



## Lab Testing Summary Report

February 2010

Report 100107

Product Category:

### Virtual Desktop Infrastructure

Vendors Tested:



Products Tested:

Citrix XenDesktop 4  
VMware View 4



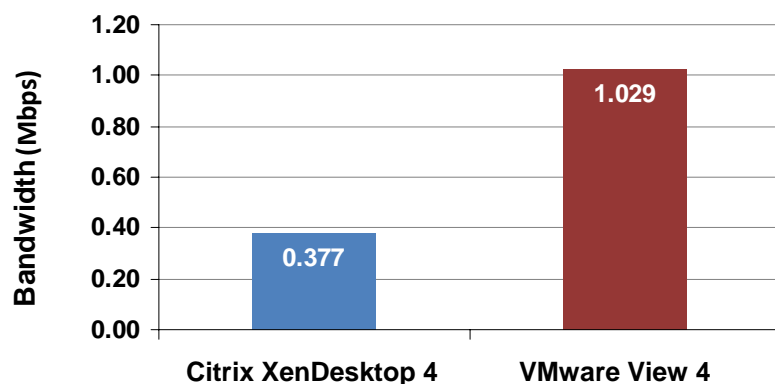
### Key findings and conclusions:

- In a comparison of Virtual Desktop Infrastructure (VDI) implementations, Citrix XenDesktop 4 provided better overall performance when compared to VMware View 4
- XenDesktop 4 used 64% less bandwidth than View 4 with PCoIP for typical tasks
- Flash video was delivered with an average of 65% less CPU usage, 89% less bandwidth, and excellent Quality of Experience by XenDesktop 4 compared to View 4
- Overall, XenDesktop 4 uses system resources more efficiently and is capable of scaling more effectively

Citrix Systems engaged Miercom to validate the overall effectiveness of similarly configured Virtual Desktop Infrastructure (VDI) solutions using Citrix XenDesktop 4 and VMware View 4. Since XenDesktop 4 Enterprise and Platinum editions offer many other forms of desktop and application virtualization not available in View 4, these tests focused primarily on VDI in order to enable a fair comparison. Specifically evaluated were the system efficiency (bandwidth and CPU consumption) and Quality of Experience (QoE) for two types of workloads: [1] real-world, everyday desktop tasks, and [2] popular forms of multimedia and rich Internet applications such as Flash. These workloads were evaluated under both LAN and WAN conditions to assess the impact of bandwidth and latency.

We verified the real world application responsiveness for the virtual clients using simulation with automated scripts that included MS Word, MS Excel and MS Outlook.

Figure 1: Bandwidth Utilization for Real-Time Desktop Workload



Source: Miercom, January 2010

Our test results showed that Citrix XenDesktop 4 used up to 64% less bandwidth compared to VMware View 4 while accessing real world applications like MS Word, Excel, Internet Explorer and Outlook.

## Bandwidth Consumption: General Desktop Workload

This test was conducted to demonstrate the bandwidth consumption when a real world workload (Microsoft Outlook, Excel, Word, PowerPoint; Flash-based websites and multimedia; PDF printing and viewing) is accessed using a virtual desktop platform. We simulated the WAN and LAN environments as explained in the test bed to generate the bandwidth constraints to match real world scenarios. The metrics of the test show the average bandwidth consumption for the applications running on virtual desktop platforms based on different delivery protocols. In the first part of the test, we executed Login Consultants VSI 2.0 script to set the benchmark for Virtual Desktop Infrastructure services on both of the servers. We used this automation framework for implementing the workload on the server when using the remote client to access these services through VDI interfaces. During this test, we measured the bandwidth consumption for both XenDesktop 4 and VMware View 4 as shown in [Figure 1 on page 1](#). This is the transmission rate at which the client is sending and receiving data over the network to the server. We used ClearSight Network Analyzer to assess protocol efficiency in client/server communications.

**Findings** On analyzing the protocol traces, we found that XenDesktop used TCP, while View 4 used primarily UDP, as well as TCP. On analyzing the ClearSight traces for protocol hierarchy, we found that the VMware's PCoIP protocol was constantly sending and receiving packets at the rate of 1.093 Mbps while XenDesktop, which uses the Citrix ICA protocol, was transmitting packets at the rate of 0.377 Mbps between client and server, resulting in less bandwidth consumption for XenDesktop 4. We observed considerably more overhead traffic in the VMware View 4 environment when compared to Citrix XenDesktop 4. During testing we observed peak measurements for the VMware environment where the added overhead between server and client overloaded network resources and impaired the application quality running on the virtual client.

As seen in [Figure 3 on page 3](#), the communication between the client and server for Citrix XenDesktop 4 consumed an average of 377 Kbps of bandwidth, while VMware View 4 consumed an average of 1.093 Mbps of bandwidth for the same test environment. Upon analyzing the traffic captures for both VDI

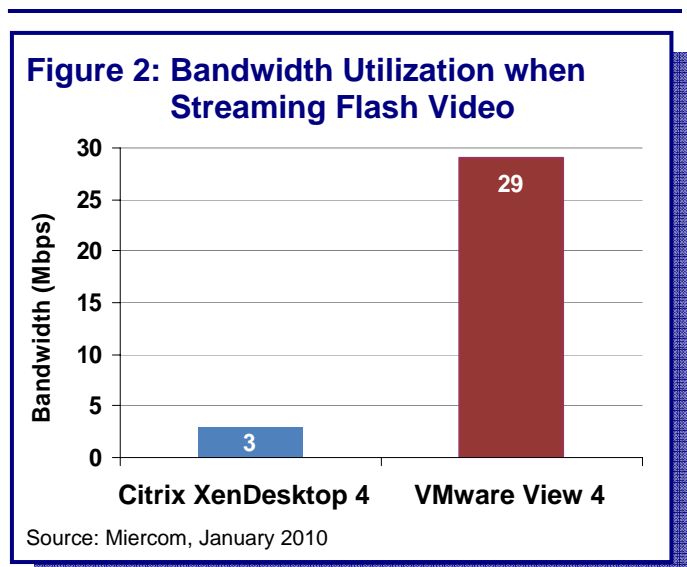
products, XenDesktop 4 had 66,945,228 Bytes, while VMware View 4 had four times more traffic at 274,726,011 Bytes (full Ethernet Frames, header and payload).

**Impact** For any organization looking to implement VDI at enterprise scale, these test results indicate that XenDesktop will enable several times more users than View 4 for a given network capacity. The desktop workload generated by Login VSI provides a good representative sampling for how real users will stress the system. The tests show that as users switch from common productivity and line-of-business applications, to more demanding web browsing with Flash media, Citrix XenDesktop will use network resources much more efficiently, while still offering high quality user experience. This will translate into lower overall costs.

## Quality of Experience: General Desktop Workload

During the running of the Login VSI test scripts, we also video-captured and observed the quality and responsiveness of the screen display. While XenDesktop maintained a very local-like appearance when running applications like MS Excel, View displayed some evident blurring that made the text difficult to read. We attribute this to the "build to lossless" feature of PCoIP. While this feature may aid in some graphic applications and media, users may find, just as we observed in our testing, that this is distracting for some applications. Sample test videos of the user experience can be seen at:

[www.miercom.com/VDICompare](http://www.miercom.com/VDICompare)



*Test results showed that Citrix XenDesktop 4 consumed only 3.008 Mbps of bandwidth compared to 29.04 Mbps of bandwidth consumption by VMware View 4.*

## Bandwidth Consumption: Flash Video

This test was conducted to demonstrate the bandwidth consumption while playing Flash videos available on Internet websites like [www.hulu.com](http://www.hulu.com) or [www.youtube.com](http://www.youtube.com). Since both XenDesktop 4 and View 4 support Flash streaming on virtual desktops, and have capabilities to optimize multimedia, we tested the bandwidth consumption as well as the Quality of Experience.

For this test, we streamed Flash videos from websites including [www.hulu.com](http://www.hulu.com) and [www.youtube.com](http://www.youtube.com) when logged in as a remote user on a thin client to both XenDesktop 4 and View 4 servers. As in previous tests, we repeated measurements in both ample bandwidth as well as constricted bandwidth environments. An [Apposite WAN emulator](#) was used to simulate the impaired network conditions that could occur over enterprise level LAN, WAN and remote access environments. We introduced WAN latency in ranges of 100-250 ms and packet loss of 0.5-5% on the 100 Mbps Ethernet links.

**Findings** [Figure 2 on page 2](#) illustrates the test results in which Citrix XenDesktop 4 consumed an average transmission rate of 3 Mbps, while VMware View 4 consumed a much greater average transmission rate of 29 Mbps over a period of three minutes Flash video streaming. We cross-checked the data from the WAN emulator with that of the ClearSight Network

Analyzer report for the average transmission rate over the WAN. As shown in [Figure 4 on page 4](#), VMware View 4 has a continuous high volume of traffic because the Flash video is rendered on the server and then pushed over the network. contrast, Citrix XenDesktop 4 sends the compressed, non-rendered video to the endpoint for rendering locally.

## Quality of Experience: Flash Video

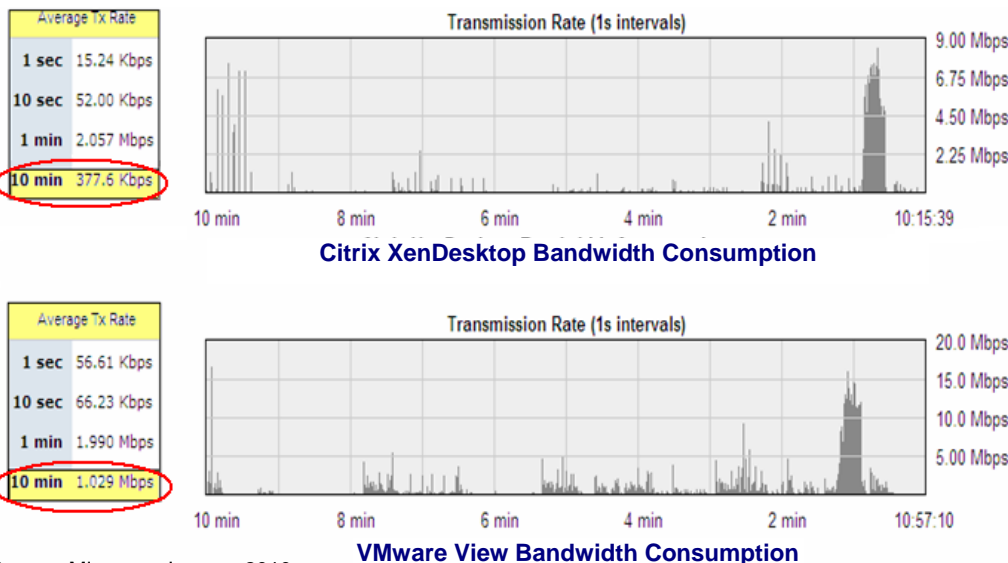
In addition to bandwidth consumption, we also assessed video quality for each product with their respective multimedia streaming optimizations as explained in the previous section.

A video mean opinion score (VidMOS) rating for the Quality of Experience (QoE) was determined for each product under test. The table describing QoE and video quality rated by video MOS relative to observable video impairments is shown in [Figure 5](#).

We streamed videos from websites including [www.hulu.com](http://www.hulu.com) and [www.youtube.com](http://www.youtube.com). Flash video streams available on the World Wide Web were played consecutively for 5 minutes with no WAN impairments introduced. We scored each video streamed on the scale as described in [Figure 5 on page 4](#), using VidMOS criteria for scoring.

With Flash optimization disabled, Citrix XenDesktop 4 scored VidMOS of 4.0 where as VMware View 4 exhibited “burstier” and less consistent video quality with many distortions, and only achieved a VidMOS score of 2.0.

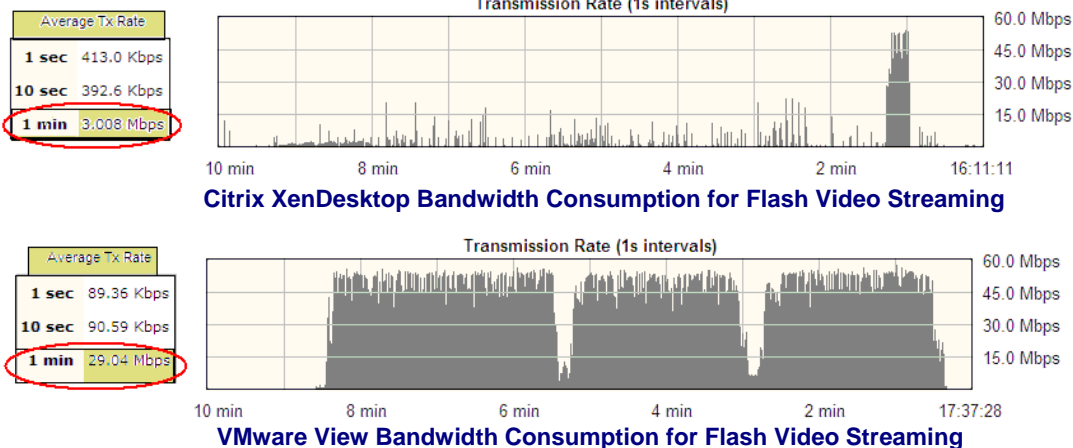
**Figure 3: Virtual Desktop Infrastructure Bandwidth Consumption for Typical Office Applications**



*Average Tx rate showed that in a time span of 10 minutes, 377Kbps of bandwidth was consumed by Citrix XenDesktop 4, whereas VMware View 4 consumed 1.029 Mbps.*

Source: Miercom, January 2010

**Figure 4: Virtual Desktop Infrastructure Bandwidth Consumption for Flash Video Streaming**



Source: Miercom, January 2010

*This streaming was done with the available Flash optimization feature enabled for both Citrix XenDesktop 4 and VMware View 4. We found that while the Flash optimization setting for VMware View 4 improves the video quality, it significantly increases bandwidth utilization as shown.*

The video quality test was repeated, this time with Flash Acceleration enabled for XenDesktop 4, Adobe Flash Quality set to high, and Adobe Flash Throttling set to Conservative for VMware View 4 PCoIP. These settings allowed for the best video experience with VMware View 4; however we found it was still inferior to the QoE achieved with Citrix XenDesktop 4. We observed improvement in video quality for VMware View 4 with PCoIP but it was at the expense of greater bandwidth and server CPU utilization. We scored the video quality for VMware View 4 a VidMOS score of 3.0 for the voice and video streamed. We noted a lack of synchronization between the video and audio, and some noticeable video degradation. VidMOS scores with the test and measurement equipment achieved between 2.9 and 3.1. For Citrix XenDesktop 4 the streaming Flash video achieved a perfect score of 5.0 rated both by the test and measurement tools as well as our user observable mean opinion scores. A score of 5.0 represents that the delivered video was identical to the source video stream, and there were no observable imperfections. Additional tests were conducted for VMware View 4 to allow for other settings such as low to high for Adobe Flash Quality and aggressive to conservative for Adobe Flash Throttling, but there was no noticeable change in video quality for VMware View 4.

We then used the ClearView QA tool for the quantitative analysis of the videos captured during these tests. The average score of 4.8 for XenDesktop 4 and 2.9 for View 4 was noted as shown in *Figure 6 on page 5*.

Constraining the bandwidth to 10 Mbps with the Apposite WAN emulator with a latency of 250 msec and packet loss of 1 percent, we observed that the quality of XenDesktop 4 was still not affected; achieving a 4.0 VidMOS score, while the quality of View 4 significantly dropped to a score of 1.1 VidMOS (unusable). For a better understanding of the quality of a 1.1 VidMOS video, these Flash videos can be accessed at:

[www.miercom.com/VDICompare](http://www.miercom.com/VDICompare)

**CPU Utilization: Flash Video**

CPU utilization was measured for both Citrix XenDesktop 4 and VMware View 4 while streaming HD-quality videos. We measured the CPU utilization of the virtual machines installed on the server for both XenDesktop 4 and View 4. We played the same Flash video for 10 minutes at the 100 Mbps line rate. We noticed that Citrix

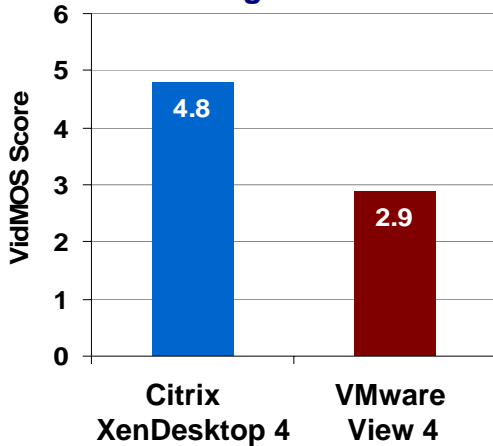
**Figure 5: Mean Opinion Score - QoE for Video Quality (VidMOS)**

Score	Quality	Impairments
5	Excellent	Not Noticeable
4	Good	Some Noticeable
3	Fair	
2	Poor	Annoying and Unusable
1	Bad	

*Video Mean Opinion Score (VidMOS) table for Quality of Experience (QoE) and video quality rated by video MOS relative to observable video impairments.*



**Figure 6: Video MOS scores with Streaming Flash Video**



Source: Miercom, January 2010

*Citrix XenDesktop 4 achieved a VidMOS score of 4.8 with streaming Flash video whereas VMware View 4 scored 2.9. These are quantitative scoring of Flash videos quality provided by VideoClarity ClearView tool.*

XenDesktop 4 consumed an average of 4.7% processor time, while VMware View 4 consumed an average of 71.5% processor time. As shown in [Figure 7 on page 5](#), we noticed that several times during the testing of View 4, the processor utilization spiked to 100%, which affected the video quality significantly.

Citrix XenDesktop 4 has a unique feature called HDX MediaStream that leverages the processing

power of the endpoint device. This feature renders the multimedia content; thereby reducing the burden on the server CPU processor. The compressed multimedia information is sent directly to the endpoint in its native format. The multimedia stream is rendered and played back locally, providing excellent performance while reducing the workload on the servers and the network.

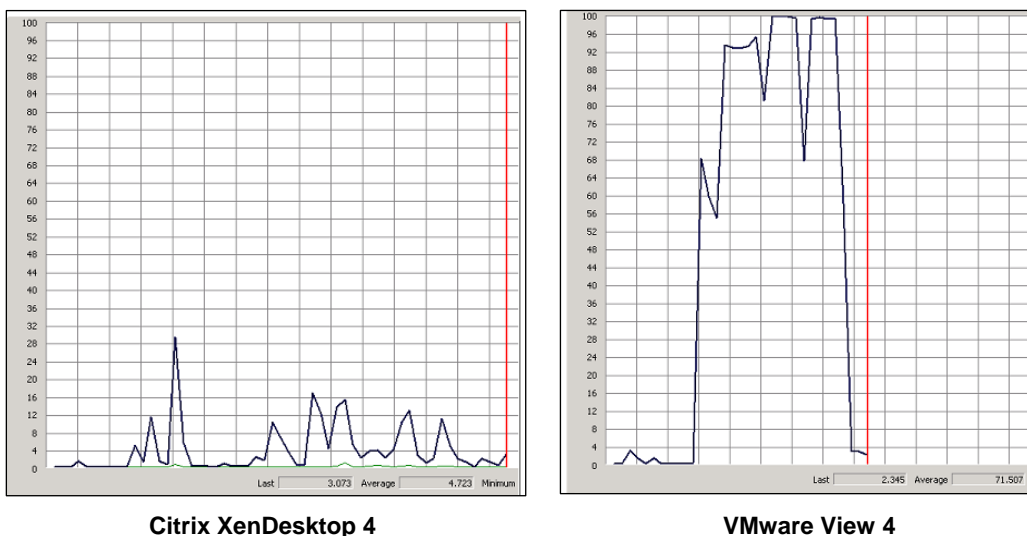
**Impact** XenDesktop, with HDX features for optimizing Flash, allows for much more efficient use of resources allocation, including up to 90% less bandwidth and 65% less CPU utilization. Even with View Flash optimization settings enabled and adjusted to several possible configurations, any improvements in experience still resulted in more bandwidth and CPU consumption. With less resources required per virtual desktop, XenDesktop 4 allows for greater scalability per server.

**Bottom Line**

Our tests clearly proved that Citrix XenDesktop 4 consumed less bandwidth and CPU resources for delivering common desktop workloads and high quality Flash videos when compared to VMware View 4. The responsiveness of applications on the virtual machines was notably faster and improved user QoE with XenDesktop than VMware View.

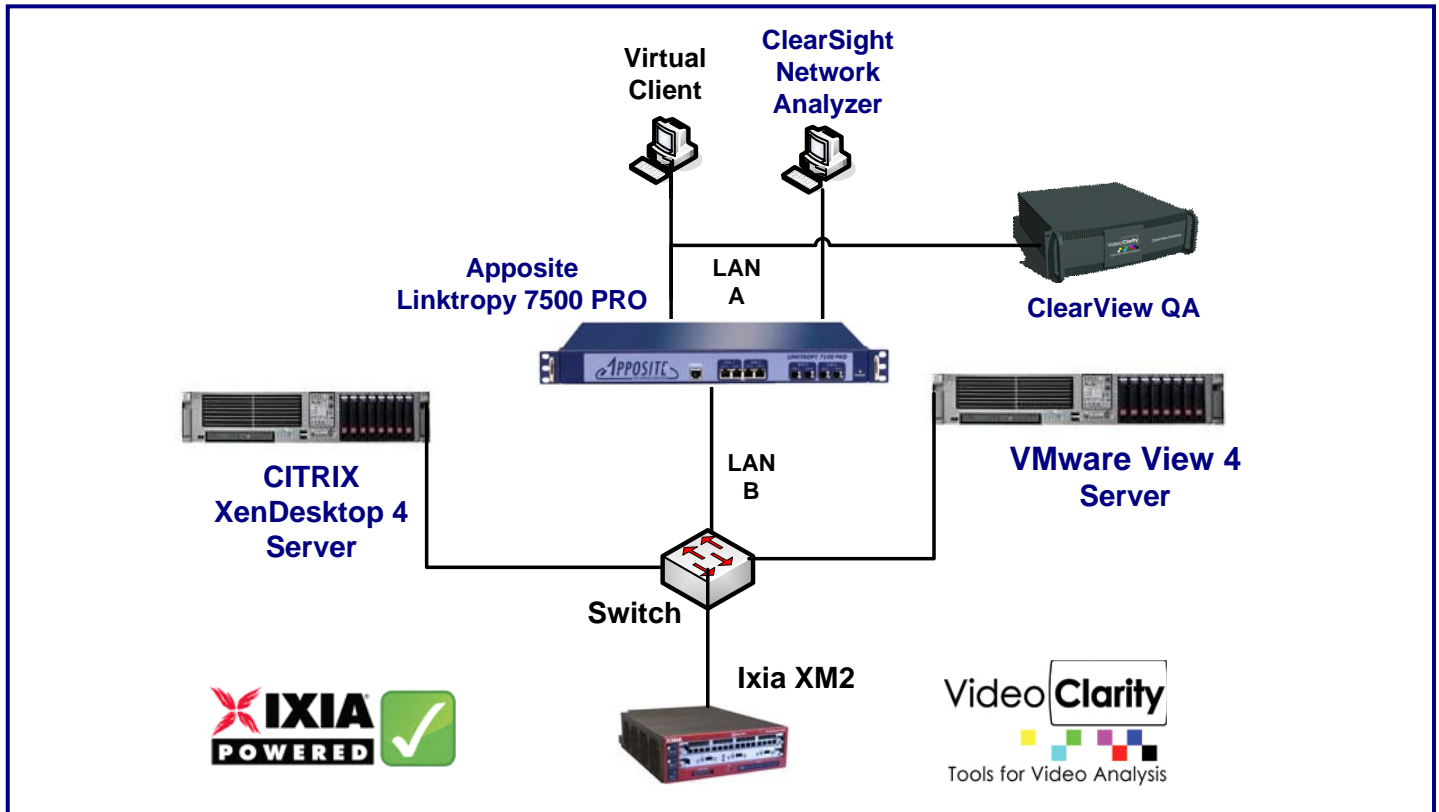
In addition, throughout our testing we noted that deployment and policy management using Citrix XenDesktop 4 proved effective and suitable for large enterprises.

**Figure 7: Citrix XenDesktop Bandwidth Consumption Comparison**  
**% CPU Utilization**



Source: Miercom, January 2010

*CPU utilization measured while the servers providing the virtual desktop environments were serving video streaming content to the virtual desktops. Flash optimization features were enabled for both VMware View 4 and Citrix XenDesktop 4.*



### Test Equipment Utilized in Testing:

We used two HP DL360 servers with 2 Intel Xeon Quad Core processors for the testing. Each server had 12GB of RAM and 3x72GB disk drives for installing the XenDesktop 4 and VMware View 4 suite for VDI testing. The server with XenDesktop 4 was loaded with XenServer version 5.3.3.1, Service Console 3.0, Desktop Delivery Controller Version 4.0, Virtual Desktop Agent 4.0.4522, Virtual Desktop Client 11.2.0.31560. The second server was loaded with a copy of VMware 4.0.0, ViewConnection Server 4.0.0-210399, ViewAgent 4.0.0-210939, ViewClient with offline 4.0.0.-210939.

### How We Did It

As shown in the test bed diagram, we connected two servers to the Apposite WAN emulator through a switch. We used an Apposite WAN emulator [www.apposite-tech.com](http://www.apposite-tech.com) for bandwidth restriction and to introduce packet loss and latency to the network to simulate remote user connections and constricted WAN environments. We also used Login Consultants VSI script [www.loginconsultants.com](http://www.loginconsultants.com) that helped automate the launch of Microsoft applications including Excel, Word and Outlook in a consistent manner while measuring CPU and bandwidth utilization. We used the ClearSight Network Analyzer [www.clearsightnetworks.com](http://www.clearsightnetworks.com) in our test bed to analyze the efficiency of the application protocols used: ICA with HDX for Citrix and PCoIP for VMware. We utilized Video Clarity ClearView systems [www.videoclarity.com](http://www.videoclarity.com) to determine VidMOS scores for quantitative analysis.

Each server was equipped with a domain controller, DNS, connection server and broker as the part of the virtualization platform.

We measured bandwidth utilization and assessed the Quality of Experience (QoE) while playing Flash movies accessed through Internet Explorer 8 from websites including [www.hulu.com](http://www.hulu.com) and [www.youtube.com](http://www.youtube.com), using the virtual desktop software installed on each client.

We used an Ixia XM2 chassis [www.ixiacom.com](http://www.ixiacom.com) to apply IMIX background traffic while capturing the Flash video content for analysis. Real-world traffic was also used in testing as generated by Ixia's test platform and test applications, principally IxNetwork for Layer 2-3 routing and switching traffic and IxLoad for Layer 4-7 application traffic.

## Miercom Performance Verified

Based on Miercom's review of Virtual Desktop Infrastructure (VDI) applications, the Citrix XenDesktop 4 is awarded Performance Verified for providing better performance when compared to VMware View 4.

XenDesktop consumed 64% less bandwidth than View with PCoIP during tests conducted using typical office applications. Flash video was delivered with an average of 65% less CPU usage, 89% less bandwidth, and better QoE by XenDesktop.

Citrix XenDesktop 4 enables businesses to deploy VDI in larger scale and supports Flash video far better than VMware View 4.



Citrix XenDesktop Version 4



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