



MERCURY INTERACTIVE

WHITE PAPER

# Web Performance Management Solutions for Streaming Media

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## **ABSTRACT**

This paper examines the proliferation of streaming media on the Internet and highlights the challenges companies face in supporting these applications. In addition, it presents Mercury Interactive's solutions for managing the performance of streaming media applications.

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## INTRODUCTION

Streaming media is rapidly bringing the power of audio, video and other rich media to Internet and corporate intranet sites. As a result, it is changing the very nature of the Web and will dramatically impact the Web strategies of companies worldwide.

As customers become more Web savvy, companies are having to reevaluate the effectiveness of their Web sites. Many are realizing that Web sites by themselves no longer constitute a competitive advantage. Even updating Web sites regularly with fresh, informative content is not enough to entice visitors to stay and learn more about products and services. As a result, companies are increasingly turning to streaming media. Rather than simply serving up information, sites with streaming media capabilities can entertain and intrigue visitors, leading to greater retention rates and online sales. Analysts in turn are noting an increase in the use of streaming media applications on the Internet.

- In September 2000, Alexa Research stated that at least 2.7 billion streaming media files were online in May 2000, which is triple the number recorded in August 1999.
- In a study completed in October 2000, Jupiter Research estimated that 68 percent of U.S. Web sites were using streaming media.
- Analysts at Forrester Research estimate that rich media will constitute at least 20 percent of online advertising revenues this year, increasing to 60 percent by 2002.

Like every great advance in technology, streaming media holds a fair amount of promise but is not without its challenges. In particular, the delivery of streaming media dramatically increases bandwidth requirements. Companies must be prepared to meet these increased bandwidth demands if they intend to deliver streaming media effectively to their target audiences. To reap the greatest benefit from this new technology, companies need to test streaming media applications prior to deployment and monitor their performance in production environments.

### WHAT IS STREAMING MEDIA?

Streaming media is a method for transmitting audio, video and other multimedia over the Internet or corporate intranets. Streaming media is used to deliver video files, audio files, image files, animation and text. Streaming media may be user-controlled (as in on-demand, pay-per-view movies) or server-controlled (as in Webcasting).

Streaming media allows users to view media in real time—as it is being delivered—with no (or minimal) download wait. This is in contrast to other mechanisms for viewing audio/visual content, in which all data must download completely before the user can access the media. Because of its real-time component, streaming media offers distinct advantages over non-streaming media. Mainly, visitors no longer need to wait for files to download before viewing them. This is important since multimedia files often are large and require a long time to download. They also can take up considerable space on visitors' hard disks—an issue that is avoided with streaming media.

To play streaming media, each client computer must have a streaming media player. Streaming media players can be downloaded for free from several sources, including RealPlayer from RealNetworks and Microsoft's Windows Media Player. If the streaming media contains audio, a sound card and speakers are also necessary.

#### **HOW DOES STREAMING MEDIA WORK?**

To produce streaming media applications, companies must first capture, record and create the content. Video can come from live recordings from Web cameras, prerecorded video from cameras or VCRs, or video that has already been converted to a file format, such as AVI or QuickTime.

Audio is typically captured at the same time as the video. Quite often additional audio will need to be re-recorded in an environment such as a sound studio, where extraneous noise may be controlled. In addition, narration may be added to accompany the video.

To minimize the network bandwidth consumed by the stream, the audio and video files are compressed using special transport protocols. Data is then delivered in specialized formats to the user as needed. Streaming media uses CODECs (COmpressor/DECompressor) to reduce audio and video files.

When the user plays the files, they are decompressed in real time. The data is decompressed and the file begins playback before the user gets all of the data. The data is delivered approximately five seconds before the user is able to view the presentation. The user is unaware of this five-second delay. When the user clicks on a link, the audio or video begins playing quickly, regardless of the presentation's length.

There are typically two servers involved in posting streaming media files—the Web server that posts the HTML pages and the streaming server that serves the streaming media. Web pages are usually transported from the server to the user via HyperText Transfer Protocol (HTTP). Because of the greater need for speed, many streaming media programs use a faster underlying protocol called the User Datagram Protocol (UDP).

#### **HOW IS STREAMING MEDIA BEING USED?**

Streaming media is being used to enhance Internet sites and corporate intranets. In many respects, streaming media is dramatically altering the ways that companies conduct business. For example, many companies are developing strategies to incorporate voice and video technologies on the Web to support their existing business models and profit from larger and expanding markets.

Increasing numbers of Global 1000 and traditional brick-and-mortar companies are starting to deploy streaming media applications. These companies are using streaming media for the following:

Some of the many ways streaming media is being used include:

- **Online shows**—Some of the most highly publicized uses of streaming media include online broadcasts. One recent high-profile example was the November 2000 Madonna concert, which achieved record attendance of 9 million viewers.

- **E-learning solutions**—Other companies are producing Webcasts to replace corporate training courses. Training on-demand reduces training costs for the company and makes training more available to end users.
- **Digital music distribution**—The music industry is using streaming media for the deployment of high-quality music promotion and secure distribution through pay-per-download and pay-per-stream content capabilities.
- **Interactive product catalogs**—Online product catalogs are being enhanced to include live fashion shows with full-motion video, audio clips and additional narration.
- **Advertising**—Studies conducted by @Home service indicate that rich media advertising significantly increases interaction rates, brand comprehension and retention. Properly designed and executed, rich media ads deliver an enjoyable consumer experience and conversion rates that improve with each iterative campaign. The September 2000 Arbitron/Edison Media Research Internet Study found that more than two-thirds of online listeners and viewers agree that advertising is a fair price to pay for free streaming content.
- **Informational presentations**—Previously, many companies would produce videotapes and then ship them to people on their mailing lists. This process was expensive and left companies with no way of knowing whether the videotapes were ever viewed. That same video now can be streamed over the Internet, enabling companies to eliminate shipping and duplication costs, while monitoring who is viewing the information.
- **Financial Webcasts**—Many companies are streaming audio and video to present corporate earnings calls to their customers.

#### **THE IMPORTANCE OF BANDWIDTH FOR STREAMING MEDIA APPLICATIONS**

Properly designed and executed, streaming media enhances the user experience and increases company revenues. However, when customers have difficulty viewing streaming media applications due to poor performance, they will often abandon a Web site.

Adequate bandwidth is essential for creating a high-quality end-user experience when sending and receiving streaming media. End users who have high-speed Internet access, like DSL (digital subscriber line) and other broadband access, are more impressed with the experience of streamed video content. The emergence of DSL and cable-connected homes has provided the ability to deliver CD-quality music and near-broadcast quality video.

Viewers are far less impressed with the streaming media experience when connected to the Internet with 28.8 kbps or 56 kbps modems, and access content without the high bandwidth. Less than one percent of the world's households use broadband Internet access, according to the 1999 Strategis Group report *International High-Speed Access: The Residential Marketplace*. But the report predicted this figure would grow to 30 percent by 2003 in several markets, including Australia, Canada,

The Netherlands, Singapore, Sweden and the United States. eMarketer and Forrester Research place broadband penetration in the United States currently at 5 to 10 percent of Internet users.

Bandwidth can make or break the streaming media experience. To ensure a positive end-user experience, companies must test and monitor their streaming media applications from a variety of end-user configurations.

## TESTING AND MONITORING STREAMING MEDIA APPLICATIONS

The potential of streaming media may be limitless, but unless it is properly deployed and monitored, streaming media may actually detract from a company's Web presence. According to a recent survey of more than 2,500 Internet users conducted by Impulse Research Corporation, more than three-quarters of those who have watched video clips on the Internet feel the quality of streaming video on the Internet fails to meet their expectations.

These results clearly emphasize the need for adequate testing and monitoring of streaming media applications in both pre- and post-deployment environments.

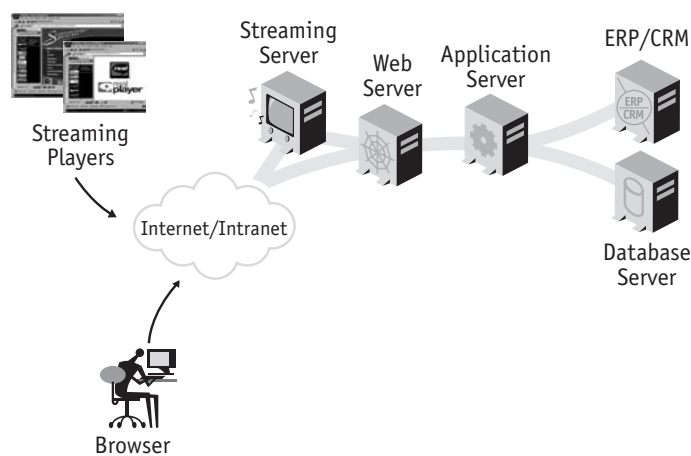


Fig. 1. Streaming media applications involve a multitude of components.

Testing streaming media performance is more complex than testing traditional Web deployments for three reasons. First, the architecture is much more complex. (See Figure 1.) Traditional architectures include a multitude of different browsers, application servers, databases and back-end servers. With streaming media applications, two additional components are involved—streaming players and streaming servers. The streaming player can be used as a separate, stand-alone application or, as is most common today, embedded in the browser itself.

There are many different formats to be considered. Streaming formats can be standard, including MP3, SMIL, MPEG, WAV, WM and ASF files, or proprietary formats. Furthermore, there are several different communications protocols that can be used, including HTTP, RTSP (real-time streaming protocol) or MMS (Microsoft's proprietary streaming protocol). All of these components add to the complexity of testing streaming media applications.

The second reason testing and monitoring are more complex is that several different technology vendors are involved in producing and deploying streaming media, including RealNetworks with RealPlayer, and Microsoft with Windows Media Player. In addition, there are application service providers (ASPs) and content delivery networks (CDNs) to be considered, including Akamai, Digital Island and iBeam. Content delivery networks are involved with physically housing the streaming media content on networks of servers around the world to bring content closer to the end users. Systems integrators (SIs) or independent software vendors (ISVs) are also involved in the process of putting streaming media applications together for their partners or customers.

Finally, the measurement of streaming media performance is more complex. In a traditional e-business environment, such as an online bookseller, performance is measured by the time required to complete a transaction—for example, the time to search for a book, or place an order. With streaming media, performance is measured by the quality of the stream to the end user. One measure is time to first frame. How long does it take from the moment the user clicked on a link for the presentation to begin? Studies show that viewers will wait only a few seconds for video and audio to commence. If the stream takes longer than a few seconds to begin, the site has probably lost its audience.

Once the stream has started, companies need to measure the quality of the signal and the amount of buffering. Does the audio and video lose synchronization? Does the user receive a message that the system is “buffering data” and requires the viewer to standby as more data is downloaded? This happens when the download from the server is taking too long. If a six-minute stream requires nine minutes to run, the viewer has had a total of three minutes of idle time while waiting for the buffering to complete. All of these are unacceptable for a good end-user streaming media experience.

## **FUNCTIONAL TESTING, LOAD TESTING AND PERFORMANCE MANAGEMENT SOLUTIONS FOR STREAMING MEDIA APPLICATIONS**

Functional testing, load testing and application performance management solutions can help companies identify, isolate and fix performance bottlenecks in their Web infrastructures before launching their streaming media applications and again after the applications go live.

### **FUNCTIONAL TESTING**

Before performing functional testing, it is important to verify that basic functionality works as expected. Often, software under test may contain a functionally unsound implementation of objects that may or may not be built using streaming media. Unless it is verified that all functional components of the

software are implemented according to specifications, application load testing and Web performance monitoring may not yield reliable results. A functional testing solution will help companies ensure that all objects, including those containing streaming media technology, function as expected.

### **LOAD TESTING**

Load testing is conducted before an application is deployed. Pre-deployment load testing analyzes Web application performance under real-world conditions to optimize system performance under different user loads and to identify and pinpoint performance problems. Load testing can emulate the workload of hundreds or even thousands of concurrent users. After performance problems are isolated, problems can be fixed, and the application can then be retested. This continuous cycle ensures optimal application performance when the site is launched.

### **APPLICATION PERFORMANCE MANAGEMENT (APM)**

APM solutions monitor deployed Web applications in real time and alert operations groups to performance problems before users experience them. They work by recording the performance of applications to measure the true end-user experience. Robust performance management solutions can measure the quality of the user's streaming experience by monitoring client-side statistics. Robust solutions also can perform root-cause analysis to pinpoint the location of the problems, not merely indicate that a site has problems "somewhere" in the application.

Both pre-deployment testing and monitoring of live sites are essential for ensuring the performance of streaming media applications.

## **MERCURY INTERACTIVE'S STREAMING MEDIA PERFORMANCE MANAGEMENT SOLUTIONS**

Mercury Interactive's world-class functional testing, load testing and application performance management solutions enable companies to ensure a high-quality experience for users of their streaming media applications.

To accurately test and monitor streaming media applications, Mercury Interactive has licensed key technology from leading streaming vendors, including RealNetworks and Microsoft. With this technology, Mercury Interactive has the ability to provide solutions that work in both pre- and post- deployment environments to:

- Record and replay any streaming format from the streaming players to identify and isolate system performance problems
- Analyze client-side performance metrics to measure stream quality
- Correlate streaming application performance problems to their root cause
- Record and replay on streaming controls to verify that applications function as expected under normal conditions

All of these capabilities allow Mercury Interactive to help organizations optimize application performance and isolate problems before end users experience them.

### **QUICKTEST PROFESSIONAL FOR STREAMING**

QuickTest™ Professional can record and replay any Web-based application. Quality engineers can use QuickTest Professional to perform verifications on such streaming controls as Real Player and Media Player. In addition, they can access and record any streaming media object, as well as validate that it has been replayed correctly. QuickTest Professional for Streaming can verify the following streaming media-related measurements:

- Length of a stream that was downloaded, comparing it with the expected length
- Links to media objects, checking that they launch the objects as expected
- Replay functionality

### **LOADRUNNER FOR STREAMING**

Mercury Interactive's LoadRunner® is the industry-standard load testing tool that predicts system behavior and performance of pre-deployment applications. It exercises an entire enterprise infrastructure by emulating thousands of users and employs real-time performance monitors to identify and isolate problems. LoadRunner for Streaming provides new capabilities for the load testing of streaming media applications. It includes streaming virtual players and monitors. LoadRunner for Streaming ensures that high numbers of streaming users don't overload a company's system.

LoadRunner records user interactions into test scripts. Script recording is performed using LoadRunner's Virtual User Generator (VUGen). The VUGen is a component that runs on a client desktop to capture the user interaction with the streaming player. After the recording process, test scripts are generated. Scripts then run as virtual players to generate the load. (See Figure 2.)

Once the scripts are built, the tester is ready to run the load test. LoadRunner's Controller is used to manage and control the running of virtual players, which emulate the operations and behavior of real users. The Controller also provides a suite of integrated performance monitors that can monitor each component of a multi-tier system during the load test. By capturing performance data from the entire system during the run, testers can view the performance of all the parts of the system in real time. As a result, they can see problems as they occur and correlate this information with the end-user loads and stream quality to pinpoint bottlenecks.

LoadRunner provides a wide range of performance graphs that monitor the network, network devices and the most common Web servers, application servers and database servers. Performance monitoring is done in a completely non-intrusive manner to minimize the impact on the application under test. Additionally all of these monitors are hardware- and OS-independent. No agents need to be installed on the remotely monitored servers.

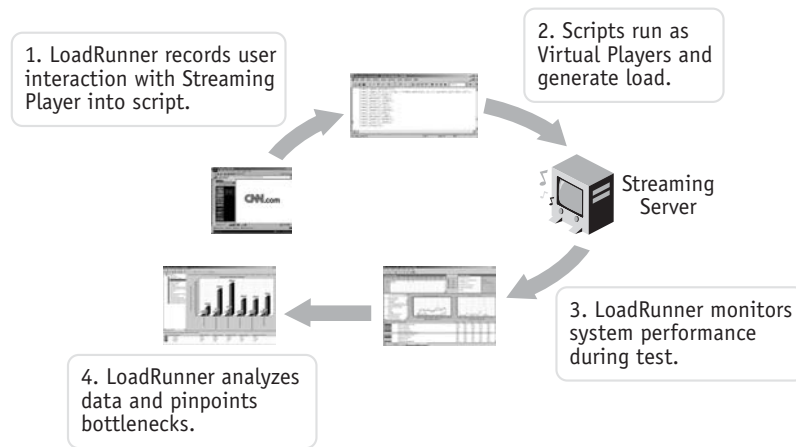


Fig. 2. LoadRunner creates scripts, generates load, monitors system performance and pinpoints performance problems.

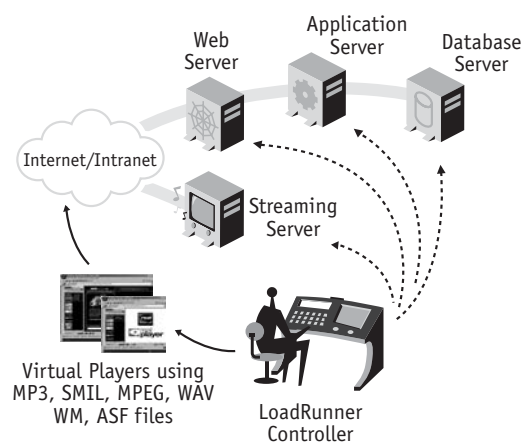


Fig. 3. IT groups can use the LoadRunner Controller to monitor the system infrastructure to identify performance problems.

Mercury Interactive has added monitors specifically for streaming. (See Figure 3.) LoadRunner's client-side monitors for streaming measure the quality of the end-user stream. In particular, these monitors measure:

- Time to first frame—If a file takes too long to start streaming, end users will not wait.
- Current and average bandwidth (Kbps)—Streaming media consumes high bandwidth. Is there enough network bandwidth to allow for each user?
- Buffering time—The amount of time end user's spend waiting for the player to buffer packets during the playing of the stream.
- Number of lost or late packets—This measures the quality and reliability of the stream.
- Quality of stream download—This includes the ratio of received packets to sent packets. Anything less than 100 percent indicates degradation in the stream.

LoadRunner's server monitors analyze the streaming server performance to help identify and pinpoint system bottlenecks. LoadRunner's server-side monitors measure:

- The number of connections—LoadRunner can identify how many users are currently connected and the type, including multicasts, unicasts, TCP and UDP. (Multicast connections are live feeds, such as concerts or news programs. Unicast connections consist of prerecorded presentations, such as replays of a company's most recent earnings report.)
- The number of clients and communications protocols—Including HTTP, PNA or RTSP.
- The number of pending connections—This can help identify how many end users are unable to connect due to high server load.
- Stream errors—All stream errors are logged for analysis of system performance.

After running and monitoring the load tests, LoadRunner analyzes the data and pinpoints bottlenecks, allowing specialists to make adjustments to the system. As a next step, testers can run the same load scenario again, to verify that the changes have had a positive impact on system performance.

#### **TOPAZ FOR STREAMING**

Topaz™ is an application performance management solution that monitors the end-user experience of a production Web site. It proactively monitors sites in real time to provide organizations with an early warning of streaming performance problems. Once Topaz detects a problem, it alerts operations groups and helps them pinpoint the root cause before users are impacted. These agents can be deployed in different parts of an organization or any geographic region. (See Figure 4.)

Monitoring can be conducted at regularly scheduled time intervals to ensure optimal, 24x7 site performance. If streaming performance degrades beyond predefined thresholds, the operations staff can be notified by e-mail, pager, fax, SMS to cell phone, or SNMP traps to enterprise consoles, such as Tivoli, Hewlett-Packard's OpenView and Computer Associates' Unicenter TNG.

Topaz uses the same scripts generated from load testing with LoadRunner. As a result, operations groups can reuse their scripts, which translates into a tremendous return on investment, as well as a substantial time and cost savings. After deployment, Topaz can monitor all of the client and server statistics LoadRunner monitors, enabling IT groups to maximize site reliability and protect their companies' revenue streams.

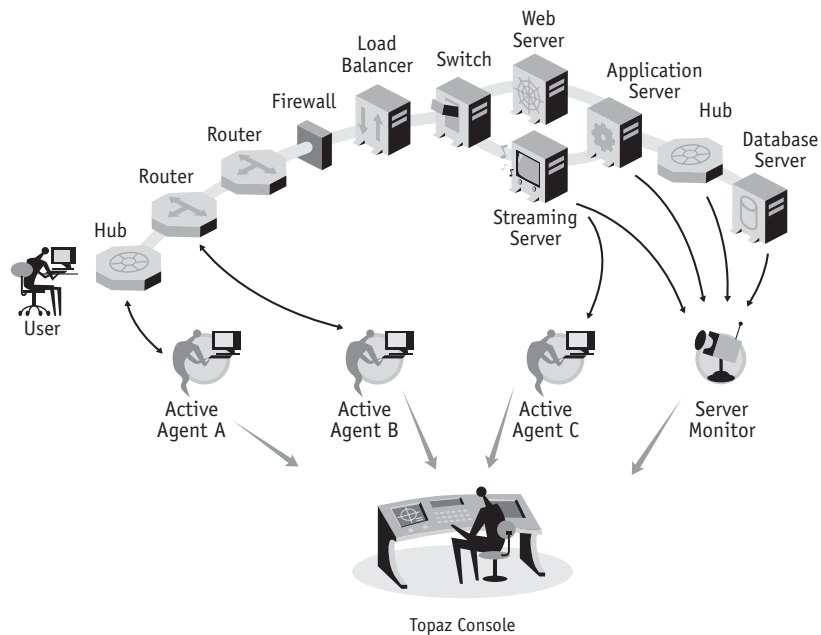


Fig. 4. Topaz ActiveAgent monitors the performance of deployed applications.

## MERCURY INTERACTIVE'S MANAGED SERVICES FOR TESTING AND PERFORMANCE MANAGEMENT

Web performance management is key to ensuring that a Web site is providing a quality experience to each end user. Poor Web performance or downtime can jeopardize business revenue and place companies at risk for losing customers. Companies can save time and critical resources by letting Mercury Interactive's experts address their load testing and monitoring needs. With Mercury Interactive's managed services, companies can focus on their core business and leave Web performance management to the experts.

### ACTIVETEST FOR STREAMING

Mercury Interactive's ActiveTest™ for Streaming is a hosted load testing service that conducts full-scale stress testing of streaming media applications. Because ActiveTest takes place over the Internet, it has the unique ability to measure the end-user experience, which is key to gauging the performance of streaming media applications.

Powered by Mercury Interactive's LoadRunner, ActiveTest enables IT groups to determine how many users their system can scale to, the breaking point at which their site's performance begins to degrade and how to increase their site's load capacity. More important, ActiveTest now enables companies to complete their load testing cycle.

### Testing Outside the Firewall

While in-house load testing tools are ideal for testing the scalability of components inside the firewall, they do not offer a complete solution by themselves. Mercury Interactive's testing experts have run more than 1,000 load tests with ActiveTest and their results show that 35% of performance

bottlenecks are found only by testing from outside the firewall. ActiveTest is the only load testing solution that delivers this capability. It validates that bandwidth is sufficient and checks that the firewall, load balancers and gateways are not inhibiting performance. As a result, ActiveTest provides a critical complement to companies' in-house load testing tools.

**ActiveTest at Work**

As a hosted service, ActiveTest provides all the resources and expertise needed to load test a Web site. In addition, ActiveTest can test any Web site that is accessible via the Internet. After companies sign up online for ActiveTest, Mercury Interactive's load test experts will contact them to learn more about their Web-based applications and system architecture. They then will record the sites' business processes and create the test scripts. These scripts emulate the unique behavior of real users navigating through these Web applications and initiating streaming sessions. In fact, they can emulate loads of more than 1 million concurrent users, more than 100,000 transactions per day and more than 3 billion hits per day. Following the ActiveTest runs, companies can keep these scripts and use them with other Mercury Interactive testing and monitoring tools.

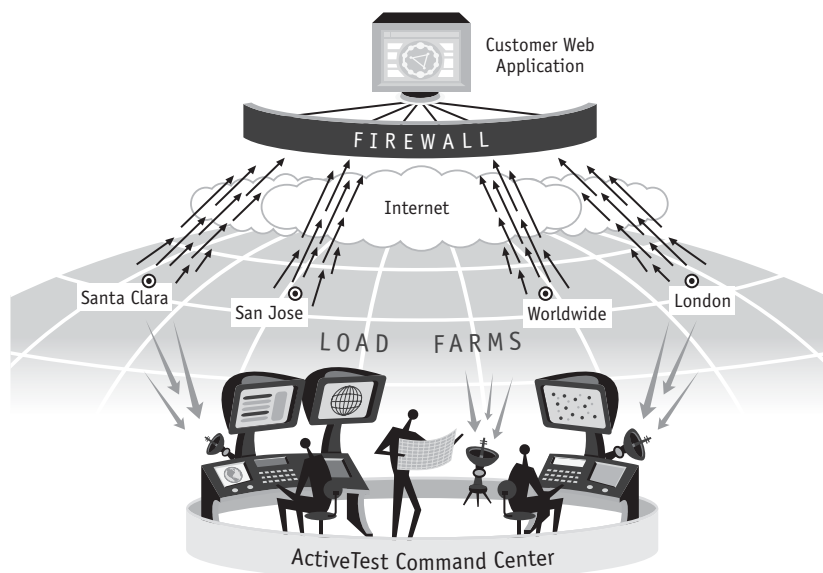


Fig. 5. This diagram shows a typical customer's Web application being tested by ActiveTest's multiple load farms via the Internet. The ActiveTest team coordinates the entire test from its Command Center.

Within 24 hours, Mercury Interactive's load test experts will set up and run the load test. As they test the Web site, IT groups can view the live results by using ActiveTest's real-time online monitors. These monitors measure transaction response times for the different business processes and provide real-time metrics for all components of the Web infrastructure, including Web servers, application servers, databases, routers, gateways and load balancers. With this information, the ActiveTest team can quickly pinpoint performance problems to a specific component of the Web infrastructure. IT groups then can quickly correct the problem and prevent it from impacting end

users. In addition, the data provided by ActiveTest allows companies to analyze how the load on their system is affecting service level agreements and other performance thresholds that are important to their business.

### **ACTIVEMWATCH FOR STREAMING**

ActiveWatch™ for Streaming is a round-the-clock service that accurately measures the end-user experience for streaming media applications. Based on Mercury Interactive's Topaz, ActiveWatch proactively identifies and pinpoints problems within even the most complex Web sites, so that companies can ensure a positive end-user experience 24x7.

ActiveWatch operates on an infrastructure maintained by leading Internet service providers (ISPs). These companies provide the infrastructure and datacenters at many geographical locations. Because ActiveWatch monitors the complete end-user experience on a site, companies don't have to invest in additional hardware, software, human resources or training.

After companies sign up for the ActiveWatch service and define which streaming media applications need to be monitored, Mercury Interactive staff will begin real-time, 24x7 site monitoring.

Companies also can define how they want to be alerted when performance issues arise and which transactions and events should trigger these alerts. When a performance problem arises, ActiveWatch will immediately notify IT groups via pager or e-mail. This alert system enables companies to respond to unexpected site issues anytime, anywhere.

At any time during the monitoring process, IT groups can view real-time status information directly from their Web browsers. They can obtain complete information on the site's performance or drill down for more detail. For example, they can view the hourly site status over the past 24 hours, or view average response times for each application. ActiveWatch provides a comprehensive breakdown analysis that tells them exactly how much time was being spent on the network and servers for each transaction.

Mercury Interactive's ActiveTest and ActiveWatch for Streaming deliver the industry's most comprehensive hosted testing and monitoring services for companies that choose to outsource their streaming media performance management solutions.

## **SUMMARY**

Streaming media can have a major impact on a company's e-business strategy. Managing streaming media infrastructure requires the power of the industry's leading performance management solutions.

Mercury Interactive's QuickTest Professional for Streaming enables organizations to verify that their streaming media applications will operate as expected before deployment and following any modifications. LoadRunner and ActiveTest for Streaming deliver a complete solution for load testing

streaming media applications in the pre- and post-deployment phases. Mercury Interactive's Topaz and ActiveWatch for Streaming provide early warning and root-cause analysis for streaming applications after the site has been deployed.

Mercury Interactive is the only vendor that enables companies to conduct pre-deployment testing and post-deployment monitoring with the same technology and using the same test scripts. All effort and investments in pre-deployment testing can be leveraged and used "as is" with post-deployment performance management.

By using Mercury Interactive's enterprise testing and performance management solutions, companies can derive the greatest benefit from streaming media technology and deliver optimal performance to all users.

## **ABOUT MERCURY INTERACTIVE**

Mercury Interactive is the leading provider of enterprise testing and performance management solutions. The company's automated software and managed services help companies deliver and maintain high-performance applications. Customers worldwide use Mercury Interactive solutions across their application and technology infrastructures to minimize hardware and operational expenses, protect revenue streams and enhance their competitive positions.

Mercury Interactive was founded in 1989 and is headquartered in Sunnyvale, California. The company has over 1,400 employees with offices in more than 20 countries. For more information on Mercury Interactive, visit the company's Web site at [www.mercuryinteractive.com](http://www.mercuryinteractive.com).