

HP t730 Thin Client with Windows Embedded Standard 7 SP1

Comparative Performance and User Experience Evaluation versus Dell Wyse 7020

Executive Summary

The growing popularity of cloud computing and the maturity of the client virtualization ecosystem have brought forth new areas where thin client computing can provide cost effective solutions. These thin client systems need to have sufficient power to handle graphics demands of today's applications as well as protocol resilience so important in cloud environments.

HP commissioned Tolly to evaluate the performance and user experience of the HP t730 Thin Client and compare it to the Dell Wyse 7020 thin client solution with the Windows Embedded Standard 7 SP1 operating system. Each is advertised as that vendor's highest performing Windows client.

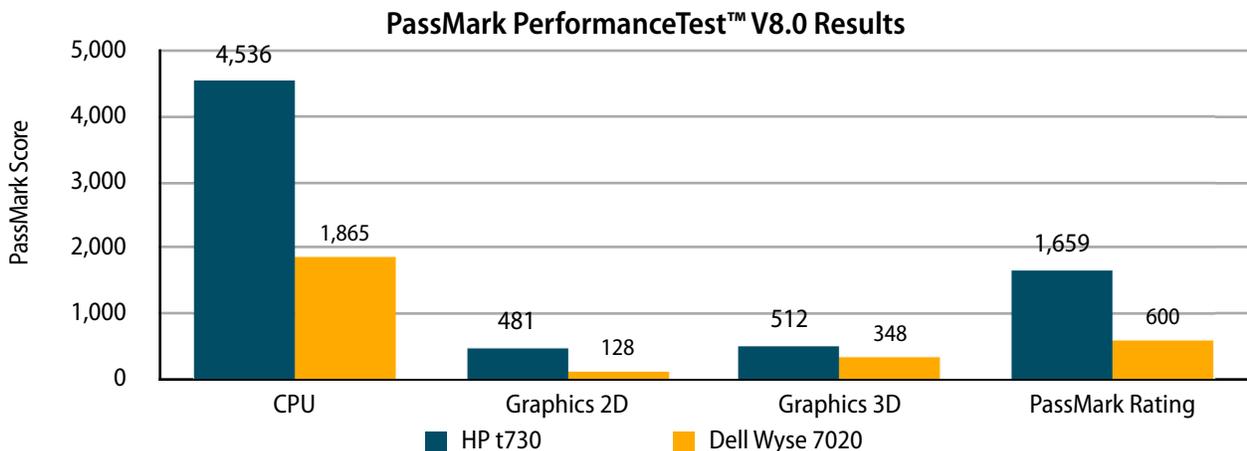
The HP t730 Thin Client delivered better performance benchmark scores than the Dell Wyse solution at a lower cost. The HP thin client also delivered higher video frame rates and file upload/download speed across a simulated WAN experiencing 0.5% frame loss. In the LAN environment, the HP thin client also delivered higher video frame rates and more traffic throughput for better use experience. Furthermore, without the dedicated graphics card, the HP client supported four 4K monitors with smooth 4K video playing while the Dell client could not play the 4K video smoothly with three 4K monitor and one 1080p monitor.

The Bottom Line

The HP t730 Thin Client vs Dell Wyse 7020 Thin Client with Windows Embedded Standard 7 SP1 delivers:

- 1 177% better PassMark overall rating, 143% better CPU score, 275% better Graphics 2D score and 47% better Graphics 3D score
- 2 120% better delivery of video under impaired WAN conditions
- 3 148% faster upload speed and more than 17 times faster download speed under impaired WAN conditions
- 4 217% higher video frame rate delivery with 179% greater video traffic throughput for better user experience in LAN
- 5 16 times more decoded blocks when playing a 4K video using four 4K monitors with HP, and three 4K monitor + one 1080p monitor with Dell

Local Hardware: HP t730 Thin Client vs. Dell Wyse 7020 Thin Client



Notes: PassMark ran from the Administrator account with the write filter disabled.

Source: Tolly, November 2015

Figure 1



Test Results

Local PassMark Performance Benchmark

Tolly engineers ran a subset of the standard PassMark performance benchmarks. The CPU, 2D & 3D graphics and overall rating are good indicators of satisfaction with overall end user experience. The HP t730 Thin Client outperformed the Dell Wyse offering in all tests. See Figure 1.

In the CPU test, the HP t730's score was 143% higher than Dell Wyse. The 2D and 3D graphics scores showed HP to be 275% and 47% higher than Dell Wyse. Finally, the overall PassMark rating for the HP t730 was 177% higher than Dell Wyse.

WAN Test

Video Delivery across Impaired WAN

By definition, cloud computing involves accessing application resources across a wide area network (WAN). As user sessions traverse the cloud, it is not uncommon for some level of packet loss to occur. Differences in how thin client stations recover from that frame loss can have an impact on end-user experience.

Tolly engineers ran two related scenarios evaluating performance in the presence of packet loss in a Citrix virtual desktop environment. Both tests were run using an emulated wide area network connection of 6.144Mbps - approximately four T1 lines - with a latency of 50ms and a packet loss of 0.5% in each direction.

When the "Citrix HDX Monitor" tool was used to benchmark delivery of a 2D video in this environment, tests showed that the HP t730 was able to deliver 22 frames per second (FPS) versus 10 FPS for Dell Wyse or 120% higher delivery for HP under the impaired network conditions. See Figure 2.

File Upload/Download across Impaired WAN

Tolly engineers benchmarked the file transfer performance using the same network environment as in the video delivery test.

For upload, a file was copied from a USB drive connected to the thin client to the Citrix virtual desktop. For download, the procedure was reversed.

The HP t730 completed both file transfer test scenarios faster than the Dell Wyse solution. In the upload test, HP was 148% faster. In the download test, HP was able to finish the downloading in 1 minute and 39 seconds while Dell did not finish the downloading after 30 minutes. See Figure 3.

LAN Test

Video Delivery across LAN

Tolly engineers also evaluated the video delivery performance in a local Citrix virtual environment built across Gigabit Ethernet switches.

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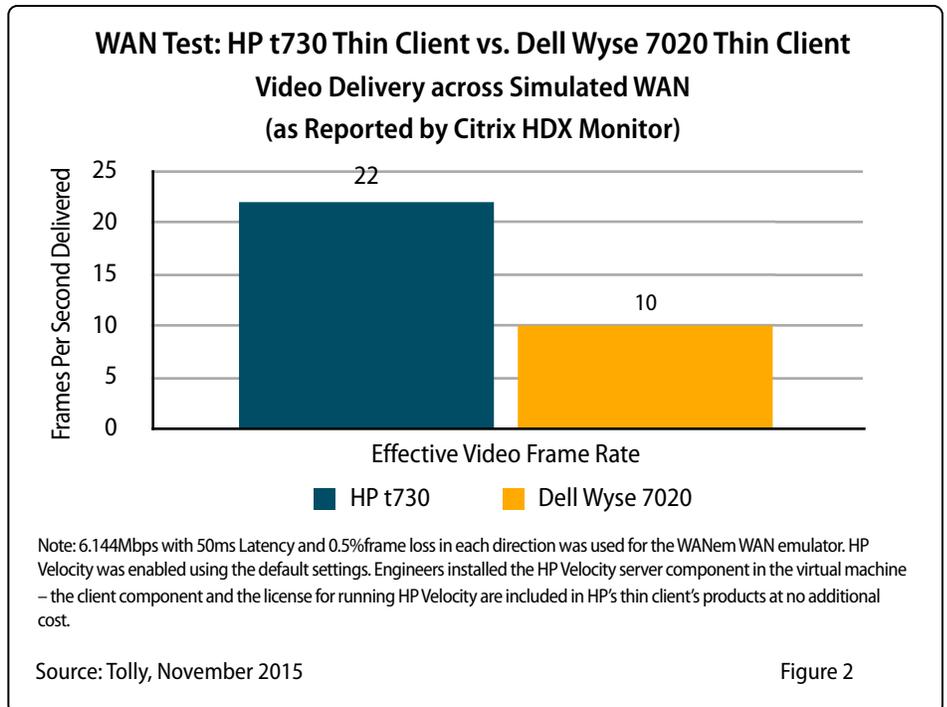
t730 Thin Client

Performance and User Experience Evaluation



Tested November 2015

When the "Citrix HDX Monitor" tool was used to benchmark delivery of three 2D video in this environment, tests showed that the HP t730 was able to deliver 19 frames per second (FPS) versus 6 FPS for Dell Wyse or 217% higher delivery for HP. The "Citrix HDX Monitor" tool also reported the "Maximum Output Bandwidth Used" as 6.08Mbps for HP and 2.18Mbps for Dell. As this is in the LAN environment, more used bandwidth delivered better user experience. See Figure 4.





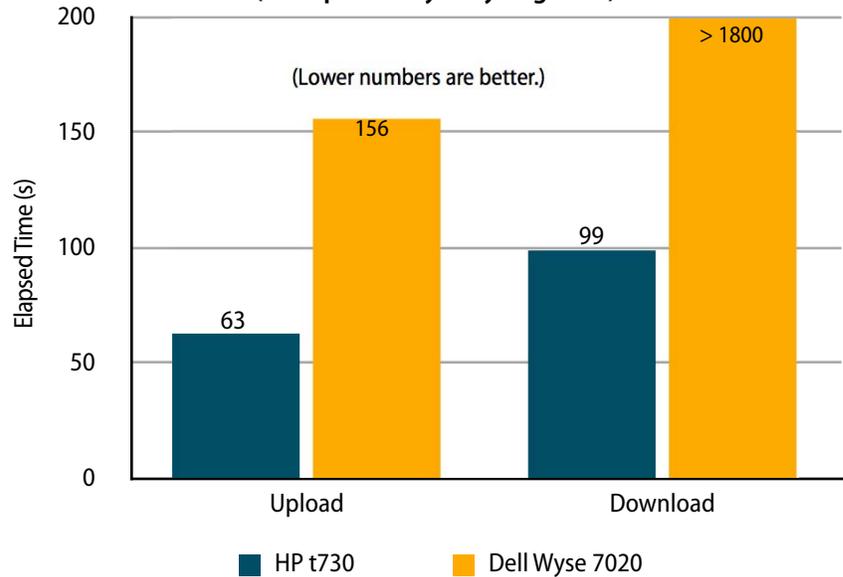
4K Display Test

Without putting the additional dedicated graphics card in the thin client, the HP t730 thin client supports four display ports on board. With the dedicated graphics card, the Dell Wyse 7020 supports three display port and one DVI port.

In the test, four HP Z27s 27-inch UHD (4K) Displays (each with 3840 x 2160 resolution) were connected to the HP t730 thin client. Three HP Z27s display with 3840 x 2160 resolution and one 1080p monitor were connected to the Dell Wyse 7020 thin client. Both thin clients have 8GB RAM installed.

Even with one more 4K monitors than the Dell Wyse 7020 thin client, the HP t730 played one 4K video smoothly while the Dell Wyse 7020 could not. The HP t730 decoded 1600% more blocks than the Dell Wyse 7020. See Figure 5.

WAN Test: HP t730 Thin Client vs. Dell Wyse 7020 Thin Client File Transfer Time across Simulated WAN (as Reported by Tolly Engineer)

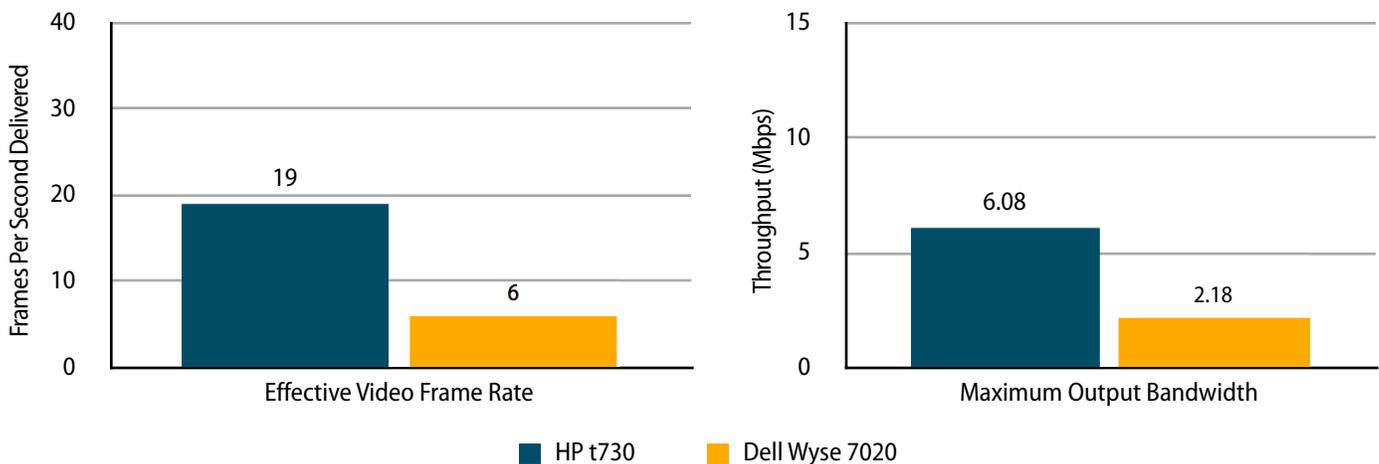


Note: 6.144Mbps with 50ms Latency and 0.5%frame loss in each direction was used for the WANem WAN emulator. HP Velocity was enabled using the default settings. Engineers installed the HP Velocity server component in the virtual machine – the client component and the license for running HP Velocity are included in HP's thin client's products at no additional cost. One 30.8MB file was copied between USB drive and the virtual desktop.

Source: Tolly, November 2015

Figure 3

LAN Test: HP t730 Thin Client vs. Dell Wyse 7020 Thin Client Video Delivery across LAN (as Reported by Citrix HDX Monitor)



Source: Tolly, November 2015

Figure 4



Test Setup & Methodology

Engineers evaluated the HP t730 and Dell Wyse 7020 thin clients, both of which are based on AMD processors, in similar configurations.

The HP t730 used for testing was equipped with an AMD RX-427BB SOC, which incorporates a 2.7 GHz quad-core APU and integrated Radeon HD 9000 based graphics core. No dedicated graphics module was used.

The Dell Wyse 7020 was equipped with a 1.5GHz quad-core AMD GX-415GA SOC with integrated Radeon HD 8330E Graphics. The dedicated graphics module was installed.

In most tests, both thin clients equipped with 4GB RAM. In the 4K display tests, both thin clients were with 8GB RAM. Both platforms were running Microsoft Windows Embedded Standard 7 SP1.

The local PassMark test was run with one 1080p monitor to each thin client. The WAN test and the LAN test were run with four 1080p monitors to each thin client. The 4K display test was run with four 4K monitors to the HP t730 thin client and four monitors (three 4K and one 1080p) with the Dell Wyse 7020 thin client.

PassMark Test

Tolly engineers loaded the latest operating system image from each vendor to the clients, disabled the write filter, installed PassMark PerformanceTest 8.0, and then ran the PassMark benchmark.

WAN Test

Graphics Performance

One WANem v2.3 WAN emulator was used to simulate a 6.144Mbps link and generate the 0.5% frame loss and 50ms latency for

each direction. All HP thin clients (excluding t310 and t420 Series) include the HP Velocity license. Tolly engineers installed HP Velocity server (version 2.1.2r21141) on the virtual desktop. The HP Velocity client (version 2.1.2r20763) was included in the HP thin client under test. Dell Wyse may also provide applications to improve the virtual desktop infrastructure's quality of experience at additional charge. As they are not included with the thin clients by default, these applications were not evaluated.

The default setting of all applications was used on both HP and Dell thin clients. Windows 7 basic theme was used on the virtual desktop. The power options were changed to "High Performance". Engineers ran the disk optimization tool once before running the test.

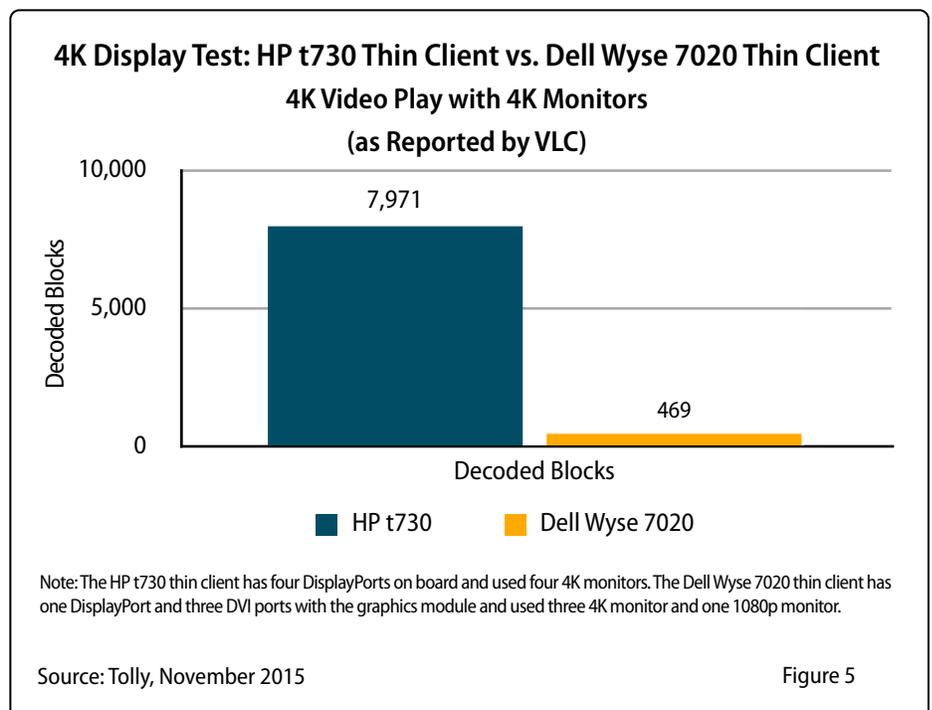
The "Citrix HDX Monitor" tool was installed on one laptop to measure the "Current FPS" of "Graphics - Thinwire Advanced" of the virtual desktop session. Tolly engineers used Citrix Receiver on each thin client to launch one Citrix virtual desktop session, and launched Windows Media Player to play one

720p video on the virtual desktop and then recorded the FPS reported by the "Citrix HDX Monitor" tool at 30, 40, 50, 60, 70, 80 and 90 seconds of the video. Each test was run with three iterations and the average FPS was reported.

Virtual desktops were hosted on one HP DL380Z Gen8 Virtual Workstation server with the dual Intel Xeon CPU E5-2697 v2 and 128GB RAM. Each virtual desktop was configured with 4 vCPUs, 8GB RAM and a 64bit Windows 7. The virtual desktop infrastructure was hosted with Citrix Desktop Delivery Controller (DDC) version 7.6.0.

File Transfer

The file transfer test used the same test bed settings as the graphics performance test. Tolly engineers copied one 30.8MB file from the local USB drive on the thin client to the virtual desktop to measure the upload file time. Then the 30.8MB file was copied from the virtual desktop to the USB drive to evaluate the download file time. Each test





was run with three iterations. The average time was reported.

To calculate how much faster one solution was than another, the formula used is $((1/T2) / (1/T1)) - 1 = (T1/T2) - 1$ where T1 is the longer duration and T2 is the shorter duration.

LAN Test

The local network was built with Gigabit Ethernet switches. No rate limiting was used in the network. Two 720p video was played by VLC and one 720p video was played by Windows Media Player. Same as in the WAN test, the "Citrix HDX Monitor" tool installed on one laptop was used to monitor the "Current FPS" of "Graphics - Thinwire Advanced" and "Maximum output bandwidth" of the virtual desktop session. The average of the FPS and the maximum output bandwidth were reported as the result.

4K Display Test

The HP t730 thin client supports four DisplayPorts on board (without using the dedicated graphics module). The Dell Wyse 7020 thin client supports three DisplayPort and one DVI port with the dedicated graphics module.

Tolly engineers connected four HP Z27s 27-inch UHD (4K) Displays (each with 3840 x 2160 resolution) to the HP thin client. Three 4K monitor and one 1080p monitors were connected to the Dell thin client. Both thin clients have 8GB RAM installed.

Tolly engineers used the VLC media player 2.2.1 to play one 4k video. The decoded blocks result reported by VLC is used in this report.

HP t730 and Dell Wyse 7020 Series Thin Client Comparison		
<i>The following information has not been evaluated by Tolly.</i>		
Model	HP t730 w/ WES7P	Dell Wyse 7020 w/ WES7 (formerly Dell 7490-Z90QQ7P)
Starting price	\$599	\$629
Operating system	WES 7P 64-bit	WES 7P 64-bit
Processor	AMD RX-427BB quad-core APU with a Radeon™ HD 9000 based graphics core 2.7GHz (Base)/3.6GHz (Boost)	Quad-core AMD GX-415GA 1.5GHz
System protection	Active Thermal Management technology Trusted Platform Module (TPM) NIST BIOS Cable lock slot Power cord retention clip Internal USB 3.0 port	
System memory	Up to 16GB DDR3L Up to 1600 MT/s	4GB DDR3 Up to 1600 MT/s
Storage	Up to 128GB	16GB
Graphics	AMD R-Series APU with GPU based on the AMD Radeon™ HD 9000 platform Optional AMD FirePro™ W2100 discrete graphics HP True Graphics	AMD Radeon™ HD 8330E (integrate with APU) and AMD Radeon™ E6240
Display	4 x DisplayPort 1.2 (DP) Up to 4 UHD/4K displays (standard) Up to 6 UHD/4K displays (with FirePro™ card)	1 x DVI 3 x DisplayPort
Software	HP Velocity HP Device Manager HP Easy Shell	- Dell Device Manager -
Ports	6 x USB 2.0 2 x USB 3.0 1 x secured USB 3.0	4 x USB 2.0 2 x USB 3.0 -

Source: HP, December 2015

Table 1



About Tolly

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You can reach the company by E-mail at sales@tolly.com, or by telephone at +1 561.391.5610.

Visit Tolly on the Internet at:
<http://www.tolly.com>

Interaction with Competitors

In accordance with Tolly's Fair Testing Charter, Tolly personnel invited representatives from Dell Wyse to participate in the testing. Dell Wyse did not respond to the invitation.



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

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