Dell Desktop Virtualization Solutions Stack with Teradici APEX™ 2800 server offload card

Performance Validation

TERADICI™

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## 1. Executive overview

Following the successful launch of the Teradici APEX 2800 server offload card in February 2012, Dell decided to test the card on their Desktop Virtualization Solutions (DVS) Stack to better understand its value proposition and possible benefits it could bring to the solution.

The testing completed by the Dell DVS Engineering team was able to confirm the effectiveness of the card in offloading, from the server CPU, the PCoIP encoding tasks of the displays of the 64 most active virtual machines, reducing server CPU utilization by up to 40% (video workload).

This result confirms Teradici's positioning of this card in providing an extra level of insurance to maintain performance expectations in VMware View environments that support end users with increased workload complexity.
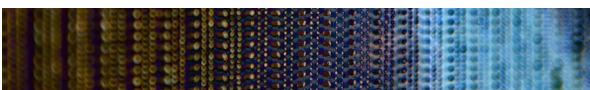
2. Introduction

2.1 Teradici APEX 2800 server offload card

The Teradici APEX 2800 card offloads the tasks related to the remote display protocol (PCoIP) from the server CPU, reducing server CPU utilization by up to 50%. However, as opposed to a GPU offload card, it does not directly improve the end-user experience but rather ensures CPU cycles are available for the "normal" tasks to be carried out by the CPU. This results in two benefits:

- The card protects and ensures a consistent end user experience as workloads change, by monitoring the activity of all the displays on the server and dynamically offloading the most active 64, seamlessly switching between soft encoding and APEX 2800 hardware encoding.
- The card increases the server density, by allowing IT managers to put more Virtual Machines (VM) on the server. Depending on the workload considered, this benefit ranges from 10% to 100% increase.

The first point is particularly important as VDI begins to be deployed for more demanding users with less predictable workloads, using more multimedia applications in terms of pixel changes.

For more information, please refer to the Teradici whitepaper "Teradici APEX 2800: Addressing the Next VDI Bottleneck" available for download at www.teradici.com

2.2 Dell positioning in the VDI eco-system

Dell has defined Desktop Virtualization as a pillar of its strategy moving forward. Its recent strategic acquisitions in this market emphasize how much Dell believes in this industry.

Dell's DVS Enterprise offering is a comprehensive solution portfolio designed to enable customers to experience the benefits of virtual end user computing. The solution is based on VMware View 5.1 and VMware vSphere 5 ESXi with Dell PowerEdge rack or blade servers, EqualLogic SAN for iSCSI or Compellent for FC, PowerConnect or Force10 network switches and Wyse thin clients. This allows Dell to be the only vendor offering a true end-to-end solution for desktop virtualization.

Based on extensive engineering, architectural design and scalability characterization work, the Dell Desktop Virtualization Solutions can be quickly and confidently deployed into production environments, thereby helping to eliminate much of the costly and time consuming trial and error often encountered during complex custom infrastructure design and implementations. This solution provides scalability and manageability for up to 50,000 users.

Dell Wyse zero and thin client devices and software provide superior security, reliability and energy efficiency when compared to a traditional PC. Wyse desktop devices and software help streamline the delivery of VMware infrastructure to millions of users around the world. Zero clients create a more secure environment that minimizes or eliminates exposure to data loss, viruses and malware. By utilizing zero or thin clients as the access device for end users, deployments can benefit from centralized management and complete control of all endpoints. Since zero clients eliminate components with high failure rates, deployments can expect reduced costs and improved reliability over the life of a desktop virtualization deployment.
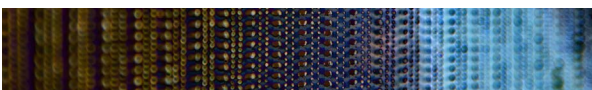
While the Teradici APEX 2800 has already been added to the Dell online e-store in USA and Europe, Dell wanted to better understand the value proposition of the card and decided to run the tests on its DVS Enterprise stack to gain visibility of the following:

- When does the card provide the most value to customers?
- What is the benefit of the card under the Dell office worker workload?
- Considering different workloads, does the card improve user experience?

For further information on Dell's Desktop Virtualization Solutions go to http://content.dell.com/us/en/enterprise/virtual-client

3. Validation testing as a commitment to quality

Both Teradici and Dell are committed to providing quality technological advances to their customers. As part of this commitment to quality, the companies conducted validation testing with the APEX 2800 on the Dell DVS stack.

3.1 Test methodology

In the test environment Login VSI (developed by Login Consultants) was used to generate the desktop workloads. Login VSI is a widely-used tool for validation of VDI environments and server-based computing / terminal services environments. It installs a standard collection of desktop application software (e.g. Microsoft Office, Adobe Acrobat Reader etc.) on each VDI desktop. It then uses launcher systems to connect a specified number of users to available desktops within the environment.

The tests were monitored using esxtop on vSphere which samples CPU utilization every 5 seconds, instead of using vCenter that samples only every 20 seconds and could therefore miss some CPU peaks and related activities.

The same sets of tests were run on an identically configured PowerEdge server without the Teradici APEX 2800 server offload card.

3.2 Test load scenarios

Testing was performed using various workloads that simulated the varied CPU usage environments associated with businesses. These different test cases provide evidence of the overall cost and time saving possibilities of the APEX 2800. The workloads, generated through Login VSI, are described below:

- **Premium Workload** (=Login VSI heavy workload)
  - Considered to be a conservative "office worker" workload with office productivity applications and 30-second video into a 10 minute loop
  - Users with a desktop resolution of 1600 x 1200
  - The workload continued for 30 minutes after all sessions were logged on to exclude the affect of the login boot storm which the APEX 2800 does not impact
- **Continuous Video Playback** (=Login VSI custom workload)
  - Considered to be a true multimedia workload, or a "peak workload", where the APEX 2800 is expected to show great benefits
 - Continuous video playback at 480p
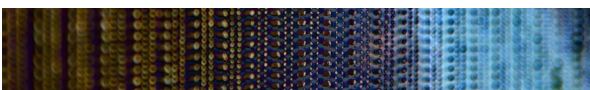
- The video played for approximately 7 minutes using the Login VSI Core (empty) workload to drive the test
- The video was played with a VLC player on a continuous loop
- **Multimedia Workload** (=Login VSI multimedia workload)
  - This is the premium workload with an extra 2 minute video inserted into a 10 minute loop, as well as playback audio playing throughout the entire workload session
  - The playback audio consumes a lot of vCPU cycles without generating any activities on the displays, so there is little difference from the premium workload
- **Customized Workload**
  - Customized workload using Login VSI heavy workload
  - Movie video from Login VSI played by VLC player for 2 minutes and 30 seconds before each loop iteration
  - This workload was designed to represent a user playing a significant percentage of video during each cycle

3.3   Test measures around three elements

The tests were performed to determine the amount of CPU usage during various workload scenarios and to understand how well the APEX 2800 server offload card works to reduce this usage. Three elements were considered:

- **Is there a reduction in CPU usage?** The tests measured the reduction of CPU usage on the host by offloading PCoIP processing to the APEX 2800 card. Various workload scenarios, described above, tested the card's ability to offload this processing against the types of usage displayed in workplace settings. CPU usage reduction reduces cost per VM.

- **Does the APEX 2800 smooth CPU spikes?** CPU utilization spikes for many reasons. A broadly distributed video creates a high CPU demand when users all watch it at the same time. Smoothing these spikes enhances the overall user experience and ensures a consistent user experience.

- **Are there differences with higher rates of pixel changes?** Video playback results in a high rate of pixel changes, requiring a lot of CPU cycles for both the rendering and the PCoIP encoding tasks. When a CPU is constrained, offloading the PCoIP encoding task will result in a better user experience (for example, smooth video viewing).
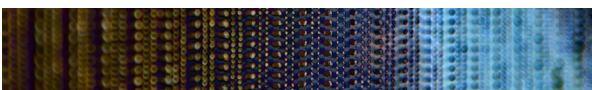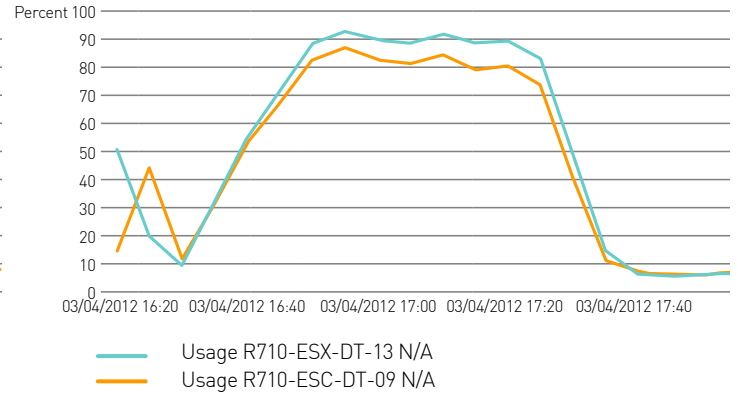
4. Test results

The Teradici APEX 2800 server offload card, hosted on the R710/R720 Dell PowerEdge rack server, showed reduction in CPU usage during testing against the different workload scenarios, ranging from 6% for workloads with little display activities to 40% with high pixel changes workloads (video playback).

CPU performance – Premium workload for 50 users
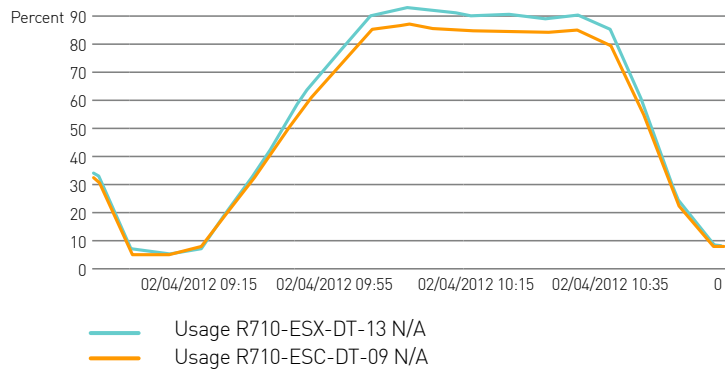
CPU performance – Login VSI multimedia workload for 42 users

As expected, CPU usage is reduced between 6% and 8% on low activity displays (premium and multimedia workloads respectively)
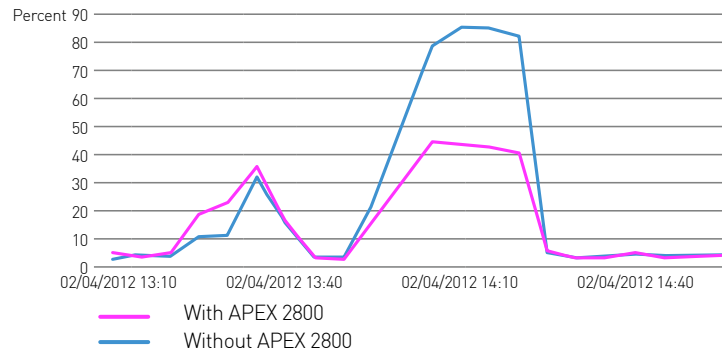Note: More on the APEX 2800 test results using the LoginVSI tool and corresponding workloads is discussed in the Teradici whitepaper *"Teradici APEX 2800 Evaluation Guide Using LoginVSI"* available on techsupport.teradici.com

The results also showed that the card instantly offloads the displays, without any lags or impact to end users, when switching from soft encoding to hardware encoding.

During the continuous video playback scenario, the CPU usage for the host without the card was 40% higher than the host with the APEX 2800 card, demonstrating the ability to run a significantly increased number of VDI users under this scenario.

CPU performance

CPU usage is reduced by 40% with APEX 2800 for sessions with continuous video playback.

The other element tested on the server was the impact of the card on the end user experience, when the server CPU, or vCPU, starts to exceed recommended thresholds (over 75% for server CPU, over 80% for vCPU). By freeing up valuable CPU cycles, the card was able to indirectly improve the end user experience, enabling smoother video and crisp audio playback, for example.
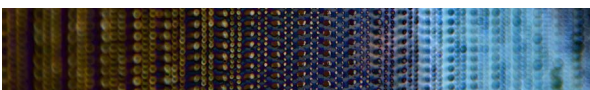
5. Benefits demonstrated by the testing

The testing was able to answer the elements put forward prior to the testing:

Is there a reduction in CPU usage?

- Yes, in all cases. We were able to demonstrate a reduction in CPU utilization, which ranged from 6% to 40%. However, 6% reduction of an already low server CPU utilization number can be quite small, especially when the server is not at maximum capacity. The highest reductions in host CPU usage were achieved with workloads that had high amounts of video and graphically intensive applications.

Does the APEX 2800 smooth CPU spikes?

- Yes, for two reasons: 1) Hardware encoding is more stable than soft encoding, by design, and 2) CPU spikes due to pixel changes on the displays are reduced by 50% instantaneously, without any lag. This validates the "insurance" value proposition of the card: "protect and insure a consistent user experience at all times as load changes".

Are there differences with higher rates of pixel changes?

- Yes, the PCoIP remote display protocol, used in VMware View, is smart enough to send over the network only the pixels that have changed on the display; little activity on the display means a small amount of PCoIP tasks and therefore low impact on CPU utilization. On the other hand, with a lot of pixel changes, a lot of PCoIP tasks are required to update the display at the end point, hence creating higher load on the CPU, so that the offload onto the APEX 2800 card will result in an important CPU utilization reduction.

6. Summary

Dell was able to confirm the value of the card as an "insurance" policy in VMware View deployments and a means to de-risk VDI roll-out as VDI moves beyond task workers, with predictable and low multimedia activities in terms of pixel changes, to office workers and power users who represent a more demanding set of end users, with unpredictable workloads and more multimedia activities.

By monitoring the activities of all the displays on the server, and dynamically offloading the most active 64, the Teradici APEX 2800 is able to reduce CPU utilization peaks by up to 40%, greatly reducing the impact of load variation on user experience. This makes the APEX 2800 an ideal choice in virtual desktop environments that need to support heavy workloads.

In market verticals with some multimedia display activities in the average workload, the benefits of the card are readily apparent and can be expressed as:

- Increased server density and reduced cost per VM.
- Improved user experience should some of these multimedia activities require more CPU cycles.
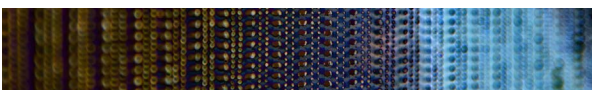
7. Appendix

Specifications of the server used for the tests were:

- 2x Intel Xeon X5660 processor
- 96 GB memory
- 8 x 146 GB SAS 6 Gbps 15k disks – RAID 10
- PERC 6i integrated RAID controller
- Embedded Broadcom 5709 GbE LOM with TCP/IP Engine (4 port)
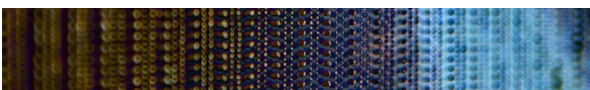
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Teradici drives innovation to fundamentally change the way people use and deploy computers by developing technology and solutions that deliver a true, uncompromised PC user experience over IP networks. Our focused approach in designing advanced image processing algorithms enables the physical separation of the computer and the user, and ultimately will change the way enterprises compute.

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