

Cisco Systems Delivers IP/TV Services to Macintosh Users

The Cisco IP/TV® solution is known for providing a network-friendly way to deliver high-quality video to PC desktops throughout large organizations. Now Macintosh customers, using the Apple QuickTime 4 application, can also receive a wide range of IP/TV video services.

Unlike many proprietary alternatives, the IP/TV solution implements network video services using open-standard IETF protocols. Apple Computer used the same standards-based approach to design the new QuickTime 4 streaming services. This standards-based approach allows IP/TV servers to interoperate with QuickTime 4 clients in numerous useful ways.

Table 1 lists the protocols and formats, jointly supported by IP/TV and QuickTime 4, that enable QuickTime 4 clients to enjoy IP/TV services. These protocols and formats are described in Appendix D.

Table 1 Jointly Supported Protocols and Formats

Category	Protocol/Format	Notes
Video CODECs	H.261	Apple plans to provide MPEG1 streaming in the future (IP/TV already has MPEG1)
Audio CODECs	PCM, DVI, GSM	Provides a wide range of interoperability
Session Description	SDP	Features a standard announcement format
Media transport	RTP	Includes RTCP for StreamWatch statistics and server stream pruning control
Stream control	RTSP	Includes redirection by the Content Manager for server load balancing
Multicast	IGMP	Provides smart network pruning

Combined QuickTime 4 and IP/TV Capabilities

When QuickTime 4 is associated with the IP/TV solution, the combined applications offer the following advantages:

- Live and prerecorded audio and video programs (QuickTime 4 uses the standard H.261 video format; Apple plans to support MPEG1 and other standard formats.)
- Programs via scheduled multicast or video-on-demand (VoD)
- Distribution of clusters of centrally managed IP/TV servers
- Load balancing, proximity management, journaling, and bandwidth management through the interaction of QuickTime 4 with IP/TV Content Manager
- IP/TV StreamWatch, which gathers and logs user statistics for QuickTime 4 clients

Using QuickTime 4 with IP/TV: Three Approaches

This paper describes three ways of using QuickTime 4 with the IP/TV solution and includes the services and benefits of each approach. All these alternatives offer the same basic video services, but differ in the way users select the content, how the content is announced, and the other communication services that are provided along with the video content.

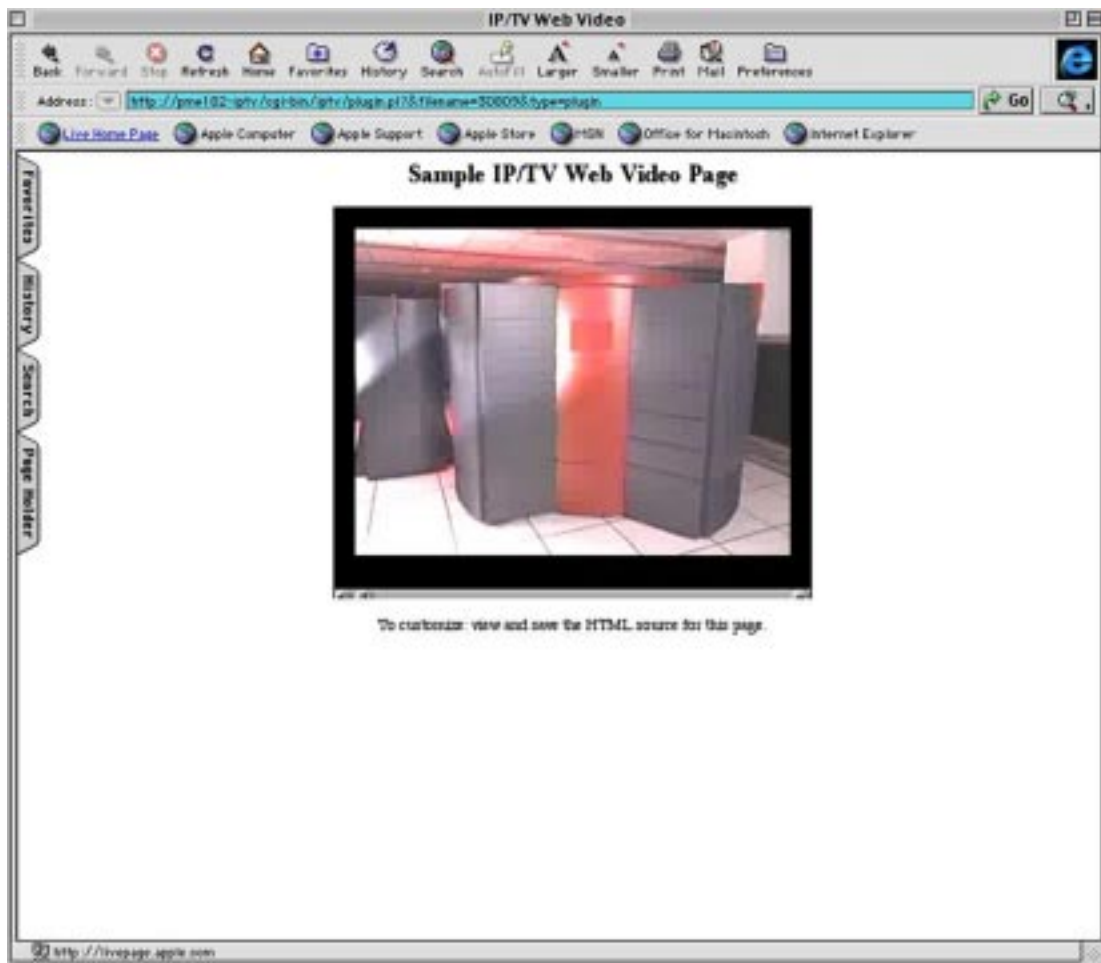
You can choose from the following three options to provide video services for Macintosh users:

- QuickTime 4 plug-in
- QuickTime 4 player application
- QuickTime 4 with the MacTV viewer

QuickTime 4 Web-Browser Plug-In

For a Web-based user experience, you can embed the QuickTime 4 Web-browser plug-in into a Web page and provide links to Session Description Protocol (SDP) files (refer to Appendix B for more information on SDP files) for multicast or Real-Time Streaming Protocol (RTSP) for VoD. This approach lets you add IP/TV videos to your own Web pages and control the look and feel of the environment. The QuickTime 4 Web-browser plug-in gives you artistic flexibility, but requires that you create Web pages and update them as content changes. For more information about QuickTime 4 Web-browser plug-in, including a link to download the application, refer to Appendix A. Instructions for creating Web pages for the QuickTime 4 Web-browser plug-in can be found in Appendix C.

Figure 1 You can enhance your QuickTime 4 Web-browser pages with IP/TV video



QuickTime 4 Player

For basic applications, a simple and low-cost approach is the QuickTime 4 player (Figure 2), which allows you to select from a few fixed channels or programs. Each program is selected using an SDP or RTSP file on the client machine. You can provide a few preconfigured files on the user's desktop or distribute them periodically via e-mail attachments or any other file distribution mechanism.

The new QuickTime 4 player offers more flexibility than the Web-browser plug-in. It provides resizable windows, a favorites list, a graphic equalizer display, and a cool, brushed-platinum look.

Figure 2 The QuickTime 4 player offers a simple, low-cost way to offer the Cisco IP/TV solution to Macintosh users.



MacTV Viewer

QuickTime can be used with MacTV, a shareware client, to provide a ready-to-go solution with a look and feel that is similar to the IP/TV PC client. (<http://members.home.com/joehuber/MacTV>)

The MacTV viewer automatically displays IP/TV program listings from an IP/TV Content Manager (Figure 3). You can select multicast or VoD programs from a catalog or search by keyword. MacTV uses QuickTime 4 to display the streams in multiple, resizable video windows. Its features include SlideCast, Question Manager, Program Search, and Internationalized Program Listings. MacTV can also use NetShow as a helper application for NetShow MPEG4 streams. Figure 4 shows an example of a PowerPoint slide included in an IP/TV program.

Figure 3 MacTV automatically displays IP/TV program listings from an IP/TV Content Manager

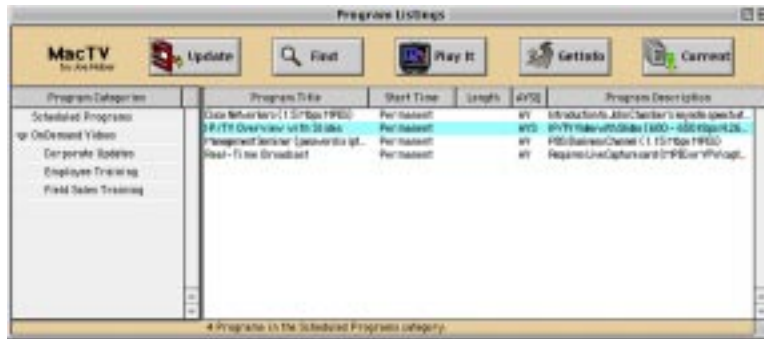
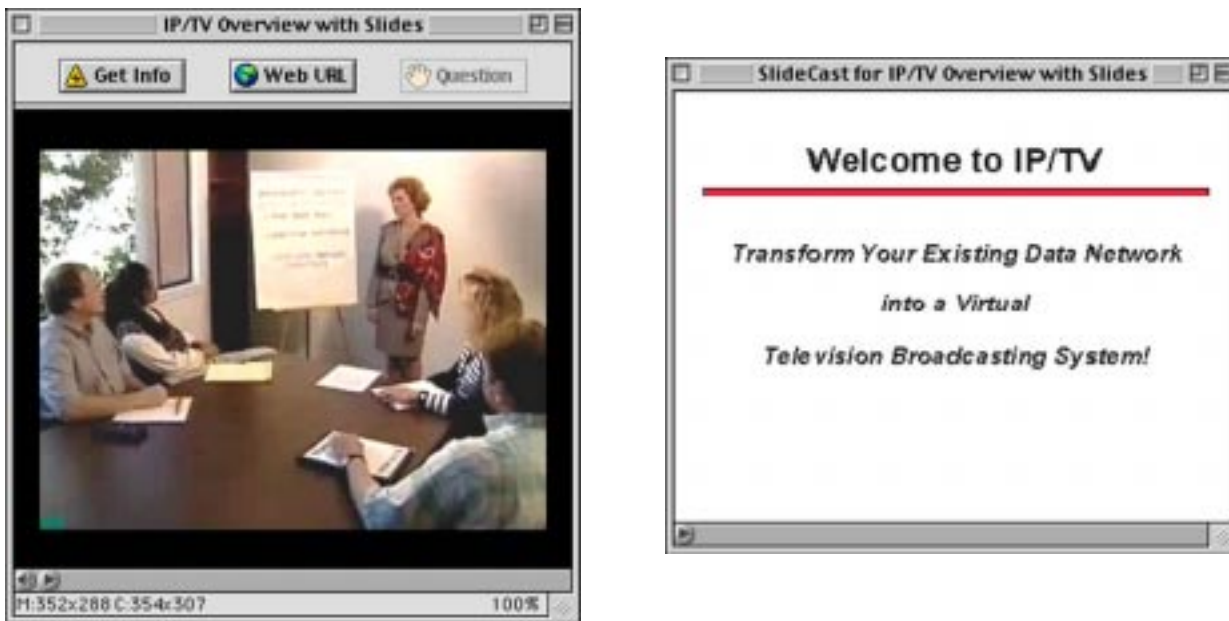



Figure 4 Using the MacTV SlideCast feature, you can include a PowerPoint slide presentation in your program.





Appendix A

Download Information and Links

Information and download sites for QuickTime 4, MacTV, and the IP/TV demo CD are provided in this appendix.

QuickTime 4 Application

QuickTime 4 is available, free of charge, via download from: <http://www.apple.com/quicktime/download/>. The basic QuickTime 4 application is sufficient for any of the solutions described in this paper. The \$29.95 Pro version is not required, but it provides additional viewing, editing, and creative capabilities.

QuickTime 4 minimum Macintosh system requirements

- PowerPC processor (G3 processor preferred)
- At least 16 MB of RAM (32 MB preferred)
- MacOS 7.1 or later (MacOS 8.5 or later preferred)

MacTV Viewer

You can download the MacTV application and product information from: <http://members.home.com/joehuber/MacTV>.

Please note that MacTV is a third-party shareware product and is not sold, endorsed, or supported by Cisco Systems.

IP/TV Demo CD

The IP/TV demo CD provides a good source of prerecorded content and can even generate a live H.261 video stream that is compatible with QuickTime 4. The IP/TV demo server runs on a Windows 95, 98, or NT system and can send both multicast and on-demand videos.

On the IP/TV 2.0 CD, the H.261 formatted content includes the “IP/TV Overview with Slides” program and the scast.rtp and the lbl-261.avi files, which are all compatible with QuickTime 4. Please note that the H.261 formatted content in the IP/TV 3.0 CD has been revised, and the file names may differ from IP/TV 2.0 file names.

You can get more information about the IP/TV solution and request a free IP/TV demo CD from: <http://www.cisco.com/iptv>.

Appendix B

Q & A: Creating SDP Files for QuickTime 4

Q. What are SDP files and why do I care about them?

A. An SDP file is the mechanism that you use to access specific programs. It is a small text file containing the technical parameters defining each program, such as program name, length, network addresses, and so forth. When you want to tune into a program, QuickTime 4 needs an SDP file to understand specifically which program you want and how it should be accessed.

The three methods of using the QuickTime 4 solution with IP/TV are all ways to deliver the desired SDP program information to the QuickTime 4 viewer.

If you use the QuickTime 4 Web-browser plug-in or QuickTime 4 player methods, you need to create SDP files for your programs. The MacTV application automatically gets SDP program information from the IP/TV Content Manager. IP/TV servers and Content Managers also use the SDP format to define programs. Next, we'll explain how the IP/TV Content Manager can help you create SDP files.

Q. How do you create SDP files?

A. This section describes three methods for creating the SDP files used with QuickTime 4 or the IP/TV viewer.

Method 1

This method requires using an IP/TV viewer on a PC:

1. Start the IP/TV viewer application.
2. When the program list is displayed, select the desired program.
3. When the program is highlighted, right-click the mouse and select Copy.
4. Paste the copied information into a text editor (such as Notepad). This data is the session description information and should be saved to a file <filename>.sdp. The filename must end with the.SDP extension.

Method 2

Manually create and edit the small SDP text file. This method requires using an SDP template file, such as the sample.sdf file provided with the IP/TV viewer, or you can copy the scheduled or VoD SDP example that follows. The sample file requires that you enter the specific program data/information between the “< >” symbols.

Sample SDP file for a scheduled program

```
v=0
o=- <random_number> IN IP4 <Streaming_Host_ip_address>
s=<Program name>
i=<additional program information No more the 256 characters>
u=http://<web_page if any>
e=<email address of program owner>
p=<program owner phone number>
m=video <multicast_UPD_port for the video>/1 RTP/AVP 31 32 96
c=IN IP4 <Multicast_ip_address_for_video>/<TTL_for_the_program>
a=rtpmap:96 WBIH/90000
a=quality:10
m=audio <multicast_UPD_port for the audio>/1 RTP/AVP 0 14 3 5 96
c=IN IP4 <Multicast_ip_address_for_audio>/<TTL_for_the_program>
a=rtpmap:96 L8/8000
```

Completed scheduled program SDP file

```
v=0
o=- 30809 1 IN IP4 171.69.235.182
s=LBNL NERSC Computing Center
i=LBNL NERSC Computer Center information Video
e=AV Staff <info@cisco.com>
p=AV Staff <408-526-4000>
b=AS:1331
t=0 0
a=tool:IP/TV Content Manager 3.0.284 Pre-release
a=type:broadcast
a=x-iptv-local:IP/TV Content Manager 3.0.284 Pre-release
a=x-iptv-file:1 name e:\asfroot\lbl-261.avi
a=x-iptv-type:scheduled
m=video 49152/1 RTP/AVP 31
c=IN IP4 239.255.0.1/15
a=x-iptv-svr:video 171.69.235.184 file 1 loop
a=framerate:15.0
a=quality:10
m=audio 16384/1 RTP/AVP 96
c=IN IP4 239.255.0.1/15
a=x-iptv-svr:audio 171.69.235.184 file 1 loop
a=rtpmap:96 L8/8000
```

Sample SDP file for a video-on-demand program

```
v=0
o=- <random_number> IN IP4 <Streaming_Host_ip_address>
s=<Program name>
i=<additional program information No more the 256 characters>
e=<email address of program owner>
p=<program owner phone number>
b=AS:1331
t=0 0
a=cat:65536
a=x-iptv-file:0 name <video_file_name>
a=control:rtsp://<iptv_content_manager>/ProgID=<VoD_program_ID>
a=x-iptv-type:ondemand
m=video 0/1 RTP/AVP 31 32 96
c=IN IP4 0.0.0.0
b=AS:1267
a=x-iptv-svr:video <iptv_content_manager> file 0
a=control:rtsp://<iptv_content_manager>/ProgID=<VoD_program_ID>/video
a=range:npt=0-489.0
a=framerate:15.0
a=quality:10
m=audio 0/1 RTP/AVP 0 14 3 5 96
c=IN IP4 0.0.0.0
b=AS:64
a=x-iptv-svr:audio <iptv_content_manager> file 0
a=control:rtsp://<iptv_content_manager>/ProgID=<VoD_program_ID>/audio
a=range:npt=0-489.0
a=rtptime:96 L8/8000
```

Completed sample video-on-demand SDP file

```
v=0
o=- 921635383 0 IN IP4 171.69.235.182
s=LBNL
i=MAC TEST
e=Cisco Systems (info@cisco.com)
p=Cisco Systems (408-526-4000)
b=AS:1331
t=0 0
a=cat:65536
a=x-iptv-file:0 name lbl-261.avi
a=control:rtsp://pml82-iptv.cisco.com/ProgID=921635383
a=x-iptv-type:ondemand
m=video 0/1 RTP/AVP 31
c=IN IP4 0.0.0.0
b=AS:1267
a=x-iptv-svr:video pml82-iptv.cisco.com file 0
a=control:rtsp://pml82-iptv.cisco.com/ProgID=921635383/video
a=range:npt=0-489.0
a=framerate:15.0
a=quality:10
m=audio 0/1 RTP/AVP 96
c=IN IP4 0.0.0.0
b=AS:64
a=x-iptv-svr:audio pml82-iptv.cisco.com file 0
a=control:rtsp://pml82-iptv.cisco.com/ProgID=921635383/audio
a=range:npt=0-489.0
a=rtptime:96 L8/8000
```

Method 3

This method may be the easiest. Download a copy of the shareware MacTV client from <http://members.home.com/joehuber/MacTV>. Install the MacTV client on a Macintosh and configure it to use your IP/TV Content Manager. Select a program and use the SaveSDP command in the File menu (Command-S) to save the SDP data to a file.

Using the SDP file

Macintosh systems can copy the SDP file created from the above examples to a shared folder or accessible FTP location. When the SDP file is opened with the QuickTime 4 Player, the player joins the multicast stream or requests VoD from the IP/TV Content Manager. Remember that the filename must end with the.SDP extension.

The same SDP file can also be used in an HTML Web page to select a video program.

Appendix C

Creating a Web Page for the QuickTime 4 Web-Browser Plug-In

This section describes how to create a set of Web pages to work with the QuickTime 4 Web-browser plug-in.

Create a video master page that contains links or URLs pointing to files on your Web server that were created using the IP/TV 3.0 Content Manager. To create the necessary HTML file to display the video, use the "Load Plug-In" button, which can be found under the review section of either a scheduled program or under the on-demand programs.

Sample HTML from the "Load" option for a scheduled program:

```
<!--Copyright (c) 1995-1999 Cisco Systems. All rights Reserved.-->
<HTML><HEAD>
<TITLE>IP/TV Web Video</TITLE>
</HEAD>
<BODY BGCOLOR="FFFFFF">
<CENTER>
<H2>Sample IP/TV Web Video Page</H2>
<P>
<!-- BEGIN GENERIC ALL BROWSER FRIENDLY HTML FOR IP/TV 3.0 -->

<OBJECT ID="IPTVPlayer" width=320 height=288 classid="CLSID:364752D0-9065-11D2-8210-0060B0F139BD"
  type="application/x-oleobject">
<PARAM NAME="FileName" Value="http://<CM_HOST>/cgi-bin/iptv/download.pl/30809.sdp">
<PARAM NAME="invokeURLs" Value="false">
<EMBED TYPE="application/sdp" SRC="http://<CM_HOST>/cgi-bin/iptv/download.pl/30809.sdp"
  name="IPTVPlayer" WIDTH=380 HEIGHT=288 invokeURLs=false>
</EMBED>
</OBJECT>
<P>To customize: view and save the HTML source for this page.</CENTER>
</BODY>
</HTML>
```

The portion of the above file that invokes the QuickTime 4 Web-browser plug-in is the "EMBED" line. Please note that "EMBED" includes the MIME type, the IP/TV Content Manager, and a call to the download.pl file with a second command entry that is the program ID and the SDP extension. This creates a dynamic SDP file when the program is requested. Using this method to start the video allows modification of the program without having to modify a static SDP file. This method for embedding video in a Web page works for both scheduled and VoD programs.

Sample HTML from the "Load Plug-In" option for an on-demand program:

```
<HTML>
<!--Copyright (c) 1995-1999 Cisco Systems. All rights reserved-->
<HEAD><TITLE>IP/TV: Web Video</TITLE></HEAD>
<BODY BGCOLOR="FFFFFF">
<CENTER>
<H2>Sample IP/TV Web Video Page</H2>
<!-- BEGIN GENERIC ALL BROWSER FRIENDLY HTML FOR IP/TV 3.0 -->
<OBJECT ID="IPTVPlayer" width=320 height=240 classid="CLSID:364752D0-9065-11D2-8210-0060B0F139BD"
  type="application/x-oleobject">
<PARAM NAME="FileName" Value="http://CM_HOST/servlet/OdPublish?ProgID=921635383">
<PARAM NAME="invokeURLs" Value="false">
<EMBED TYPE="application/sdp" SRC="http://CM_HOST/servlet/OdPublish?ProgID=921635383"
  name="IPTVPlayer" WIDTH=380 HEIGHT=288 invokeURLs=false>
</EMBED>
</OBJECT>
<P>To customize: view and save the HTML source for this page.
</CENTER>
</BODY>
</HTML>
```

The portion of the above file that invokes the QuickTime 4 Web-browser plug-in is the "EMBED" line. Please note that "EMBED" includes the MIME type, the IP/TV Content Manager, and a call to the OdPublish file with a second command entry that is the program ID. This creates a dynamic SDP file when the program is requested. Using this method to start the video allows program modification without modifying a static SDP file. This method for embedding video in a Web page works for both scheduled and VoD programs.

Appendix D

Protocol Glossary

This section describes the transport and signaling protocols used with the IP/TV solution, including IP Multicast, IGMP, TCP, UDP, RTP, RTCP, and RTSP.

- **Internet Protocol (IP) Multicast**—This is used to establish one-to-many communications in which multiple clients can receive the same stream from a server. To receive a multicast, a client must have access to a multicast-enabled network. In contrast, a unicast is a one-to-one connection in which one client receives a distinct stream from a server. The signaling protocol from the client to the network to request to enter or leave a multicast is Internet Group Management Protocol (IGMP).
With IP multicast, a single server stream can be received by an unlimited number of users. This is the most scalable method to reach a large user population. Network hardware and operational conditions are the only elements that limit scalability.
- **Internet Group Management Protocol (IGMP)**—This is the mechanism that end nodes use to signal the network that they are joining a specific multicast group. A host sends an IGMP report to join the multicast group. The network maintains a list of multicast group members. Periodically, the router sends a query to learn which hosts are still part of the group. If the host does not respond to the query, it is pruned out of the multicast group. The version of IGMP in use, v.1 or v.2, is determined by the version of WINSOCK on a Windows machine. The main feature of v.2 is to allow explicit leaves from the multicast group; the router can prune the host from the multicast group without waiting for the next query.
- **Transmission Control Protocol (TCP)**—This is a connection or session-oriented protocol. Each client connection to the server requires a session setup and breakdown. TCP sessions ensure that packet delivery is completed without intervention from the application using the data. TCP is a more reliable transport that has higher overhead and is more complex than other protocols. For the client, TCP adds reliability; however, that can adversely affect the video-viewing user experience. When TCP is used as the transport for video, the video must wait for any lost packets to be retransmitted causing the entire video to pause for as much as one frame. The additional latency drastically increases the delay in viewing real-time information. For this reason, TCP is not used as the transport for video with the IP/TV solution. TCP is used for the HTTP and RTSP requests from the IP/TV hosts.

- **User Datagram Protocol (UDP)**—This is not a session-based protocol, but connectionless transport protocol. UDP, such as Transmission Control Protocol (TCP), runs on top of IP networks. UDP does not guarantee packet delivery, but delivery that is usually acceptable for streaming media—as long as the occasional lost packets do not become so excessive that viewers notice their absence. UDP provides very few error-recovery services, which in this case is an advantage, as it makes UDP a more efficient and direct way to send and receive datagrams over an IP network. UDP does not provide guaranteed delivery, but is useful in situations in which TCP would be too complex, too slow, or unnecessary. It discards video packets that arrive too late to be decoded, allowing content to degrade gracefully. Quality of service (QoS) can be implemented for video applications that need a mechanism to guarantee packet delivery.
- **Real Time Protocol (RTP)**—With its adjunct, Real-Time Transport Control Protocol (RTCP), RTP works in conjunction with UDP to carry streaming data over the network. RTP uses packet headers that contain sequencing information and time stamps required to time the output (for example, display of frames) and synchronize different data streams (for example, audio and video), and information on the packet’s “payload” (for example, MPEG versus H.261 encoding). This payload descriptor allows RTP to support multiple compression types.
- **Real-Time Transport Control Protocol (RTCP)**—This provides feedback on current network conditions and reception quality, allowing applications to automatically adapt to those conditions. For example, a slowdown being experienced by many recipients is most likely due to a network problem—for example, a downed T1 line being backed up by a slower 56-Kbps line—and not to an individual computer. In this case, the source application might choose to make an “on-the-fly” change to its encoding scheme, temporarily eliminate the video portion of a transmission, or switch from color to monochrome to improve the transfer of information. The fact that RTCP sends feedback not only to the sender, but to all other recipients of a multicast stream, allows an individual user determine whether a problem is specific to the local end node or attributable to systemwide problems. The RTCP multicast feedback mechanism also aids in the implementation of third-party network monitors, helping network managers control the quality of multicast distribution. RTCP also provides feedback on who has subscribed to a given group at any time. In a distance training application, for example, this feature can be used to determine who is “attending” the training session.
- **Real Time Streaming Protocol (RTSP)**—This protocol is used to signal the server for audio/video stream control and to control “start-stop-pause” position of the stream on the video-on-demand server. The Cisco IP/TV solution forces all RTSP requests from a client to first contact the content manager, and then redirects each request to the appropriate server or denies service, depending on policy and current available capacity.
- **Hypertext Transfer Protocol (HTTP)**—IP/TV and Macintosh clients use this protocol to obtain programming information. The servers use this protocol to obtain their programming schedules.
- **Session Description Protocol (SDP)**—This protocol describes the format of each program and how to receive and display it. For further technical details you can refer to the IETF RFC-2327 document at <http://www.cis.ohio-state.edu/htbin/rfc/rfc2327.html>



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