
"...If you're delivering a lot of streaming content over the Internet, telecommunications bandwidth is typically the major expense. Leasing costs for the high-bandwidth digital lines you need can cost more per week than your server and software cost annually."

—"Setting up a Streaming Server"
QuickTime Book⁵⁰

If your files are MBR (multiple bit rate) encoded, use the above equation for each stream contained in every MBR file. Add the results of your calculations for all of your streaming media files together, then don't forget to add the amount of storage you need for the server software itself, and whatever incremental capacity you anticipate needing.

What about my Internet connection?

Perhaps surprisingly, the capacity of the streaming server is not typically the limiting factor for throughput—the bandwidth of your Internet connection is what really counts. "A single Macintosh running QuickTime Streaming Server can deliver up to 1,000 simultaneous streams at 56 kilobits each, or an aggregate of over 50 megabits per second. That's enough to saturate 40 T1 connections to the Internet, or to completely swamp five 10Base-T Ethernet LANs."⁵¹

But the good news is that you only need enough bandwidth to accommodate the amount of streaming you plan to do... To serve a small number of streams from your home or office, 128K DSL is the minimum you should consider. Cable modem can be used, but continual traffic fluctuations make the network unreliable, potentially compromising the quality of your streams. In fact, attempting a live Webcast over a cable modem connection would be unwise. A single T1 line can carry enough streaming data

to serve 25 end-users simultaneously connected at 56K. Whatever your connection, be sure to check with your ISP—your throughput will be limited by your ISP's backbone carrier; some ISPs are better prepared for the anticipated explosion of streaming media demand than others.

So just how much bandwidth *do* you need? Let's use a bit more bandwidth math to figure it out—the bandwidth required for serving content can be calculated by multiplying the data rate (in kilobits per second) of your streaming production(s) by the maximum number of simultaneous streams you expect to serve:

$$\text{Kbps} \times \text{maximum number of simultaneous streams} = \text{Kbps of bandwidth needed}$$

Example bandwidth calculations

Data rate of streams	Max. audience size	Bandwidth needed	Example connection
20 Kbps	60	1,200 Kbps or 1.2 Mbps	T1
60% 20 Kbps plus 40% 80 Kbps	100	4,400 Kbps or 4.4 Mbps	Fractional T3
80 Kbps	100	8,000 Kbps or 8 Mbps	10 Mbps fractional T3
20 Kbps	2,000	40,000 Kbps or 40 Mbps	T3

Enough math already! I just want to *make* streaming media...

We've got good news for you... If you don't want to mess around with servers, you don't have to. Just as there are Web hosting providers, there are hosting services that can serve your streaming media files for you. Should you serve your own streaming media or outsource?

"...Define your target audience: Are they dial-up or broadband customers? Is your content video, audio or both? Live or on-demand? Is your content mission critical? How much redundancy do you require? Do you require support or do you have the expertise to run the hardware and software? Do you want yourself or someone else to take the page at 3am when the service is down?"

—Steve Stevenson
StreamingMedia.com⁵²

⁵⁰ QuickTime for the Web, by Steven W. Gulie, May 1, 2000, Morgan Kaufmann Publishers

⁵¹ Ibid.

⁵² "Choosing a Hosting Provider," by Steve Stevenson, http://www.streamingmedia.com/tutorials/view.asp?tutorial_id=52

"...quantify what you will need from a host and do your due diligence in investigating hosting companies. Ask for a free evaluation to test their service and talk to your friends in the industry of their experiences... make sure you have weighed the factors of service, availability, speed, reliability, support, and quality."

—Gene Shin
StreamingMedia.com⁵³

What do streaming host providers have to offer?

A streaming service or an ISP that hosts streaming media is a very attractive choice for the hobbyist or small business—you get to do the creative part and leave most of the technicalities (and capital expenditures) to experts. For industrial-strength, global implementations, there are enterprise-focused co-locations that maintain streaming server farms and dedicated bandwidth. Like top-notch Web hosting co-locations, they provide security, dedicated or shared servers, load balancing, edge-caching, e-commerce transaction capabilities, metrics, and reporting. Some specialized streaming host providers also offer encoding and Web casting services.

How do the costs compare?

Several popular consumer-focused ISPs host streaming content at very reasonable prices—we've seen advertisements for as low as \$9.95 per month. The costs to set up a streaming server in-house can range from \$3,500 for hardware and software (really a consumer solution) up to \$25,000 or more for an adequate corporate system, and into the hundreds of thousands of dollars for an enterprise-level, live Web-casting facility. Commercial quality hosting costs are likely to be thousands of dollars per month, but before you make the capital investment to do it

in-house, remember that streaming technology is rapidly advancing. Be sure to do the math to determine the scope of your hosting needs and investigate potential providers with care. Ask direct questions about set-up fees, surcharges (apparent and hidden), length of contract, upgrade/downgrade fees, and reporting costs. And don't forget that this is an emerging industry—*everything* is negotiable!

SHOULD YOU SERVE YOUR STREAMS IN-HOUSE OR OUTSOURCE?

FOR ENTHUSIASTS:

If you are a hobbyist or have a very small business, and you want to stream a few, short clips, the easiest option is to outsource. Check with your ISP—in addition to offering Web hosting, they may provide streaming media hosting services, as well. There are also some, primarily consumer-targeted, businesses offering streaming services for free or for very low monthly rates—check out iClips, SpotLife, StreamCode, and QuickStream, to name just a few.

If you're an intrepid "stream-it-yourself," you may want to set up your own server. To stream media yourself requires a combination of hardware, software, and bandwidth—here are some minimum basics:

- ▶ 500MHz processor
- ▶ 128K RAM
- ▶ Video capture card
- ▶ Minimum 7200rpm hard drive
- ▶ Minimum connection 128K DSL
- ▶ Video editing software (e.g., Adobe Premiere)
- ▶ Encoding and server software (e.g., Windows Media, RealMedia, QuickTime)

To serve a small number of streams from your home or office, you will need at least 128K DSL speeds. Cable modems will suffice, although the amount of traffic on the network is unpredictable and may degrade the quality of the streams you provide. You definitely won't be supporting a live Webcast using a cable modem, because you need a reliable, dedicated connection that does not fluctuate connection rates. By doing it yourself, you are limited to the backbone carrier of your ISP where your streams may suffer from network congestion or limited bandwidth availability due to the ISP's network.

FOR CORPORATE IT DEPARTMENTS:

You probably do not want to set up in-house streaming capabilities if:

- ▶ You lack a well-developed internal network and a high-speed (T1+) Internet connection with excess bandwidth
- ▶ Management wants existing IT staff to focus on core competencies and/or progress on mission critical tasks cannot be derailed by a new initiative and/or existing IT staff has significant project backlog
- ▶ Staff has little or no experience with Web hosting, video streaming, or video conversion
- ▶ No network management function is in place to ensure availability, performance, and bandwidth utilization for a streaming system
- ▶ No access to video editing suite and editing/conversion tools
- ▶ No existing server resources available to provide video streaming service
- ▶ Number of concurrent video streams is likely to vary significantly
- ▶ Bandwidth usage during peak video demand is likely to exceed surplus bandwidth or compete/degrade performance of mission critical applications
- ▶ Monthly cost with no capital or up-front expenditures for equipment or software is preferred; organization willing to pay higher monthly costs to reduce short-term risk
- ▶ Very short timeline to implement; desire is to begin streaming in days
- ▶ Organization is unsure of the role of streaming media
- ▶ Company wishes to pilot a streaming media program, and may bring it in-house after pilot is successful

FOR CORPORATE IT DEPARTMENTS:

It may make sense to set up in-house streaming capabilities if:

- ▶ You already have a significant internal network and high-speed (T1+) Internet connectivity with significant surplus bandwidth available on Internet uplink
- ▶ Staff has experience in web hosting, video streaming, and video conversion
- ▶ Network management ensures effective bandwidth utilization
- ▶ Organization already owns video editing suite and editing/conversion tools
- ▶ Data center has adequate existing server resources available to provide video streaming service
- ▶ Number of concurrent video streams is expected to be fairly consistent
- ▶ Bandwidth usage during peak video demand will be significantly less than available surplus bandwidth
- ▶ Preference is to incur capital expenses (servers, tools, software, etc.) to avoid recurring charges; organization willing to make long-term investments for lower costs
- ▶ Organization is willing to spend time and money to purchase equipment/software/tools, and to build infrastructure
- ▶ IT department has existing excess staff to implement, manage, and monitor the streaming media solution.
- ▶ Organization has a clear vision of media streaming strategy

INTEGRATING STREAMING MEDIA

How do I link my streaming media to my Web page?

If you use a standard HTML `<a href>` tag, browsers will download the streaming media file just as if it was being served by a Web server—that is, the file must download completely before being played from the user's hard drive—as you know, this is *not* streaming.

To differentiate between a downloadable media file and a streaming media file, a media **metafile** is used. The link you insert into your Web page points to the metafile, which is posted on the Web server. The metafile, which is a simple text file, invokes the correct media player on the client desktop, locates the selected streaming media file on the streaming media server and, as the streaming media file downloads, redirects it from the browser to the media player.

Metafile extensions and streaming media file extensions

Architecture	Metafile Extensions	Streaming Media File Extensions
RealMedia	.rpm or .ram	.rm
Windows Media	.asx, .wax, or .wvx	.asf or .wmv (.wma for audio)
QuickTime	.mov or .sdp	.mov (sometimes .qt or .qti)

The QuickTime approach is a bit different from RealMedia and Windows Media. In the QuickTime architecture, the streaming instructions are embedded right into the movie as a **hint track**, and the link from the Web page goes directly to the streaming server. But some browsers will automatically attempt to open an RTSP URL with the specified default player, which may not be QuickTime. To be sure the QuickTime player is invoked, a form of metafile which Apple calls a **reference movie** can be employed; to take advantage of QuickTime's answer to MBR—alternate bit rate files—a reference movie *must* be used. A reference movie is a separate, tiny .mov file published on your Web server. When invoked, the reference movie calls up the appropriate streaming (i.e., hinted) movie file from the streaming media server. Live feeds in QuickTime use a more standard metafile scheme, with a text file format called SDP (Session Description Protocol); the SDP file is published on the Web server and points to the proper location on the broadcasting media server.

"[SMIL] is a simple but powerful markup language that lets you coordinate the clips so that they each play how, when and where you want them to... If you are familiar with other Web-based markup languages, such as HTML, you will pick up SMIL quickly. You'll need to be careful, though, because SMIL is less forgiving than HTML. Lapses that may not matter in HTML markup, such as missing quotations marks... will prevent a SMIL file from working properly."

—SMIL Basics
realnetworks.com54

Integrating streaming media into a rich media experience

A Web page is often like a three-ring circus, with different things going on, in different places, on different timelines. It has been difficult for Web developers to synchronize presentations comprised of assorted components, especially when those components are served up from different locations via connections that are each subject to their own congestion patterns. **Synchronized Multimedia Integration Language**, or SMIL (pronounced "smile"), lets Web developers choreograph rich media presentations, including streaming media, with comparative ease.

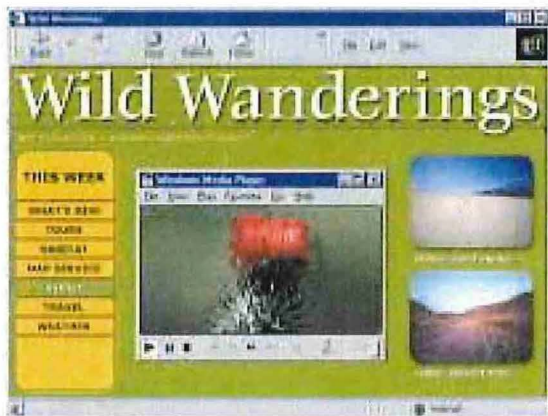
SMIL, based on the language XML, is reputed to be as easy to learn and use as HTML. It can, of course, be written with a text editor, but there are several convenient SMIL editors now available for this relatively new technology. In essence, SMIL is to RTSP and media servers what HTML is to HTTP and Web servers—it is the language that best takes advantage of the benefits of the streaming protocol. And, as HTML is the standard language used to coordinate the content displayed on Web browsers, SMIL is the language that is rapidly becoming the standard for coordinating the content played on media players. Once your "clips" (e.g., video, text, still images, animations, etc.) are encoded in their streaming (or other) formats, you assemble your presentation using SMIL.

The end-user must have an SMIL-enabled media player or browser to take advantage of SMIL files. The latest versions of all three dominant architectures' players and several others', as well as the newest version of Internet Explorer, are compliant.

SMIL offers numerous benefits:

- ▶ **Bandwidth negotiation**—Similar to QuickTime's alternate bit rate scheme, you can individually encode and optimize your media files to get the best result at different bit rates. SMIL can automatically negotiate the appropriate file to stream, depending on available bandwidth, without the quality compromises inherent in MBR files.
- ▶ **Personalized content**—A SMIL file can list different language or content options for clips. For example, to create a video with soundtracks in different languages or soundtrack content targeting different audiences, you could produce just one video clip, with no soundtrack, then create separate audio clips for each language or version. Your SMIL file has just one link, and the appropriate soundtrack is synchronized and streamed with the video, based on the preferences each end-user set-up in his/her media player.
- ▶ **Interactivity**—Using SMIL, you can easily create interactive media presentations, such as an audio or video jukebox that plays a different clip each time the user clicks a button.
- ▶ **Flexibility and control**—SMIL puts the developer in control of the presentation. When your presentation includes multiple clips, you can use SMIL to define the layout. You can start playing a clip at any point in its internal timeline, without changing the encoded clip itself. And, since a SMIL file lists a separate URL for each clip, you can assemble presentations from clips stored on any server (media and/or Web servers), anywhere.
- ▶ **An open standard**—SMIL can be used to choreograph a wide variety of file formats for a variety of different media players and browsers.

This Web page, with its embedded media player, was assembled with Adobe GoLive and other tools in the Adobe Streaming Media Collection



"It is easier to run the streaming player as a stand-alone application, but if you are creating content that needs to be very interactive or needs to be integrated with other Internet technologies, embedding is the way to go... Lately, most popular player platforms have been implementing interactive content through information included in metafiles (SMIL, ASX, RAM). This new trend has made it easier to create the interactivity that developers are looking for, but it is still not as extensible as embedding the player.

—Gene Shin
StreamingMedia.com53

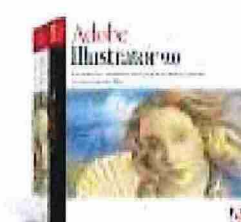
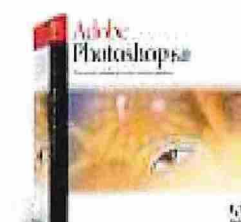
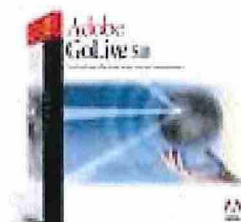
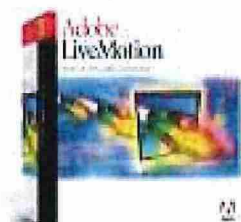
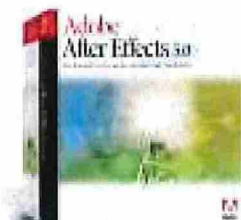
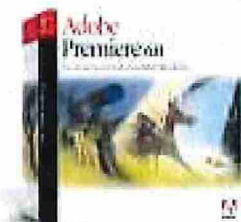
What about embedding streaming media into my Web pages?

This question should really be, "What about embedding a streaming media *player* into my Web pages?" When your end-user clicks on a link to access streaming media, the media player first has to load, usually opening a new window that is distinctly separate from the browser window. If you want to provide an experience whereby your streaming content is more seamlessly integrated with your other Web content—including text, still images, animations, music and other audio—as well as high levels of interactivity, you may want to embed a media player into your Web page.

An embedded player can have a custom skin (look and feel), as well as customized controls (functionality). You can also include functions that trigger on mouse-over events, or player states. URL flips triggered by Web markers inserted into the video timeline can synchronize other elements on the Web page with the streaming content.

The drawback to embedding a media player is that you must choose *which* player to embed. The quality of the rich media experience you create for your audience comes at the expense of end-user preferences. If your audience preferences are controlled (e.g., by corporate or institutional dictate) or predictable (e.g., by platform or content), then embedding a player is likely to be a good choice. If, however, you are targeting a widely diverse demographic (e.g., consumers), embedding a player will be sure to diminish the size of the audience you actually reach.

If you plan to embed a media player, especially for implementations where end-users may employ a variety of browsers and/or platforms, you'll need some fairly advanced Web development skills and an understanding of the differences between the different browsers' implementations of JavaScript, Active X controls and plug-ins. To learn more about the specifics of embedding streaming media players, a good place to start is the SDK (software developer kit) downloadable (typically for free) from the Web site of your preferred architecture.



HOW CAN ADOBE HELP ME CREATE STREAMING MEDIA?

The best way to learn more about streaming is to actually start creating your own streaming media content. Powerful, professional Adobe® software products are an excellent choice for creating streaming media, Web graphics, and animations, as well as for integrating all kinds of content into dynamic and compelling Web sites.

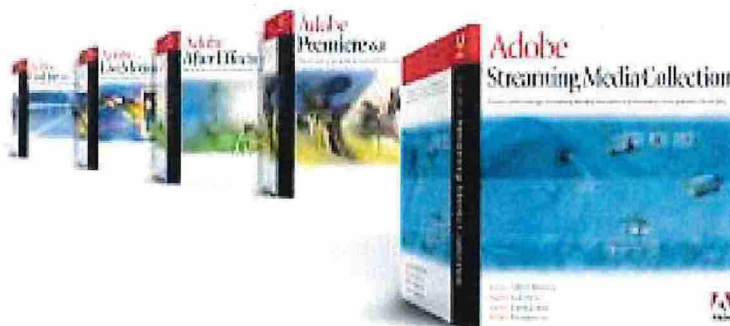
Output to all the most popular streaming formats: One of the best reasons to choose Adobe software for creating streaming media is the broad range of output options available to help ensure that everyone in your Web audience gets the files they need to enjoy your productions. In addition to flexible output options for the traditional video mediums, **Adobe Premiere** offers one-step Web output to all the most popular streaming media formats including RealMedia G2, Windows® Media, and Apple® QuickTime™ streaming formats, through a special, built-in version of Terran Interactive's Media Cleaner EZ 5. Plus, **Adobe Premiere** provides advanced output options for both RealMedia and Windows Media, offering even more precise control. With **Adobe After Effects**, you can render to both the QuickTime and Flash (SWF) formats, as well as outputting for film, broadcast, and multimedia. Tight integration also makes it easy for you to import your **Adobe After Effects** compositions and animations into **Adobe Premiere** to take advantage of all the streaming media output options there.

DV in, Web out.: It can be just that easy. With a DV camcorder and **Adobe Premiere**, any reasonably savvy software user can "Shoot it! Cut it! Web it!" But you'll also find that **Adobe Premiere** software delivers an extraordinarily powerful toolset for every aspect of digital video editing. **Adobe Premiere 6.0** has been rebuilt from the ground up, making this long-popular digital video editing software an even more powerful tool that novices and experienced professionals will all appreciate. **Adobe Premiere** lets you work the way you want to, with more customizable features than ever before, more precise creative control, more time-saving automation, and even a sophisticated new sound-studio-style audio mixer that lets you view your video while mixing multi-track audio in real time. Cross-platform interoperability and tight integration with industry-standard tools, including **Adobe After Effects**, **Adobe Photoshop®**, and **Adobe Illustrator®**, enhance productivity and streamline your workflow. The award-winning Adobe user interface makes **Adobe Premiere** easy to learn and use, sharing many of the same intuitive toolbars, palettes, menus, and other features found in familiar Adobe software products.

A complete streaming solution: Combining comprehensive streaming media and interactive animation with powerful Web capabilities, the **Adobe Streaming Media Collection** delivers the cost-effective toolset professionals need to make Web sites more dynamic. The **Adobe Streaming Media Collection** includes four full-featured Adobe software products:

- ▶ **Adobe Premiere**—The essential tool for professional digital video editing
- ▶ **Adobe After Effects**—The essential tool for motion graphics and visual effects
- ▶ **Adobe LiveMotion™**—Professional web graphics and animation
- ▶ **Adobe GoLive®**—Professional web authoring and site management

Cross-platform interoperability between the components, as well as tight integration with other familiar Adobe products including **Adobe Photoshop** and **Adobe Illustrator** software, supports a highly productive, collaborative workflow and speeds learning. With every component in the **Adobe Streaming Media Collection**, you'll enjoy the extraordinary depth of features and functionality you have come to expect from award-winning Adobe products.



HOW TO PURCHASE ADOBE SOFTWARE PRODUCTS

Via Web:

<http://www.adobe.com/store>

Via Phone:

Adobe After Effects Hotline: (800) 685-3504

Adobe Premiere Hotline: (888) 724-4507

Education customers:

Contact an Adobe Authorized Education Reseller at:

<http://www.adobe.com/education/purchasing/resellers.html>

Free Tryouts:

Adobe After Effects: <http://www.adobe.com/products/aftereffects/tryreg.html>

Adobe Premiere: <http://www.adobe.com/products/premiere/tryreg.html>

To find the reseller nearest you, visit:

<http://www.adobe.com/store/otherplaces/uscanada/main.html>

FOR MORE INFORMATION

There are a variety of resources available for obtaining technical information about *Adobe Streaming Media Collection* products. There also is an abundance of places to share your experiences with other users. For a complete list of these resources go to <http://www.adobe.com>. Additionally, the following digital video resources may be helpful:

VIDEO CAPTURE CARDS:

To find a video capture card that suits your needs and is certified with Adobe Premiere, go to www.adobe.com/premiere; click on the "Capture Cards" link.

BOOKS ON DIGITAL VIDEO:

Adobe Products "Classroom in a Book" by Adobe Press (800) 428-5331
www.adobe.com/products/adobepress

Digital Video for Dummies by Martin Doucette, published by IDG Books Worldwide, Inc., 1999

Real World After Effects by Sherry London and Eric Reinfeld, published by Peachpit Press, Inc.

Creating Motion Graphics with After Effects: High Impact Animation for Video and Film by Trish Meyer and Chris Meyer, published by Miller Freeman Books

DIGITAL VIDEO CONFERENCES:

BDA (Broadcast Designers Association)
www.bdaweb.com

DV Expo
T: (415) 278-5300/F: (415) 278-5200
www.dvexpo.com

IBC (International Broadcasting Convention)
www.ibc.org.uk/

NAB (National Association of Broadcasters)
T: (202) 429-5300/F: (202) 429-5343
www.nab.org

newMedia
www.newmedia.ca/

SIGGRAPH
T: (312) 321-6830/F: (312) 321-6876
www.siggraph.org

WEVA (Wedding & Event Videographers Association)
www.weva.com

DIGITAL VIDEO TRAINING:

Adobe Certified Training Program
Adobe certified trainers listing
www.adobe.com/products/partnerfinder/searchtraining.html

Total Training Inc.
Video training (760) 944-3900
www.totaltraining.com

Digital Institute of Video Arts
Video training (510) 932-2282
www.knowpath.com

Mac/Windows Academy
Training on video cassette
(800) 527-1914/(904) 677-1918
www.macacademy.com

Payne Media Inc.
Video: "Up and Running with Digital Video"
(425) 455-1025
www.paynemediamedia.com

Straight Scoop Enterprises
CD: "Secrets of Adobe Premiere 5"
(503) 643-3976
www.straight-scoop.com

Virtual Training Company (VTC)
CD-based training for Adobe Premiere
(888) TRAIN-CD/(408) 492-1051
www.vtco.com

VideoSynasies: The Motion Graphics Problem Solver
Videotapes by Trish and Chris Meyer
www.deskimages.com/ae.shtm

DIGITAL VIDEO WEB BASED FORUMS:

Adobe User to User Forums
www.adobe.com/support/forums/main.html

Helptalk Online www.helptalk.net/
audiovideo

Digital Editor Online
www.digitaleditor.com

The World Wide Users Group Forums for After Effects Users
www.wug.com/forums/adobe_aftereffect/index.htm

The World Wide Users Group Forums for Premiere Users
www.wug.com/forums/adobe_premiere/index.htm

LIST SERVERS:

Adobe After Effects List-server
www.fido.se/Pages/maillist.html

Adobe Premiere List-server
www.wug.com

The DV-L List Server
www.dvcentral.org

After Effects Mail Group
www.softmotion.com/Pages/start.html; Click on Mailing link; click on Info button for After Effects list

DIGITAL VIDEO NEWSGROUPS:

rec.video.desktop
rec.video.production
rec.video.professional

ADOBE SYSTEMS DIGITAL VIDEO RESOURCES:

Adobe Systems Incorporated
345 Park Avenue San Jose, CA 95110
T: 408-536-6000/F: 408-537-7000

Adobe After Effects Customer Service
800-685-3504

Adobe Premiere Customer Service
888-724-4507

Adobe After Effects for Mac OS Technical Support
206-675-6210

Adobe After Effects for Windows Technical Support
206-675-6310

Adobe Premiere for Mac OS Technical Support
206-675-6205

Adobe Premiere for Windows Technical Support
206-675-6305

Adobe Premiere for SGI Technical Support
206-675-6405/www.adobe.com

Main Customer Support Website
www.adobe.com/support/main.html

Searchable Support Databases Website
www.adobe.com/support/database.html

Techdocs e-mail (automated system)
techdocs@adobe.com

Index of Adobe Premiere and Adobe After Effects documents
310099

Index of all available documents:
100099

GLOSSARY

adaptive streaming: See *MBR*.

analog: The principal feature of analog representations is that they are continuous. For example, clocks with hands are analog—the hands move continuously around the clock face. As the minute hand goes around, it not only touches the numbers 1 through 12, but also the infinite number of points in between. Similarly, our experience of the world, perceived in sight and sound, is analog. We perceive infinitely smooth gradations of light and shadow; infinitely smooth modulations of sound. Traditional (non-digital) video is analog.

animated GIF: GIF is a bitmap file format often used on the Web. GIF (which may be correctly pronounced as either “giff” with a hard “g” or “jiff”) stands for Graphic Interchange Format. Because it applies data compression, GIF is often used for photographic images. An animated GIF combines several images into a single GIF file. Applications that support the animated GIF standard (GIF89A) cycle through the images, creating the impression of motion. The animated GIF format does not provide as much control and flexibility as other animation formats but, because it is supported by nearly every Web browser, has become very popular.

architecture: The structure of the software, or the system of software components, responsible for the creation, storage, and playback of multimedia content. An architecture may include such things such as encoders, compression/decompression support, file formats, server software, and browser plug-ins. Different multimedia architectures offer different features and options, and store data in different file formats. *QuickTime*, *RealVideo*, and *Windows Media* are examples of streaming media architectures.

artifact: Visible degradations of an image resulting from any of a variety of processes. In digital video, artifacts usually result from color compression, and are most noticeable around sharply contrasting color boundaries such as black next to white.

ASF: Defined by Microsoft, “ASF” stands for *Advanced Streaming Format*. ASF is the file format in the Windows Media architecture.

ASP: An *application service provider* (ASP) is a third party entity that manages and distributes software-based services and solutions to customers across a wide area network from a central data center.

aspect ratio: The ratio of an image’s width to its height. For example, a standard video display has an aspect ratio of 4:3.

asynchronous: Not coordinated in time; contrasted with synchronous. In a typical synchronous protocol, each successive transmission of data requires a response to the previous transmission before a new one can be initiated. An asynchronous protocol allows transmissions to occur independently of one another. In computer communications using asynchronous protocols, each piece of data usually has a start bit at the beginning and a stop bit at the end, so that the valid data can be distinguished from random noise. Most communications between computers and devices are asynchronous; the public Internet is based on an asynchronous system.

AVI: Defined by Microsoft, “AVI” stands for *Audio Video Interleave*. AVI is the standard file format for digital video on the Microsoft® Windows® platform. AVI is not a streaming format; ASF (*Advanced Streaming Format*) is the Windows Media streaming format.

bandwidth: The data-carrying capacity of a network. Bandwidth is the maximum amount of data that can travel a communications path in a given time, usually measured in kilobits per second (Kbps). If you think of the communications path as a pipe, then bandwidth represents the width of the pipe, which determines how much data can flow through it at once. Connections of 56 Kbps or lower (typical dial-up connection rates) are considered low-bandwidth, aka *narrowband*. High-bandwidth, aka *broadband* connections are higher than 56 Kbps (e.g., ISDN, DSL, cable modem, T-1).

bit: The smallest unit of data used by computer systems. A bit (short for binary digit) has a value of either 0 (nil) or 1. Bits are the “building blocks” of binary data.

bit depth: See *bitmap*.

bitmap: Also known as *raster*, bitmap data comprises a set of binary values specifying the color of individual *pixels* that make up an image. Bitmap data is characterized by *resolution* and *bit depth*. Resolution relates to the detail in an image, and is expressed in dots per inch (dpi) or pixels per inch (ppi). The higher the resolution (i.e., the more dots used to describe the image), the more detail possible. Bit depth defines the number of colors the image can display. A high-contrast (no grey tones) black and white image is 1-bit, meaning it can be off or on, black or white. As bit depth increases, more colors become available:

Bit depth	Maximum colors
1	2
2	4
4	16
8	256
16	32,768
24/32	16.7 million

For image detail and quality, bit depth is as important as resolution, since the bit depth determines the colors available in the palette. When fewer colors are available, areas that may have shown a subtle shift of tones and hues are rendered instead as single blocks of solid color, eliminating image detail. Bitmap data is indispensable for continuous tone images, such as scanned or digital photographs, and for anti-aliased images. However, bitmap data is consistently larger than vector data. Each pixel in a bitmap image has to be defined. A relatively small 150-pixel x 150-pixel graphic requires 22,500 discrete bits of information plus the palette, or color lookup table (CLUT), that is usually included. For more information see the online Adobe Technical Guides at <http://www.adobe.com/support/techguides/livemotion/lnobjects/page2.html>

bit rate: In a digital network, the number of bits that pass a given point, in a given amount of time, usually a second. Bit rate is usually measured in kilobits (Kbps), or thousands of bits per second. While the term "bit rate" is a synonym for *data transfer rate* (aka *data rate*), bit rate seems to be used more often when referring to telecommunications transmission technology, and data transfer rate (or data rate) is used more often when referring to computing systems.

bluescreen: Video editing technique used to combine a subject with a background shot separately. The subject is shot against a solid blue (or sometimes green) color screen. The blue color can be selected on a frame-by-frame basis, through the use of a video editing system. A matte can then be generated to isolate the subject, in order to composite it onto the desired still or motion background clip.

broadband: High-bandwidth network (Internet or intranet) connections higher than 56 Kbps (e.g., ISDN, DSL, cable modem, T-1).

broadcast: A single stream transmitted to all clients on a network, whereby all the clients experience the same portion of the media program, at the same time, whether the program is live or pre-recorded.

broadcast quality: Standard of quality associated with current expectations of clearly-received network or cable television.

browser: A *client* application, usually with a graphical user interface (GUI), that provides a way to experience and interact with files hosted on a network, such as the Internet or an intranet. Web browsers provide access via the Internet to files posted on the *World Wide Web*. Web browsers use the *Hypertext Transfer Protocol (HTTP)* to make requests of *Web servers* connected to the Internet, on behalf of the browser user. The two most popular browsers in use today are Netscape Navigator and Microsoft Internet Explorer.

buffer: A temporary storage area, or holding place, usually in the RAM (random access memory) of a computer or peripheral device (e.g., a printer), where data can be collected and/or held for ongoing or later processing.

byte: Eight (8) *bits*.

camcorder: A video camera, i.e., a device that records continuous pictures and generates a signal for display or recording. To avoid confusion, it is recommended that the term "camcorder" be used rather than "camera"—in contrast, a digital camera records still images, while a digital camcorder records continuous video images.

capture: If the source footage is analog, "capture" refers to the act of digitization (conversion to a digital format) to make the video usable on a computer and, usually, the simultaneous application of *compression* to reduce the video to a manageable *data rate* for processing and storage. If the source video is *DV*, "capture" typically refers to the simple transfer of video from an external device, such as a digital camcorder or tape deck, to a computer hard drive.

capture card: A printed circuit board that fits into an expansion slot on a computer and provides functionality for capturing video from an external source.

chapterization: The process of placing markers into the timeline of a video to demark the beginning points of sequences, or chapters, to which a viewer may

"jump," at will, during playback, so long as chapterization is supported by the video architecture in use. *True streaming* of video supports chapterization; *pseudo-streaming*, a.k.a. *progressive download*, does not.

client: In a client/server architecture, the client is a software application that makes requests of the *server* on behalf of the end-user. A *Web browser* is a client application; a *media player* is also a client application. Sometimes the term "client" is also used to refer to a PC or workstation (hardware) on a network being used by an individual to access data and/or applications hosted on a server.

clip: A digitized portion of media, typically video or audio.

clipping: Clipping occurs when audio volume reaches or exceeds 0 decibels (db) for 3 consecutive seconds. If you don't lower the volume so it is within the clipping threshold, data will be lost.

codec: Short for *compressor/decompressor*; comprised of algorithms that handle the compression of video to make it easier to work with and store, as well as the decompression of video for playback.

co-location: An outsource, usually a dedicated facility or facilities, that provides physical space for and/or shared usage of essential computer equipment such as Web servers and, often, mission-critical managed services. Co-locations typically provide a high level of security and protection against fire, theft, vandalism, power outages or irregularities, and other risks which might, potentially, devastate a business that is reliant on 24/7/365 computer operations.

compositing: The process of combining two or more images to yield a resulting, or "composite" image.

compression: Algorithms used by a computer to reduce the total amount of data in a digitized frame or series of frames of video and/or audio.

datagram: See *packet*.

data rate or data transfer rate: Amount of data moved over a period of time, such as 10MB per second. Often used to describe a hard drive's ability to retrieve and deliver information. Also see *bit rate*.

de-interlacing: The process, usually performed by video editing software, of removing *interlacing* from video originally intended for display on television monitors, in order to make it suitable for display on computer monitors.

delta frame: In *interframe* (a.k.a. *temporal*) *compression*, periodic *keyframes* store all the information that comprises a frame, while delta frames store only the information that changes from frame-to-frame in between keyframes.

digital: In contrast to *analog*, digital representations consist of values measured at discrete intervals. Digital clocks go from one value to the next without displaying all intermediate values. Computers are digital machines employing a binary system, i.e., at their most basic level they can distinguish between just two values, 0 and 1 (off and on); there is no simple way to represent all the values in between, such as 0.25. All data that a computer processes must be digital, encoded as a series of zeroes and ones. Digital representations are approximations of analog events. They are useful because they are relatively easy to store and manipulate electronically.

digital rights management (DRM): Server software that protects against the illegal distribution (a.k.a. pirating) of copyrighted content over the Internet.

digitizing: Act of converting an analog audio or video signal to digital information.

download: The act of one computer requesting and receiving data, via a network, from another computer.

downloadable media: *Media* (i.e., video and/or audio) that can be downloaded and written to disk (i.e., saved onto a computer hard drive); typically refers to media files hosted on a *Web server* (as opposed to a *media server*) which can, and often must, be entirely downloaded and written to disk in order to be played (as contrasted to *streaming media*).

DV: Generally refers to a *digital* video format that incorporates *DV compression*, the type of compression used by DV systems or by a *DV camcorder* that employs the DV format. A standard consumer DV camcorder uses mini-DV tape, compresses the video using the DV25 standard, and has an *IEEE 1394* port for connecting to a desktop computer. The DV designation is also used to for a special type of tape cartridge used in DV camcorders and DV tape decks.

DV25: The most common form of DV *compression*, using a fixed data rate of 25 megabits/sec.

dynamic media: Refers to design elements that incorporate motion and/or sound such as video, animation, and audio.

effect: Distortion of a frame or frames of video to change its appearance; distortion of audio to alter the quality of sound.

encoder: A software application or a device (hardware) used to encode—i.e., compress and format (see *encoding*) digital video or audio.

encoding: Encoding accomplishes two main objectives: 1) it reduces the size of your video and audio files, by means of compression, making Internet delivery feasible, and 2) it saves your files in a format that can be read and played back on the desktops of your targeted audience. Some encoding solutions may also be configured to provide additional processing functions, such as digital watermarking, for example. Encoding may be handled by a software application, or by specialized hardware with encoding software built in. Note that the term *compression* is often used interchangeably with the term “encoding” when referring to the final step in preparing media files for Web distribution; but compression is only a part of the encoding process.

fast-start streaming: Term used in Apple's QuickTime architecture for *progressive download*.

fields: The sets of upper (odd) and lower (even) lines drawn by the electron gun when illuminating the phosphors on the inside of a standard television screen, thereby resulting in displaying an *interlaced* image. In the *NTSC* standard, one complete vertical scan of the picture—or *field*—contains 262.5 lines. Two fields make up a complete television *frame*—the lines of field 1 are vertically interlaced with field 2 for 525 lines of resolution.

FireWire: The Apple Computer trade name for *IEEE 1394*.

Flash: Macromedia Flash is a popular architecture for vector-based Web animation. Often referred to as

“streaming,” Flash does not fit the definition of “true streaming” used in this Primer. While Flash shares some characteristics with *streaming media*, and can simulate video by animating sequential frames, it does not deliver standard, full-motion video file formats over the Web and is constrained to files containing no more than 16,000 frames (approximately 17 minutes of material at 15 fps). The Flash file format, SWF, can be created using Adobe After Effects and Adobe GoLive software, as well as other applications.

FPS: Number of “frames per second,” a method for describing *frame rate*.

frame: A single still image in a sequence of images which, when displayed in rapid succession, creates the illusion of motion—the more frames per second (*FPS*), the smoother the motion appears.

frame rate: The number of images (video frames) shown within a specified time period; often represented as *FPS* (frames per second). A complete *NTSC* TV picture consisting of two fields, a total scanning of all 525 lines of the raster area, occurs every 1/30 of a second. In countries where *PAL* and *SECAM* are the video standard, a *frame* consists of 625 lines at 25 frames/sec.

FTP: File Transfer Protocol is the simplest way to exchange files between computers on the Internet. Like the Hypertext Transfer Protocol (*HTTP*), which transfers displayable Web pages and related files, and the Simple Mail Transfer Protocol (*SMTP*), which transfers e-mail, FTP uses the Internet's TCP/IP protocols. FTP is commonly used to transfer Web page files from the on which they were created to a Web server.

hinted movie: Term used in Apple's QuickTime architecture for video files that are formatted for *true streaming*.

hint track: Term used in Apple's QuickTime architecture for the set of streaming instructions which, in the QuickTime streaming format, are embedded right into the movie. Other architectures provide streaming instructions as *metafiles* which are often downloaded separately from the actual movie file.

host: A computer system providing data to be accessed by a user working on a remote system, via a network such as the Internet; can be a synonym for *server*. The term “host” is also used to refer to businesses that provide such systems. A hosting services provider (*HSP*) is an application service provider (*ASP*) dedicated to providing hosting services. A hosting services provider typically operates a Web server farm, at a data center or co-location facility. The term “host” may also be used as a verb, as in “to host” files on a server.

HTML: Hypertext Markup Language is a lexicon of formatting commands typically used to create Web pages. HTML is the language that describes all the basic elements of a page (such as text and graphics), but its current incarnation can't do much to make a page interactive; Java and ActiveX are often used to build interactivity into Web pages.

HTTP: HyperText Transfer Protocol comprises the underlying set of rules used by the World Wide Web to define how messages are formatted and transmitted, and to communicate what actions Web servers and browsers should take in response to various commands. For example, when a URL is specified in a browser, an

HTTP command is sent to a Web server directing it to fetch and transmit the requested Web page.

HTTP streaming: See *progressive download*.

hypertext: A database system wherein objects (text, images, video, audio, and applications) can be linked to each other. For example, while reading an article about jazz music, you might click on the name of a musician to see a photograph, biography, or discography; you might click on the name of a song to hear it played or to view score. A Web page is simply a graphical user interface (GUI) used to convey a hypertext document.

IEEE 1394: The interface standard that enables the direct transfer of DV between devices such as a DV camcorder and a computer; also used to describe the cables and connectors utilizing this standard.

i.LINK: The Sony trade name for *IEEE 1394*.

inter-frame compression: Also known as *temporal compression*, inter-frame compression reduces the amount of video information by storing only the *differences* between frames.

interlacing: System developed for early television and still in use in standard television displays. To compensate for limited persistence, the electron gun used to illuminate the phosphors coating the inside of the screen alternately draws even, then odd horizontal lines. By the time the even lines are dimming, the odd lines are illuminated. We perceive these "interlaced" fields of lines as complete pictures.

intra-frame compression: Also known as *spatial compression*, intra-frame compression reduces the amount of video information within each frame individually.

IP: Internet Protocol, the basis of most Internet protocols, breaks up large chunks of information into digestible *packets*. In addition to the data being conveyed, each packet (also known as a *datagram*) carries a header containing the source and destination *IP addresses*, as well as a sequence number that allows the destination computer to reconstruct the packets in the correct sequence, when they arrive.

IP address: A numeric identifier for a computer or device on the Internet. An IP address consists of four numbers separated by periods, or dots (e.g., 192.168.0.1), representing a unique 32-bit address. An IP address consists of a network portion and a host portion; how many bits designate the network and how many designate the host varies.

KB: Kilobytes

Kbps: Kilobits per second

keyframe: A frame selected at the beginning or end of a sequence of frames, that is used as a reference for any of a variety of functions. In inter-frame video compression, keyframes typically store complete information about the image, while the frames in between may store only the differences between two keyframes.

live feed: Data which is fed to a server in real time (i.e., as it is recorded), rather than being pre-recorded.

live-live: Sometimes used to refer to the streaming of a *live feed*.

lossy: Generally refers to a compression scheme or other process, such as duplication, that causes degradation of signal fidelity.

lossless: A process that does not affect signal fidelity; e.g., the transfer of DV via an IEEE 1394 connection.

MB: Megabytes

M-Bone: The MBONE (Multicast Backbone) is a virtual network layered on top of the physical Internet to support the routing of multicast packets. For more information, see www.mbone.com.

Mbps: Megabits per second

MBR: Short for *multiple (or multi) bit rate*, and also known as *adaptive streaming*, MBR is a technique by which several streams, compressed at different bitrates, are encoded together into a single file. When the client calls for the media file, a negotiation between client and server determines the available bandwidth, and the appropriate stream is transmitted.

media: A term with many different meanings, in the context of *streaming media*, it refers to video, animation, and audio. The term "media" may also refer to something used for storage or transmission, such as tapes, diskettes, CD-ROMs, DVDs, or networks such as the Internet.

media server: Specialized server software that takes advantage of appropriate Web transfer protocols such as RTSP (real time streaming protocol), as well as special communication techniques between clients and servers, to facilitate the continuous playback of synchronized audio and video in real time, adjusting the streams transmitted to the actual bandwidth available. Media server software may be running on discrete hardware, or can be deployed in combination with Web server software running on the same device.

metafile: A file containing information that describes or specifies another file. Some streaming media formats use metafiles to invoke the client media player and/or to specify the location of a streaming file on a media server.

mic: Pronounced like "mike," short for microphone.

MPEG: *Motion Pictures Expert Group* of the International Organization for Standardization (ISO) has defined multiple standards for compressing audio and video sequences. Setting it apart from *JPEG* which compresses individual frames, MPEG compression uses a technique where the *differences* in what has changed between one frame and its predecessor are calculated and encoded. MPEG is both a type of *compression* and a video *format*. "MPEG-1" was initially designed to deliver near-broadcast quality video through a standard speed CD-ROM. Playback of MPEG-1 video requires either a software decoder coupled with a high-end machine, or a hardware decoder. "MPEG-2" is the broadcast quality video found on DVD's. It requires a hardware decoder (e.g.; a DVD-ROM player) for playback. "MPEG-4" is a relatively new standard, now being used in some architectures for streaming media.

multiple (or multi) bit rate: See *MBR*.

multicast: Multicast is an efficient way to transmit the same media stream to many recipients simultaneously, by replicating the stream at router hops where the path to different multicast group members diverges. Multicast end-users experience the same portion of the media, at the same time (in contrast to *unicast*, which can allow each end-user to control their own experience

when accessing pre-recorded, or on-demand, files). The infrastructure to handle multicasting, known as the *M-Bone* (multicast backbone) is still emerging; the Internet is not yet ready for the popular proliferation of multicasting. The terms "multicast" and *narrowcast* are sometimes used interchangeably, although "multicast" more specifically refers to the actual technology inherent in the process.

narrowband: Low-bandwidth (typically dial-up) network connections usually 56 Kbps or lower.

narrowcast: Transmission of media to multiple end-users but, as differentiated from *broadcast*, not to everyone on a network

NTSC: *National Television Standards Committee* standard for color television transmission used in the United States, Japan and elsewhere. NTSC incorporates an *interlaced* display with 60 *fields* per second, 29.97 *frames per second*.

on-demand: Media which is not transmitted live, as it is recorded, but is made available as an archive on a server, for end-users to access when they wish. A television broadcast is "live," renting a video and watching it at home is "on-demand."

optimize: Another term for *pre-process*.

packet: Although computers and modems can send data one character at a time, it's more efficient to send information in larger blocks called data "packets," or *datagrams*. When using the standard Internet protocol, TCP/IP, packets are typically around 1,500 characters. Packets consist of the data being transmitted plus the IP address information of the sender and the recipient

PAL: *Phase-alternating line* television standard popular in most European and South American countries. PAL uses an *interlaced* display with 50 *fields* per second, 25 *frames per second*.

pixel: An abbreviation for *picture element*. The minimum computer display element, represented as a point with a specified color and intensity level. One way to measure image *resolution* is by the number of pixels used to create the image.

player: In a multimedia *architecture*, the client software application, typically a *plug-in*, that enables playback of the media.

plug-in: A plug-in extends the capabilities of a Web browser, enabling the client to display or playback a file type which the browser itself cannot handle.

Pre-processing: Sometimes called *optimizing*, pre-processing removes non-essential information from your video and audio—information that is difficult to encode and/or does not substantively add to the quality of the streamed media. So pre-processing prior to encoding reduces the burden on the compressor, potentially saving time and CPU capacity.

post-production: The phase of a film or video project that involves editing and assembling footage and adding effects, graphics, titles, and sound.

pre-production: The planning phase of a film or video project—usually completed prior to commencing production.

production: The phase of a film or video project comprised of shooting or recording raw footage.

progressive download: Also known as *pseudo-streaming*, "progressive download" allows end-users to experience media accessed via a network such as the Internet, while the media file is still in the process of downloading; as opposed to *downloadable media*, which cannot be played back until the entire file is received. Unlike *true streaming*, progressive download leaves a copy of the media file on the client. Progressive download is also called *HTTP streaming* because Web server software using standard protocols (HTTP servers) can deliver progressive download files, unlike true streaming, which takes advantage of the special protocols used by *media server* software to adjust transmission to match the actual available bandwidth.

protocol: A formal description of, i.e., rules for, how specific types of computer systems interact.

pseudo-streaming: See *progressive download*.

QuickTime: Apple's multi-platform, multimedia software *architecture*; used by software developers, hardware manufacturers, and content creators to author and publish synchronized graphics, sound, video, text, music, VR, and 3D media. "QuickTime 4" includes strong support for "real" (RTSP) *streaming*.

RealMedia: *Architecture* developed by RealNetworks to deliver audio and video content on the Web. Along with QuickTime and Windows Media, one of three dominant streaming architectures.

real-time: In computing, refers to an operating mode under which data is received, processed and the results returned so quickly as to seem instantaneous. In terms of streaming media, refers to content streamed live, or as-it-happens.

reference movie: A *metafile* in the QuickTime architecture, used to invoke the QuickTime player and/or to refer the browser to an adaptive bit rate (MBR) file.

resolution: The amount of information in each frame of video, normally represented by the number of horizontal *pixels* times the number of vertical pixels (e.g. 640x480). All other things being equal, a higher resolution will result in a better quality image.

rich media: Another term for *multimedia*.

RTP: Realtime Transfer Protocol is used as the transfer protocol for RTSP streaming (true streaming), and can deliver a streaming media file to one or more end-users simultaneously (i.e., can *unicast* or *multicast*).

RTSP: Realtime Streaming Protocol provides the functionality allowing end-users to randomly access and control the delivery of streaming media content.

server cluster or server farm: A group of networked servers that streamline internal processes by distributing the workload and expedite computing processes by harnessing the power of multiple servers. Load-balancing software tracks demand for processing power from different machines, prioritizing the tasks, and scheduling and rescheduling them depending on priority and demand users put on the network. Redundancy ensures that if one server in the farm fails, another can step in as backup.

SECAM: Similar to PAL at 25 FPS, the SECAM format is employed primarily in France, the Middle East, and Africa. It is only used for broadcasting. In countries employing the SECAM standard, PAL format cameras and decks are used.

skin: A custom GUI (graphical user interface) designed for a specific media player.

SMIL: Pronounced like "smile," SMIL stands for Synchronized Multimedia Integration Language. Like HTML, it is a markup language designed to be easy to learn and deploy on Web sites. SMIL was created specifically to solve the problems of coordinating the display of a variety of multimedia on Web sites. By using a single timeline for all of the media on a page, display can be time-coordinated and synchronized.

spatial compression: See *intra-frame compression*.

static media: Refers to design elements that do not incorporate motion or sound such as still photos or graphics.

stream: Data of a distinct type sent from server to client at a rate defined by the server. For a typical video broadcast, for example, one stream could consist of the video signal, one stream could consist of the audio data, and one stream could contain the closed caption information. In most cases, each stream is served at the rate that it should be rendered by the client.

streaming: Process of sending media over the Internet or other network, allowing playback on the desktop as the video is received, rather than requiring that the entire file be downloaded prior to playback.

SWF: The SWF graphic file format is a version of the Macromedia Flash Player vector-based graphics format introduced in 1997. The SWF file format is ideal for presenting vector-based interactive and animated graphics with sound for the Web. Vector images are ideal for graphics with solid areas of color and distinct object definitions. Because a SWF file is vector-based, its graphics are scalable and play back smoothly on any screen size and across multiple platforms. A vector animation usually has a smaller file size than a bitmap animation. For more information see the online Adobe Technical Guides at: www.adobe.com/support/techguides/webpublishing/flash/

TCP/IP: These two protocols (Transmission Control Protocol/Internet Protocol) were developed by the U.S. military to allow computers to talk to each other over long distance networks. IP is responsible for moving packets of data between nodes. TCP is responsible for verifying delivery from client to server. TCP/IP forms the basis of the Internet, and is built into most every common operating system.

temporal compression: See *inter-frame compression*.

timeline: The graphical representation of program length onto which video, audio and graphics clips are arranged.

true streaming: Affording real-time access to content via the Internet or an intranet, true streaming is enabled by a specialized server application, that relies on streaming protocols to adjust the rate of transmission to accommodate available bandwidth.

tunneling: The use of specially designed paths to carry multicast traffic over the Internet.

24-bit color: Type of color representation used by current computers. For each of the Red, Green, and Blue components, 8 bits of information are stored and transmitted—24 bits in total. With these 24 bits of information, over a million different variations of color can be represented.

UDP: User Datagram Protocol, like TCP, runs on top of IP networks. Unlike TCP/IP, UDP/IP provides very little error recovery, offering instead a direct way to send and receive datagrams over an IP network. It is primarily used for streaming over the Internet.

unicast: The technique whereby a single stream is transmitted to a single end-user; i.e., each end-user gets a unique stream. Bandwidth-hogging unicasting is not as efficient as *multicasting*.

upload: The act of one computer sending data, via a network, to another computer.

URL: A Uniform Resource Locator is the "address" used to find a document or resource on the World Wide Web. The first part of the address specifies the protocol (typically HTTP for Web pages, FTP for files not residing on a Web server, or RTSP for streaming files); the second part specifies the IP address, or domain name; and the rest specifies the directory structure for finding the discrete file on the host computer.

URL flip: A coded marker embedded in the timeline of video or audio that calls up a link to a Web page during playback.

video capture card (or board): Installed inside a computer, adds the functionality needed to *digitize* analog video for use by the computer. Using a hardware or software *codec*, the capture card also compresses video in and decompresses video out for display on a television monitor.

VOD: Video On Demand refers to streaming files that are archived on a streaming server and may be accessed by an end-user at any time, as contrasted with live, or real-time, content.

Webcasting: The technique of broadcasting media over an intranet, extranet, or the Internet.

Web server streaming: Yet another term for *HTTP streaming*, *pseudo-streaming*, or *progressive download*; see *progressive download*.

Windows Media: Offered by Microsoft, one of the three dominant architectures for distributing media on the Web, including streaming media.