated by commands that change its position or appearance.

SSL (Secure Sockets Layer) An Internet protocol that allows you to send encrypted, authenticated information across the Internet.

static IP address An IP address that is assigned to a computer or device once and is never changed.

streaming Delivery of video or audio data over a network in real-time, as a stream of packets instead of a single file download.

TCP (Transmission Control Protocol) A method used along with the Internet Protocol (IP) to send data in the form of message units between computers over the Internet. IP takes care of handling the actual delivery of the data, and TCP takes care of keeping track of the individual units of data (called packets) into which a message is divided for efficient routing through the Internet.

temporal compression Image compression that is performed between frames in a sequence. This compression technique takes advantage of redundancy between adjacent frames in a sequence to reduce the amount of data that is required to accurately represent each frame in the sequence. Sequences that have been temporally compressed typically contain *key* frames at regular intervals.

track A QuickTime data structure that represents a single data stream in a QuickTime movie. A movie may contain one or more tracks. Each track is independent of other tracks in the movie and represents its own data stream.

TTL (time-to-live) The specified length of time that DNS information is stored in a cache. When a domain name–IP address pair has been cached longer than the TTL value, the entry is deleted from the name server’s cache (but not from the primary DNS server).

tween track A track that modifies the display of other tracks.

UDP (User Datagram Protocol) A communications method that uses the Internet Protocol (IP) to send a data unit (called a datagram) from one computer to another in a network. Network applications that have very small data units to exchange may use UDP rather than TCP.

unicast The one-to-one form of streaming. If RTSP is provided, the user can move freely from point to point in an on-demand movie.

URL (Uniform Resource Locator) The address of a computer, file, or resource that can be accessed on a local network or the Internet. The URL is made up of the name of the protocol needed to access the resource, a domain name that identifies a specific computer on the Internet, and a hierarchical description of a file location on the computer.

VBR (variable bit rate) A method of compressing data that takes advantage of changes in the media’s data rate.

wav A Windows format for sound files.

webcast A broadcast of live video or audio on the Internet.

XLR plug A three-pin audio connector that can be used with three-wire balanced cables, which cause electromagnetic interference to be canceled out.

XML An extensible markup language, similar to HTML but more formal and more flexible.

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