

Wyse Z90D7 Thin Client: Comparative Performance Evaluation vs. Chip PC EX-PC W7D4791 and HP t5740e Running Microsoft Windows Embedded Standard 7

EXECUTIVE SUMMARY

As Cloud Computing and Virtual Desktop Infrastructure (VDI) computing continue their dramatic growth as enterprise computing solutions, the demands on the thin client systems, also known as “thin clients”, grows as well. In addition to traditional data applications, the surge in demand for video - especially high-definition (HD) video, can place significant demands on systems. The Wyse Z90D7 has been designed to deliver high performance for both traditional and new-generation HD video applications.

Wyse commissioned Tolly to compare the performance of Wyse Z90D7 thin client against Chip PC EX-PC W7D4791 and HP t5740e running on Microsoft Windows Embedded Standard (WES) 7 operating system, using industry-standard PassMark performance tests as well as playback scenarios of HD video, Adobe Flash and Windows Media Video 9 files.

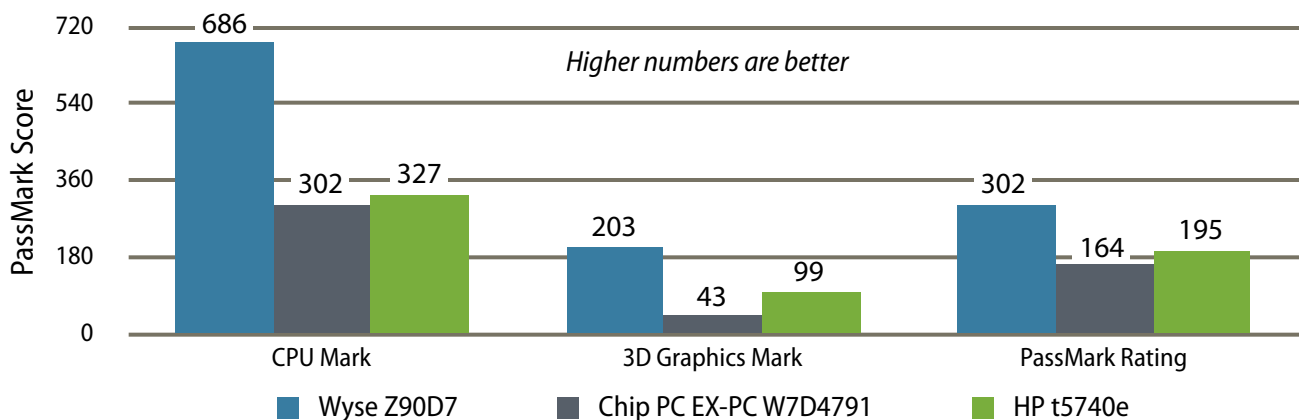
The Wyse thin client consistently delivered better scores than the competition with respect to CPU power and CPU/memory resource usage. Additionally, the Wyse solution consistently delivered a very good user experience in both local, remote and VDI playback of HD video compared to Chip PC and HP thin clients.

THE BOTTOM LINE

The Wyse Z90D7:

- 1 Achieves up to 5 times higher thin client system performance ratings on industry standard tests when compared to the competition
- 2 Delivers the best user experience across local Flash, WMV9, H.264 playback with 1/5th the CPU consumption and around 1/2 the memory consumption compared to the competition
- 3 Delivers the best, reliable remote Flash video playback experience compared to the competition

Local System Performance of Wyse Z90D7 Thin Client vs. Chip PC EX-PC W7D4791 and HP t5740e
(as reported by PassMark Performance Test 7.0 running on Microsoft Windows Embedded Standard 7)



Note: Aero and high-performance power settings enabled. Wyse system is dual-core, 64-bit, while others were single-core, 32-bit CPU. Windows Embedded Standard 7 install was 32-bit.

Source: Tolly, April 2011

Figure 1



Test Results

PassMark Performance Test

The tests compared the performance of Wyse Z90D7 to a Chip PC EX-PC W7D4791 and an HP t5740e thin client systems.

The PassMark Performance Test suite exercises various components of the local system in a manner that is reproducible and thus provides a useful reference for comparing system performance.

The effectiveness of the dual-core CPU configuration of the Wyse Z90D7 was immediately evident in the test results. The CPU Mark score of 686 for the Wyse Z90D7 was more than twice that of the two competitors. See Figure 1.

The difference in 3D Graphics Mark benchmark scores were even more dramatic. The Wyse Z90D7 score of 203 is 4.72 times greater than that of the Chip PC EX-PC and more than twice the score of the HP t5740e.

Finally, the Wyse Z90D7 again scored higher than the competing devices in the overall system rating which is a composite built from the tests run¹. The Wyse score of 302 was 1.84 times that of Chip PC EX-PC and and 1.54 times that of the HP t5740e.

HD Video Quality and Resource Consumption

Given the ever-growing importance of video playback in enterprise applications, the remaining tests focused on playback of

Wyse Technology, Inc.

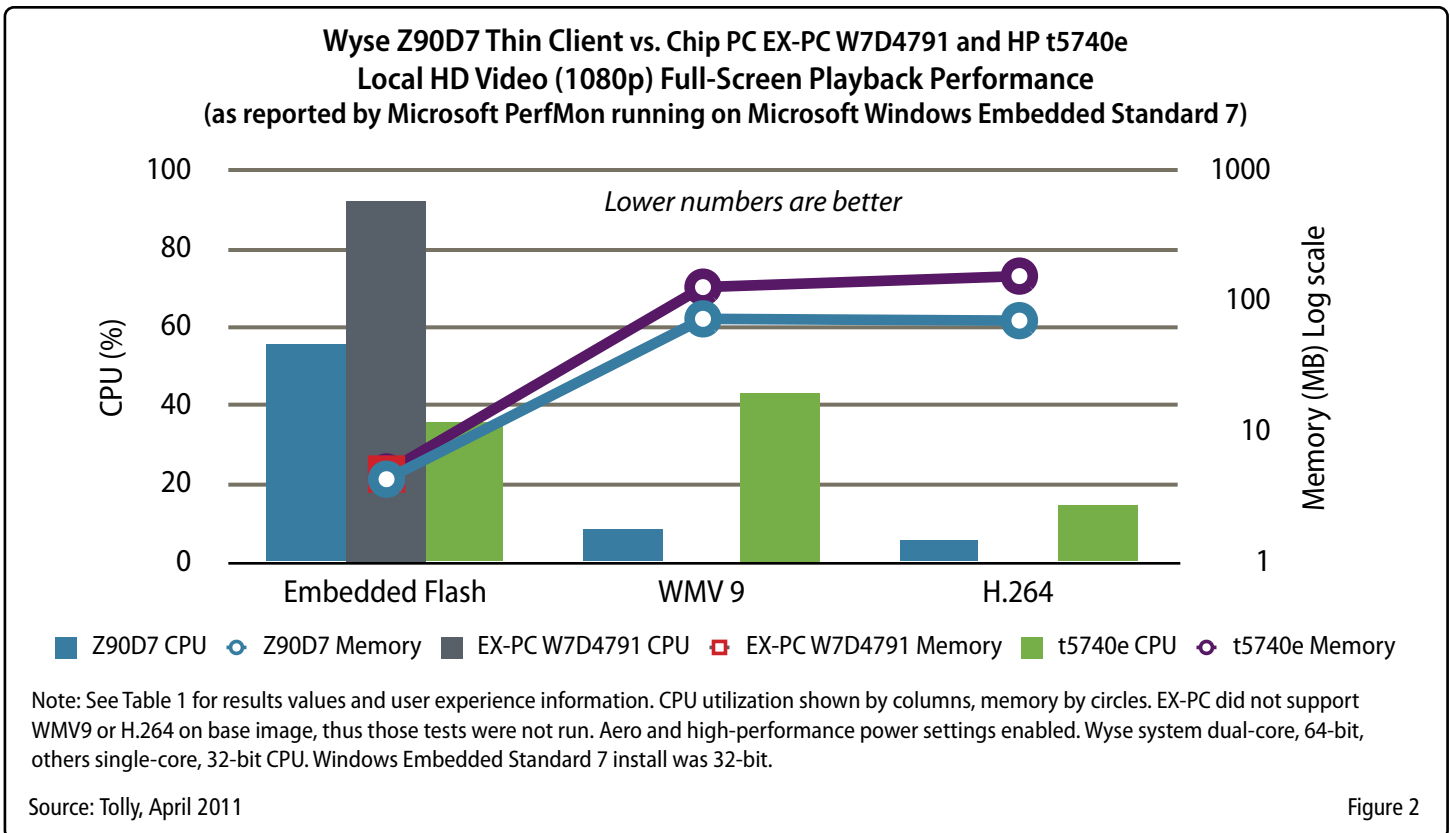
Z90D7

Thin Client Performance Running WES7



Tested April 2011

full-screen video. Tests included playback of both locally stored and remotely rendered files with media types including Flash, Windows Media Video (WMV) 9 and H.264. The remote tests included both the Citrix



¹ See Test Setup and Methodology section for more details about the PassMark tests used to calculate the PassMark Rating.



**Wyse Z90D7 Thin Client vs. Chip PC EX-PC W7D4791 and HP t5740e
Local HD Video (1080p) Full-Screen Playback Performance and User Experience
(as reported by Microsoft PerfMon on Microsoft Windows Embedded Standard 7)**

Media Type:	Embedded Flash		Windows Media Video 9		H.264		User Experience/Notes
	Vendor/System	CPU (%)	Memory (MB)	CPU (%)	Memory (MB)	CPU (%)	
Wyse Z90D7	56	4	8	73	6	71	✓ Good experience. No issues.
Chip PC EX-PC W7D4791	92.3	4.761	✗	✗	✗	✗	✗ No support for WMV9 or H.264 on base image. Embedded Flash playback: Sound out of sync, video playback choppy
HP t5740e	36	5	43	128	15	156	✗ 1080p Flash steady frame loss, Audio out of sync over 1 second. Playback froze at 1:20 mark. High CPU utilization and memory consumption

Note: See Figure2 for graphical representation. User experience as observed by Tolly engineer. EX-PC did not support WMV9 or H.264 on base image, thus those tests were not run. Aero and high-performance power settings enabled. Wyse system dual-core, 64-bit, others single-core, 32-bit CPU. Windows Embedded Standard 7 install was 32-bit. Lower numbers are better.

Source: Tolly, April 2011

Table 1

High Definition User Experience (HDX) protocol and the Microsoft Remote Desktop Protocol (RDP). The tests measured the CPU and RAM requirements of the DUT as well as observations about video quality and user experience made by the Tolly engineer.

Local HD Video Playback

Of the three solutions, the Wyse Z90D7 was able to deliver the best user experience across Flash, WMV9 and H.264 playback scenarios. See Table 1 and Figure 2.

The Chip PC EX-PC did not support rendering WMV9 or H.264 in its base image and, thus, was not tested in those areas.

When playing back Flash embedded in a web page, both the Chip PC and HP

devices manifested playback quality issues that degraded the user experience.

For Chip PC, the sound was out of sync with the video and the video playback itself was choppy.

For HP, engineers observed steady frame loss and audio that was out of sync with video by approximately 1 second. Ultimately, playback on the HP system froze at 1:20 into the test. While the HP delivered a good user experience in the tests of local playback for WMV9 and H.264 video, its resource consumption was significantly higher than the Wyse system.

In the WMV9 playback tests, HP's CPU consumption was more than 5 times greater than Wyse and HP's RAM consumption was 1.75 times that of Wyse.

In the H.264 playback tests, HP's CPU consumption was 2.5 times that of Wyse and HP's RAM consumption was 2.2 times that of Wyse.

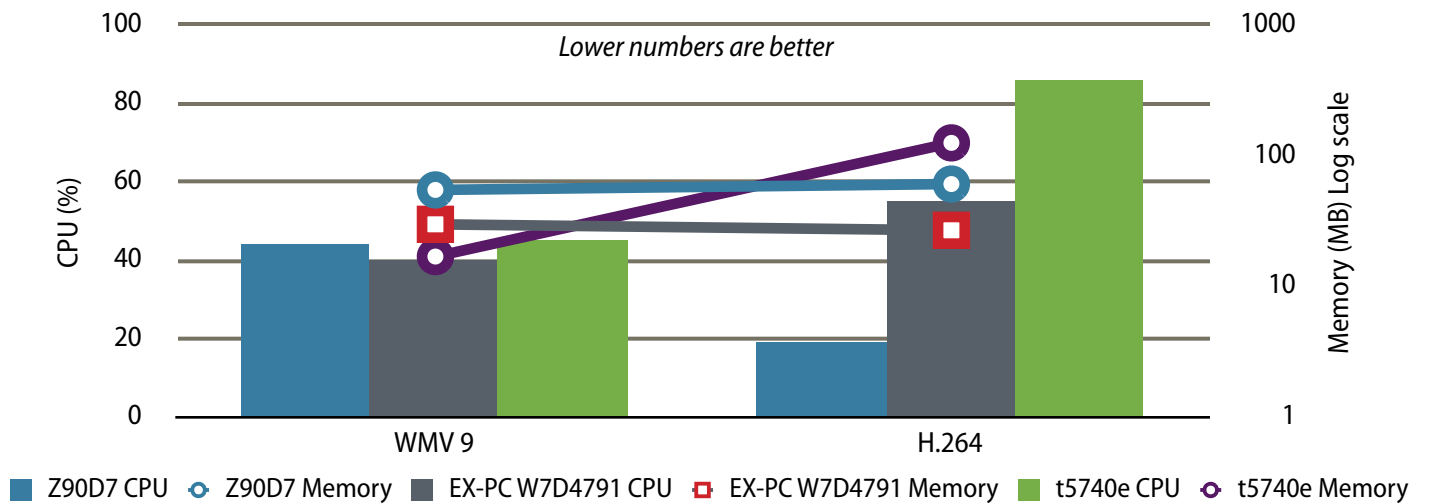
Remote HD Video Playback via Microsoft RDP7

In this test, the client system connected via a LAN to a server system using the RDP protocol and was tested playing back WMV9 and H.264 video files stored on that server.

Again, of the three solutions, the Wyse system delivered a good user experience with only a minor audio sync issue with the WMV9 test. See Table 2 and Figure 3.

The Chip PC system once again exhibited problematic behavior in both tests. When

**Wyse Z90D7 Thin Client vs. Chip PC EX-PC W7D4791 and HP t5740e
Remote HD Video (1080p) Full-Screen Playback Performance Using Microsoft RDP7
(as reported by PerfMon running on Microsoft Windows Embedded Standard 7)**



Note: See Table 2 for results values and user experience information. CPU utilization shown by columns, memory by circles. User experience as observed by Tolly engineer. Connection level: LAN (10Mbps or higher). Aero disabled local and VM and high-performance power settings enabled. Wyse system dual-core, 64-bit, others single-core, 32-bit CPU. Windows Embedded Standard 7 install was 32-bit. Lower numbers are better. Memory: Maximum memory used by RDP client.

Source: Tolly, April 2011

Figure 3

**Wyse Z90D7 Thin Client vs. Chip PC EX-PC W7D4791 and HP t5740e
Remote HD Video (1080p) Full-Screen Playback Performance Using Microsoft RDP7
(as reported by PerfMon running on Microsoft Windows Embedded Standard 7)**

Media Type:	Windows Media Video 9			H.264		
	Vendor/ System	CPU (%)	Memory (MB)	User Experience	CPU (%)	Memory (MB)
Wyse Z90D7	44	55	✓ Very smooth playback with very minor audio sync issue	19	61	✓ Very smooth playback with audio and video in sync
Chip PC EX-PC W7D4791	40	30	✗ Very choppy playback with audio and video totally out of sync	55	27	✗ Played with very slow frame rate, video pixelation, and audio out of sync with video for most of the playing time
HP t5740e	45	86	✓ At times, slightly choppy video	17	126	✓ Consumes higher memory than Wyse Z90D7

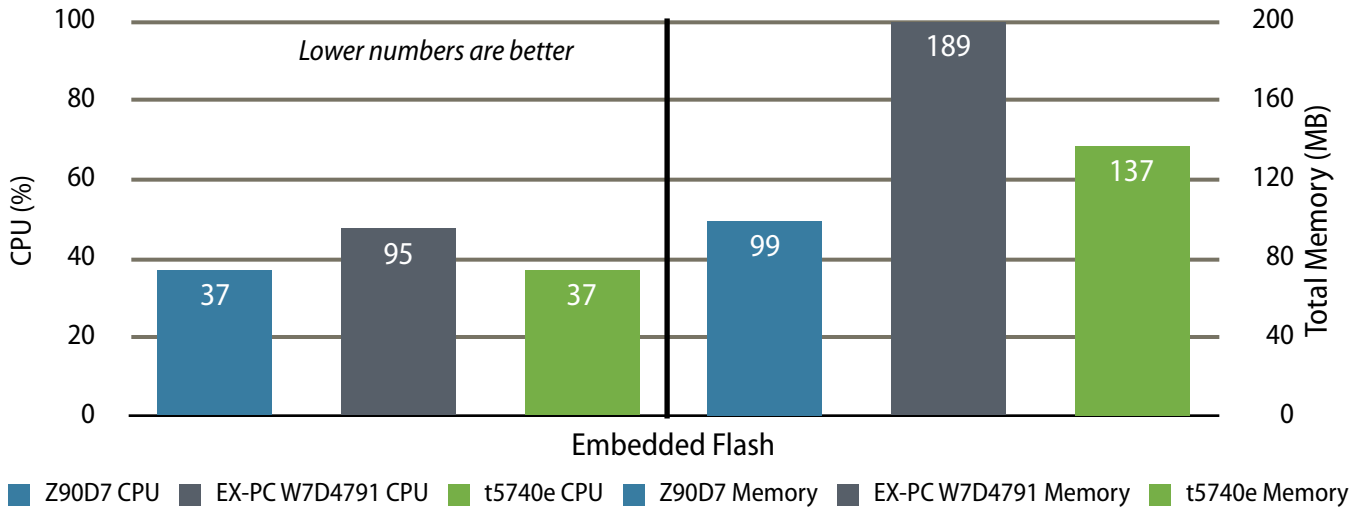
Note: See Figure3 for graphical representation. User experience as observed by Tolly engineer. Connection level: LAN (10Mbps or higher). Aero disabled local and VM and high-performance power settings enabled. Wyse system dual-core, 64-bit, others single-core, 32-bit CPU. Windows Embedded Standard 7 install was 32-bit. Lower numbers are better. Memory: Maximum memory used by RDP client, MSTSC.exe.

Source: Tolly, April 2011

Table 2



**Wyse Z90D7 Thin Client vs. Chip PC EX-PC W7D4791 and HP t5740e
Remote HD Video (1080p) Full-Screen Playback Performance Using Citrix HDX
(as reported by PerfMon running on Microsoft Windows Embedded Standard 7)**



Note: See Table 3 for results values and user experience information. CPU utilization shown by columns, memory by circles. User experience as observed by Tolly engineer. Connection level: LAN (10Mbps or higher). Aero disabled local and VM and high-performance power settings enabled. Wyse system dual-core, 64-bit, others single-core, 32-bit CPU. Windows Embedded Standard 7 install was 32-bit. Lower numbers are better. Memory: Total of ICA client and HDX Mediastream client.

Source: Tolly, April 2011

Figure 4

**Wyse Z90D7 Thin Client vs. Chip PC EX-PC W7D4791 and HP t5740e
Remote HD Video (1080p) Full-Screen Playback Performance Using Citrix HDX
(as reported by PerfMon running on Microsoft Windows Embedded Standard 7)**

Media Type: Vendor/System	Embedded Flash			User Experience
	CPU (%)	Maximum Memory (MB)		
		ICA Client	HDX Mediastream Client	
Wyse Z90D7	37	35	64	✓ Very smooth playback
Chip PC EX-PC W7D4791	95	27	162	✗ Very choppy playback with major audio and video dropouts
HP t5740e	37	25	112	✗ Device did not support 4x anti-aliasing. Playback froze at 1:03 mark

Note: See Figure4 for graphical representation. User experience as observed by Tolly engineer. Connection level: LAN (10Mbps or higher). Aero disabled local and VM and high-performance power settings enabled. Wyse system dual-core, 64-bit, others single-core, 32-bit CPU. Windows Embedded Standard 7 install was 32-bit. Lower numbers are better. ICA client: WFICA32.exec, MediaStream Client: PseudoContainer.exe.

Source: Tolly, April 2011

Table 3



playing the WMV9 file the playback was very choppy with the audio and video totally out of sync. Similarly, the H.264 file played back with a very slow frame with pixelated video and the audio and video out of sync for most of the playing time.

For WMV9, the HP system delivered a good user experience, with interludes of slight choppiness. While delivering comparable CPU consumption to Wyse, the memory consumption of the HP was some 1.5 times that of the Wyse system. For H.264, the HP system delivered a good user experience. While delivering comparable CPU consumption to Wyse, HP consumed over twice the memory required by Wyse.

Remote HD Video Playback via Citrix HDX

In this test, the thin client systems connected via a LAN to a virtual desktop hosted on a server and tested the user experience while playing back an Adobe Flash video file embedded in a Web page. The clients used the Citrix Online plugin

and the video playback was accelerated using the Citrix HDX protocol.

Again, of the three solutions, the Wyse system delivered the best playback experience. See Table 3 and Figure 4. In this and previous tests, the video playback quality of the Chip PC device was problematic with very choppy playback and major dropouts of both audio and video.

The HP solution's video playback froze a little more than one minute into the video, with audio/video sync issues and choppy video playback.

Test Setup & Methodology

Local Performance Benchmark

To benchmark the processing power of the DUTs, engineers ran the PassMark Performance Test 7.0 and ran all of the standard test suites (except Disk test and

CD/DVD test). PassMark then created a composite rating (PassMark Rating) based on the scores from all the individual tests. Tests were run three times and averaged.

Media Playback Experience Tests

Engineers evaluated the playback experience of popular media formats such as H.264, Windows Media Video 9 and Adobe Flash, under various scenarios like playback on the local machine, and playback in a virtual desktop, accelerated using Microsoft Remote Desktop Protocol 7 (RDP7) or Citrix HDX display protocols.

Tests using local playback and remote media playback using RDP7 focused on playing back H.264, WMV and embedded Flash video files at 1080p. Tests for remote playback using HDX only focused on 1080p playback for Flash.

Local Media Playback

Engineers used Internet Explorer 9 browser to playback a 1080p Youtube

Systems Under Test

System Configuration								
Vendor/ System	CPU	Memory (GB)		Video	Video Buffer (MB)	RAM Disk (MB)	OS	Notes
		Flash	RAM					
Wyse Z90D7	64-bit Dual Core AMD G-T56N @ 1.60 GHz	4	2	AMD Radeon HD 6310	384	256	32-bit Microsoft Windows Embedded Standard 7 SP1 (build 814)	N/A
Chip PC EX-PC W7D4791	32-bit Single Core Intel Atom N270 @ 1.6 GHz	4	2	Mobile Intel® 945 Express	224	(see notes)	32-bit Microsoft Windows Embedded Standard 7 SP1 (Version 010303)	No RAM disk detected
HP t5740e	32-bit Single Core Intel Atom N280 @ 1.66 GHz	4	2	Intel GL40	Auto	99	32-bit Microsoft Windows Embedded Standard 7 (version 6.1.7600.112)	No option to configure video buffer in HP BIOS

Source: Tolly, April 2011

Table 4



video: (Tron Legacy - official trailer at <http://www.youtube.com/watch?v=L9szn1QQfas>).

Pause the playback while the local client buffers the entire duration of the video clip before starting playback. This helps to avoid buffering issues over the Internet that might not be strictly related to playback issues.

Using Perfmon.exe utility built into Windows, record the following performance counters:

- \Processor(_Total)\%Processor Time. Report average CPU utilization.
- \Process(iexplore)\Working Set. Report maximum memory utilization.

Record any issues with the smoothness of playback, buffering, pixelation, audio/video sync, etc. of each DUT.

Repeat each test three times, and average the performance counter results from the three runs.

H.264 playback:

Test files: Use Windows Media Player 12 to play back a H.264 video at 1080p resolution.

Using Perfmon.exe utility built into Windows, record the following performance counters:

- \Processor(_Total)\%Processor Time. Report average CPU utilization.
- \Process(wmplayer)\Working Set. Report maximum memory utilization.

Record any issues with the smoothness of playback, buffering, pixelation, audio/video sync, etc. of each DUT.

Repeat each test three times, and average the performance counter results from the three runs.

WMV9 playback:

Test files: Use Windows Media Player 12 to play back a 1080p Windows Media Video 9 video file

The_Rules_of_Attraction_1080.wmv.

Performance counters to record:

- \Processor(_Total)\%Processor Time. Report average CPU utilization.
- \Process(wmplayer)\Working Set. Report maximum memory utilization.
- Record any issues with the smoothness of playback, buffering, pixelation, audio/video sync, etc. of each DUT.
- Repeat each test three times, and average the performance counter results from the three runs.

Comparison Criteria

When comparing two products to determine a superior media playback experience, the order of preference of determining factors are:

- Smoothness of playback
- Average CPU and max memory utilization. For two DUTs with similar quality of playback, a DUT with lower CPU and memory utilization is considered better. The reasoning is that the lower the CPU and memory utilization, the more resources the user can have to engage in other productivity tasks.

Configuration Notes for HDX Tests

For multimedia tests using Citrix HDX, engineers had to modify a Windows registry key that controls network utilization of HDX MediaStream. On 64-bit Windows platforms, the registry path is: HKLM\SOFTWARE Wow6432Node\Citrix\HdxMediastream\MinimumBandwidth.

See <http://support.citrix.com/article/CTX124777>.

To configure HDX MediaStream for Flash, engineers followed Citrix's recommendations outlined at <http://support.citrix.com/article/CTX124190>

To prepare the DUTs for the test, engineers installed the latest version of Flash, and Windows updates available at the time of testing. Also the base OS image on each DUT was updated with the latest publicly available updates/drivers provided by each vendor.

Engineers also configured the RAM disk size to the maximum supported by the vendor. Finally, engineers configured the Windows power management profile for maximum performance.



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Interaction with Competitors

In accordance with Tolly's fair testing charter, Tolly personnel invited representatives from both Hewlett-Packard and Chip PC to review the testing. Representatives from Hewlett-Packard reviewed the test plan, but provided no formal feedback. Representatives from Chip PC were unresponsive and did not participate in testing.



For more information on the Tolly Fair Testing Charter, visit: <http://www.tolly.com/FTC.aspx>

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