



VMware View Planner 3.5

VDI Performance Characterization Tool

TECHNICAL WHITE PAPER

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Executive Summary

This whitepaper provides a brief summary of View Planner 3.5 new features, which include the support of Horizon 6, RDSH-based desktop session and application publishing, and new workloads for mouse operations and video-audio quality measurement. Later, some use cases of View Planner 3.5 are presented.

Introduction

In recent times, the enterprise world has been increasingly mobile and that has altered the way information is consumed, processed, and stored. This gave rise to Virtual Desktop Infrastructure, popularly known as VDI. Traditionally, the “desktop” was not really designed as something that could be operated upon in a distributed environment. Instead, it operated as a silo, where its compute, memory, and storage were local to the operating system and applications. With VDI, virtualized compute, memory and more recently, virtualized storage (VSAN) and virtualized networking are leveraged to provide the necessary infrastructure to truly bring the “desktop” to a distributed environment.

Quantifying a user experience in such a shared infrastructure is challenging. If either of the compute, memory, storage, or networking becomes a bottleneck, the resulting symptom is a poor user experience. Therefore, a singular measure of success of a VDI deployment is its end user experience.

VMware View Planner 3.5 is a workload generator that simulates typical office user operations, such as typing a word in Microsoft Word, playing a PowerPoint slideshow, reading Outlook emails, browsing PDF pages, browsing Web pages, watching video, and so on. More details about the View Planner are described in the VMware View Planner user guide [1] and a recent article in *VMware Technical Journal*[2].



Figure 1. Supported applications in VMware View Planner 3.5

View Planner supports different Microsoft Office 2010 applications (and also supports Office 2007). Other typical apps include Adobe Reader, Microsoft Internet Explorer, Mozilla Firefox, and Microsoft Windows Media Player. In the standard benchmark profile, all the applications are selected with fast video and a think time of 2 seconds.

The architecture block diagram of VMware View Planner is shown in Figure 2, below.

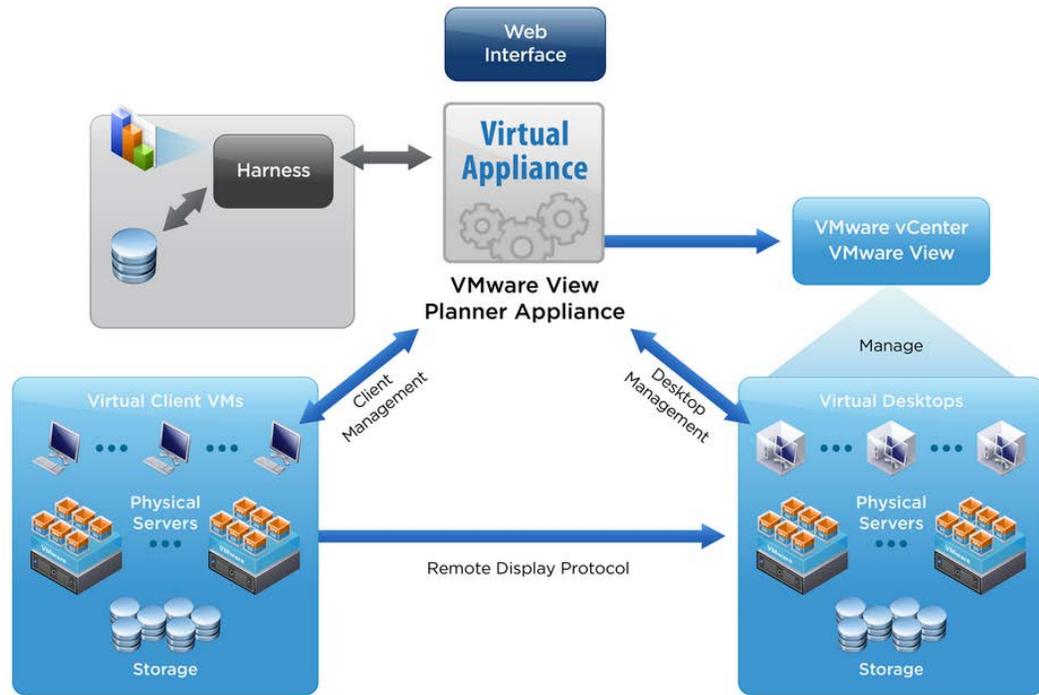


Figure 2. VMware View Planner 3.5 architecture block diagram

View Planner QoS

The View Planner score is represented as the VDI mark. This metric encapsulates the number of VDI users that can be run on a given system with application response time less than the set threshold agreed upon. Hence, the scoring is based on several factors such as the response time of the operations, compliance of the setup and configurations, and so on. For response-time characterization, View Planner operations are divided into four main groups.

1. Group A for interactive operations (mostly CPU bound)
2. Group B for interactive but I/O sensitive operations
3. Group C for background operations
4. Group X for special workload operations

The score is determined separately for Group A and Group B user operations by calculating the 95th percentile latency of all the operations in a group. The default thresholds are 1.0 seconds for Group A and 6.0 seconds for Group B. More details about Group A, Group B, and Group C can be found in the VMware View Planner user guide [1]. Group X is a newly introduced metric that captures results from two workloads defined in VMware View Planner 3.5. The intention of these workloads, named UEbench and AVbench, is to measure the “User Perception” of VDI desktops in terms of both “screen responsiveness” and audio-video fidelity, respectively. Since these new workloads are in tech-preview, they are not used in the VDI score.

VMware View Planner 3.5 New Features

In addition to retaining all the features available in VMware View Planner 3.0, View Planner 3.5 addresses following use-cases:

- Support for VMware Horizon 6
- Support for Windows 8.1 as desktops
- Improved user experience
- Audio-Video sync (AVBench)
- Drag and Scroll workload (UEBench)
- Support for Windows 7 as clients

Detailed documentation for installation and configuration can be found in the View Planner user's guide [1].

Support of VMware Horizon 6

Horizon 6 introduced streaming multiple user sessions and/or streaming published applications through the PCoIP protocol from a single or a farm of Remote Desktop Session (RDS) servers. With VMware View Planner 3.5, you can evaluate the infrastructure of their choice for hosted virtual machines, remote sessions, as well as published applications. With remote desktop sessions or published applications, multiple end users connect to the same remote desktop server machine and share the operating system as well as the application instance. Now, with VMware View Planner 3.5, you can perform a single host scale run to determine:

- The **consolidation ratios** for the number of users per host.
- The number of **remote desktop sessions** per host.
- The number of **published applications** per host.

Innovative New VDI Workloads

UEBench

End users can feel the interactivity or the lack of it much more on operations like window drags. To mimic that user action from a View client, View Planner emulates the end user by sending mouse events to click and drag this window with a special bitmap on a predefined trajectory. This bitmap is specifically constructed to help in measurements by detecting the current window locations while the window is being moved over the pivot points. The bitmap detects the current location of the window using black, white, and red tiles as seen by the View client. On the client side, View Planner records the location and timestamp. Then, FPS and smoothness of movement is calculated, which quantifies temporal and spatial variance.

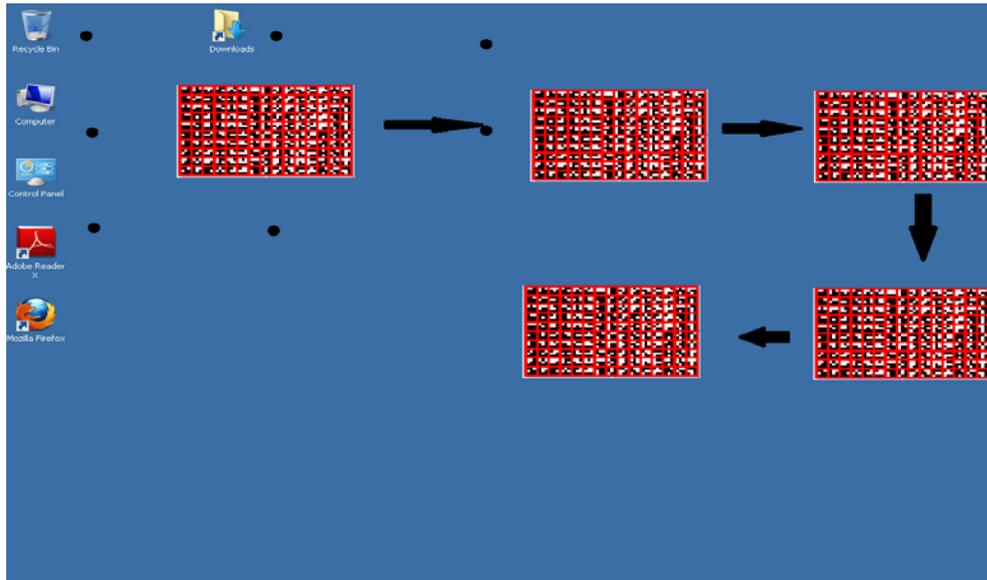


Figure 3. Mouse click and drag workload as part of UEbench

Another very interactive operation that end users do is scrolling, and they notice interactivity issues, very quickly. Again a unique-colored bitmap is constructed that helps View Planner detect which page is active while scrolling. View Planner scrolls a long, vertical bitmap in a window by sending mouse-click-scroll from the View client. Then, the current displayed region is detected by reading the color of pixels in the middle of the window. The temporal and spatial variance is found when View Planner records “page” on the bitmap and timestamp.

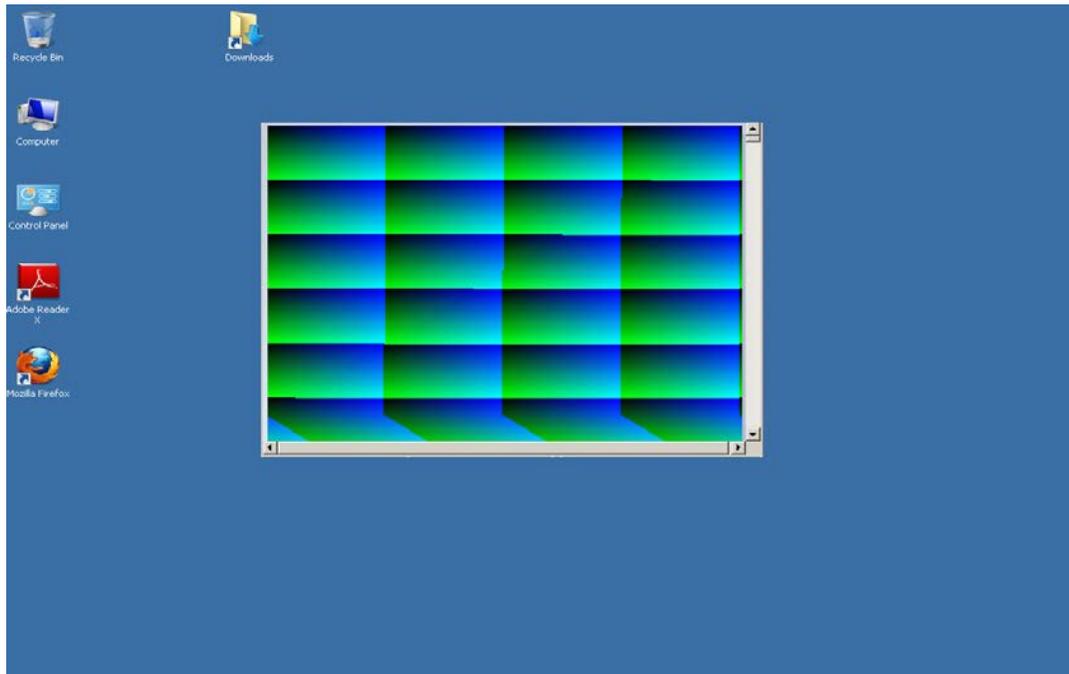


Figure 4. Mouse click and scroll workload as part of UEbench

AVBench

Previously unaddressed in View Planner, there is a need to quantify audio fidelity in VDI deployments where the video and audio streams are not tethered. A virtualized or consolidated environment has a greater potential for “lip-sync” problems. This is because of the high probability for mis-synchronization between two streams. This mis-synchronization is a direct consequence of a shared environment, as is the case with VDI deployments. As the number of virtual desktops is scaled up, and more virtual desktops share resources, so do the odds of having this mis-synchronization. View Planner 3.5 has a new workload (AVSync) that quantifies the synchronization between the audio and video streams.

The AV workload is created by embedding timing information (markers) into an audio stream and subsequently multiplexing the audio stream in a video stream. This method can be compared with inserting frame metadata in a video stream. The use of a spread spectrum technique provides redundancy and robustness for the audio stream to survive lossy compression. On the client side, View Planner compares the received audio stream with the original in post-processing to get an objective metric.

Office 2013 Tech Preview

Support for Microsoft Office 2013 is introduced as a tech preview in View Planner 3.5.

Windows 8.1 as Desktops

View Planner 3.5 expands the guest operating system support matrix. View Planner 3.5 fully supports Windows 8.1. As in Windows 7, you can measure the performance of your infrastructure when planning a Windows 8.1 VDI deployment.

Using Windows 7 VMs as Clients

Recently Microsoft announced end-of-life for the Windows XP operating system. Hence, starting with VMware View Planner 3.5, Windows 7 32-bit and Windows 7 64-bit will be the supported operating system for the “View Planner agent for client.” When you configure View Planner 3.5, you must use Windows 7 to install the View client and then install the View Planner agent for client.

Enhanced Run Visibility

VMware View Planner 3.5 has several improvements aimed at improving the user experience. These improvements were implemented based on the valuable feedback from our customers and partners who we engage with.

With VMware View Planner 3.5, you can track the progress of the on-going run and accurately know what state the current test run is in.

As shown in the screenshot below, the current run is in progress and virtual machines are being powered on as indicated by the light green colored box. Whereas, states like getting vCenter (VC) resources and matching the correct number of virtual machines completed for this run are highlighted in the green colored boxes. Items in both light green and dark green colors are hyperlinks that yield more meaningful information when you click on them.

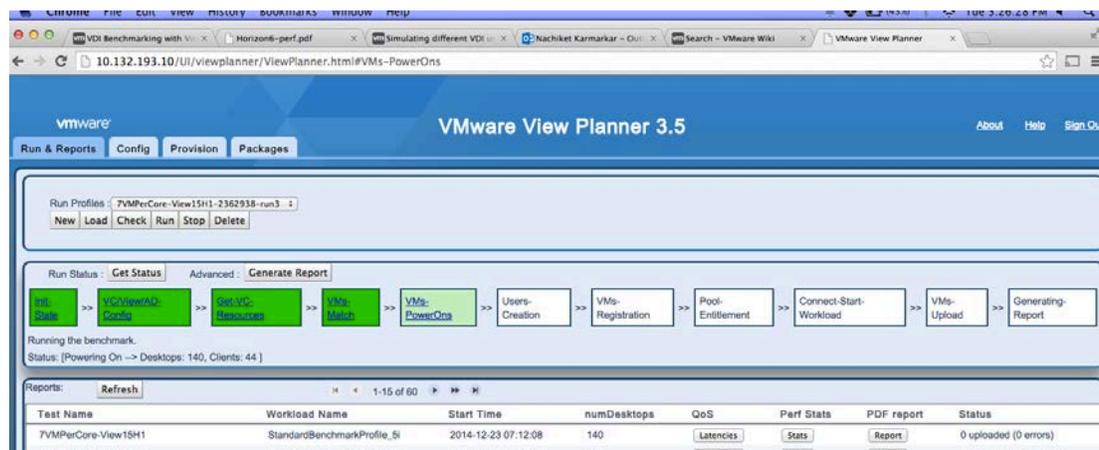


Figure 5. View Planner run states highlighted with boxes following a color code

As you can see in the figure below, the **Connection-Start-Workload** box is turned orange, which means not all desktops are connected. Once all clients launch connections and start the workload, the box turns green to indicate 100% success. As described earlier, by clicking on the hyperlink inside the box, you can see the result of that activity in a pop-up box as shown in Figure 6. This is helpful when you need to debug issues.

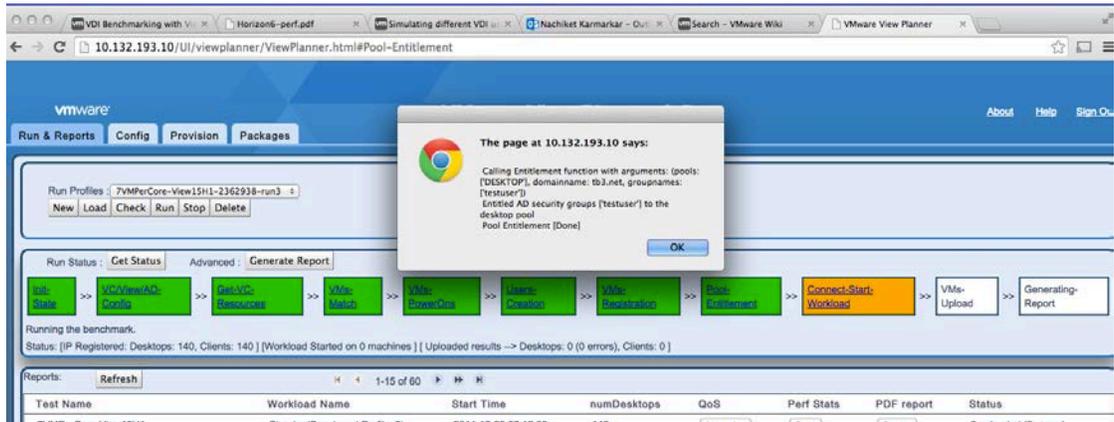


Figure 6. Pop-up showing details of a run state when clicked on a text within a box

In addition to that, there is a **Check** button that lets you check a run profile before running it. To use this feature, select the run profile name to check and click the **Check** button. This verifies if there are enough desktops and clients needed for the run, if virtual machine settings that are needed are set, and so on.

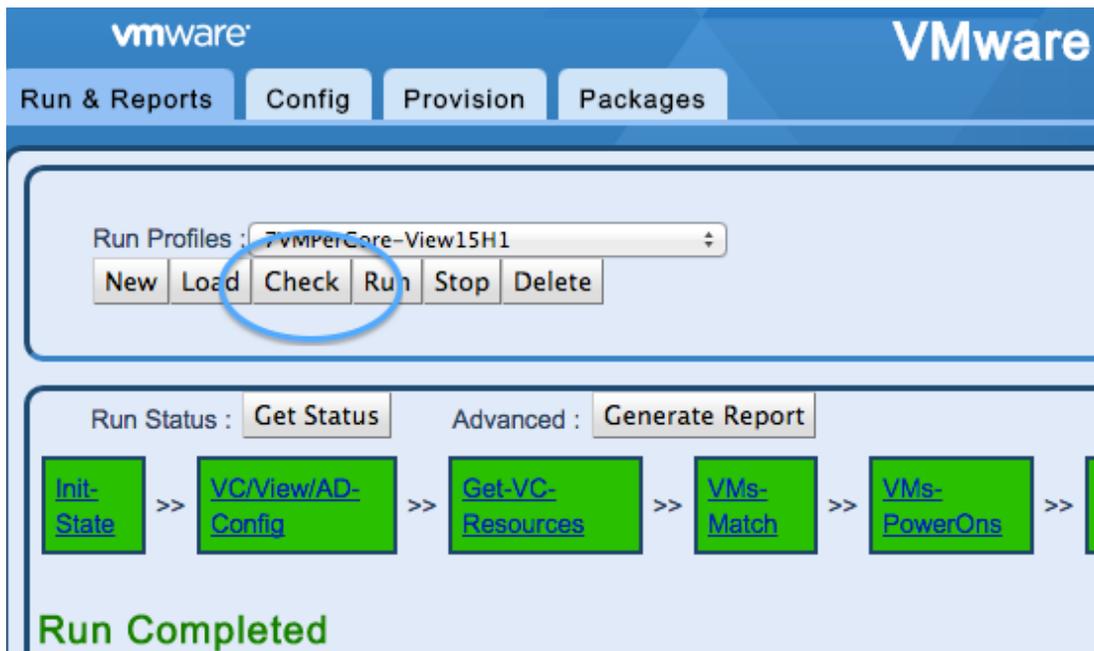


Figure 7. Check button in Run & Reports tab to check configured Run Profile

In the **Config** tab in the View Planner user interface, you can check VC, View, and AD Server settings that you have saved in the appliance. When you click on **Test** in the vCenter Information tile, View Planner will test the VC connection using the IP address and credentials provided and display the result in a pop-up. **Test AD** and **Test View** do the same for verifying connectivity to the AD server and View Connection Server respectively. However, this feature will display an error when View Planner is configured to use a dummy user.

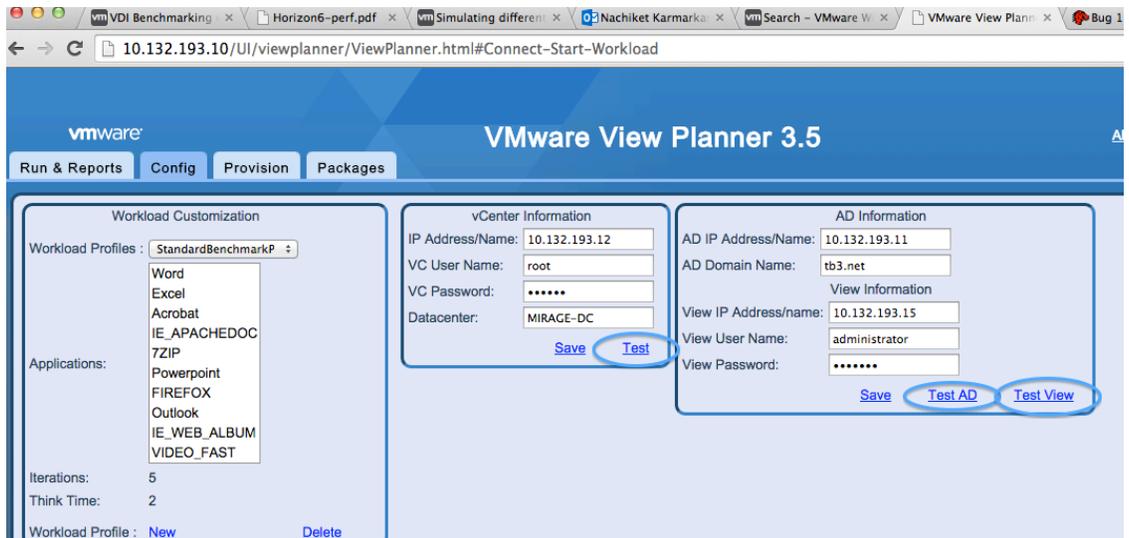


Figure 8. Test link to test VC configuration. Test AD and Test View links to test AD server and view server settings, respectively.

Ease of Use

Prior to VMware View Planner 3.5, template virtual machines used for desktop and client pool creation needed manual configuration in order to prepare them for View Planner agent installation. After user feedback, starting in View Planner 3.5, you can “bring your own template” and the entire configuration needed for View Planner agent installation is automated and driven through the installer. The installer follows [3] [4] best practices recommended for VMware Horizon 6.0 [5]. The installer now has a user interface that tracks the current state of the agent installation. This interface also indicates completion status using a color code with green for success or red for error.

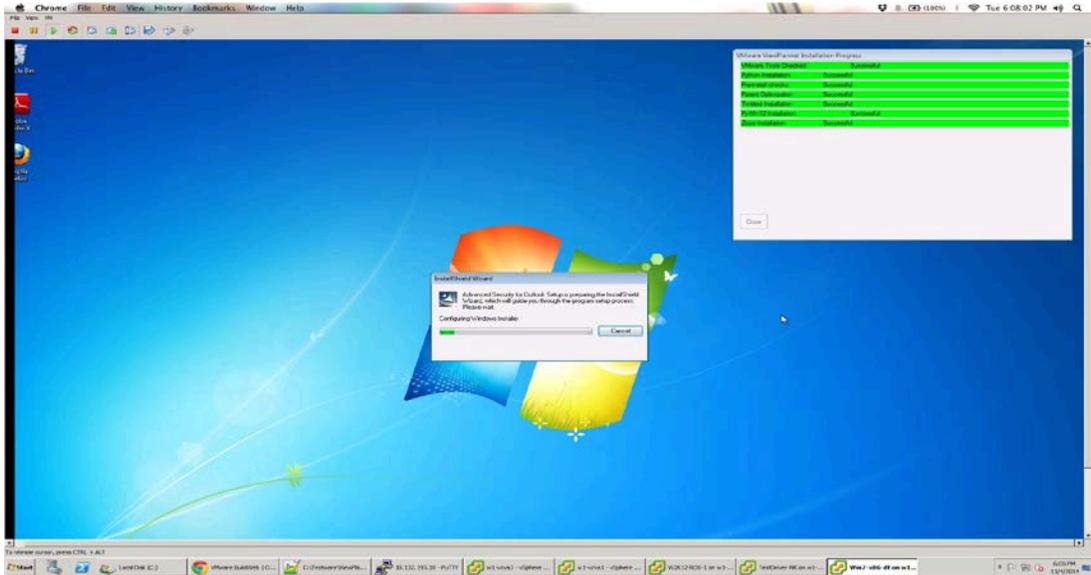


Figure 9. View Planner agent installation UI to track different stages of installation

View Planner Use Cases

View Planner is being used for various use cases internally and in the field. Below is a list of some examples of use cases:

- Platform characterization (CPU architecture, storage array and protocols, and so on)
- Host consolidation or user density
- Solutions characterization
- Bring your own application (BYOA) – custom application performance characterization
- Performance check-pointing
- Effect of different features/configurations

In this section, some of these use cases are covered and the experimental setup provided below is used unless stated otherwise.

Experimental Setup

Server Type	Cisco UCS 240-M3S
No. of sockets/host	2
No. of cores/socket	10
CPU Type	E5-2680 v2 @ 2.80 GHz
Memory	256 GB
No. of servers	20
Networking	Dual channel Broadcom NetXtreme II 10G
Storage Array	Pure Storage FA-420
Storage Array Firmware	4.0.12
Storage Type	FC SAN
Storage Networking	ISP2532 based 8GB FC HBA PCI Express
Virtualization Platform	VMware vSphere 5.5
Virtual Desktop Infrastructure (VDI)	VMware View 6.0

VDI Scaling

We started with a small number of desktops on a single host and increased them until the Group A and Group B numbers exceeded the threshold limits previously defined in “View Planner QoS.” We used the **Standard Benchmark Profile** that is pre-defined in the View Planner. In this standard benchmark profile, we selected all user applications including 720p HD video. The desktop resolution was set to 1920 x 1200 while the “think time” (the time between two subsequent user actions) was set to 2 seconds. This defines a workload profile that emulates a heavy user.

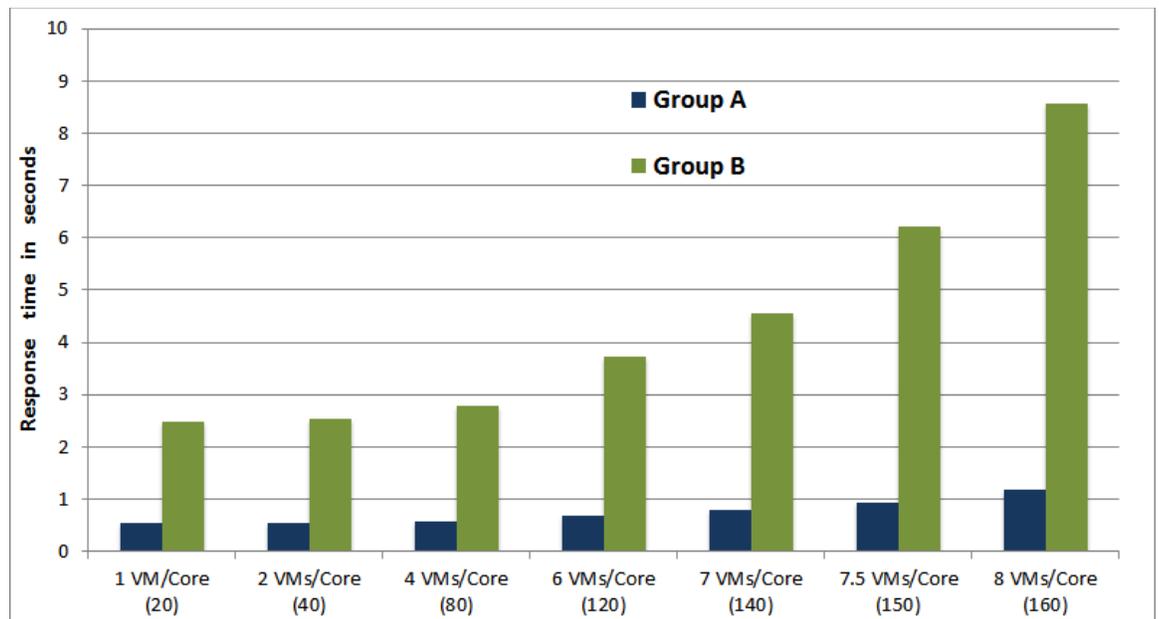


Figure 10. Single server characterization with hosted desktops for CISCO UCS C240

Our results show that a single Cisco UCS C240 server with 20 CPUs at 2.8 GHz each can scale up to 7 to 7.5 virtual machines per core or can support between 140 to 150 desktops.

RDSH Scaling

Single Host Scaling (Remote Desktop Sessions)

We followed the best practices prescribed for VMware Horizon 6 [4] and set up a number of remote desktop session (RDS) servers that would fully consolidate a single UCS C240 vSphere server. We started with a small number of user sessions per core and then increased them until the Group A and Group B numbers exceed the threshold level as previously defined in “View Planner QoS.”

For remote desktop sessions, View Planner 3.5 has a pre-determined workload profile that includes all standard applications along with 240p video. The time between subsequent user actions (think time) is set to 5 seconds.

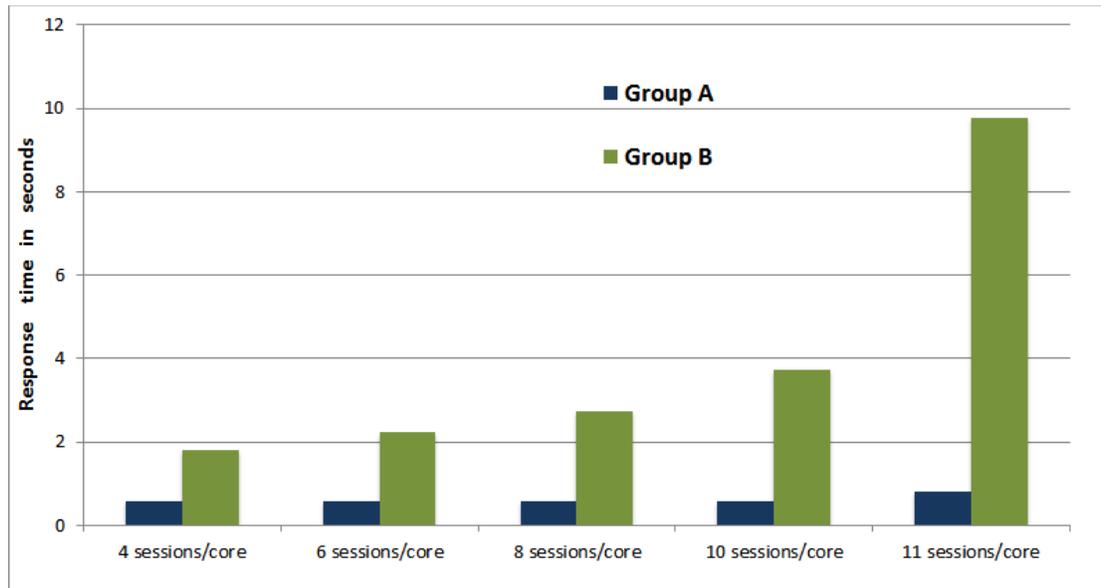


Figure 11. Single server characterization with RDS sessions for CISCO UCS C240

Our results indicate that a single UCS C240 host can scale up to 10 sessions per core or 200 user sessions with the given hardware configuration.

Storage Characterization: Pure Storage FlashArray

In this release, we intended to scale the View Planner appliance in order to verify its capability in driving a workload and managing incoming uploads at a bigger scale. We verified View Planner scalability on a Pure Storage FlashArray FA-420 (11TB) with a large number of desktops. A total of 3000 desktops were deployed on a 14-node cluster on the Pure Storage FlashArray, and then the desktops executed the standard benchmark profile in local mode.

One reason to do this was to efficiently use the available hardware while achieving our goal of verifying View Planner scalability. With powerful systems like the Cisco UCS C240 and equally powerful and capable SAN provided by the Pure Storage All Flash Storage FlashArray (FA-420 11TB), results are pretty impressive at scale. We were able to scale from 2000 to 3000 on the same hardware without compromising the application response time in 8RU.

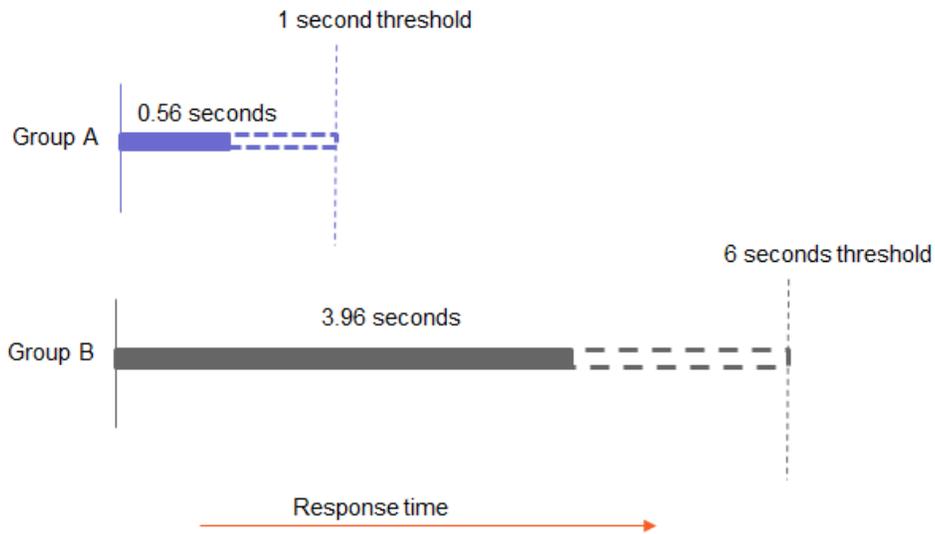


Figure 12. Local mode QoS result from 3000 desktops running on Pure Storage FA-420 storage array

The Group-A and Group-B response time of 3000 desktops is shown in Figure 12. Our results indicate that VMware View Planner 3.5 demonstrated scaling up to 3000 desktops in terms of driving a standard benchmark workload, managing inbound uploads, analyzing latency data, and meeting quality-of-service (QoS) criteria of that many number of desktops.

The latency of individual Group-A operations is shown in Figure 13, whereas for Group-B it is shown in Figure 14. As seen in these graphs, the response times of all these operations are well below the threshold of Group-A of 1 second and the Group-B threshold of 6 seconds.

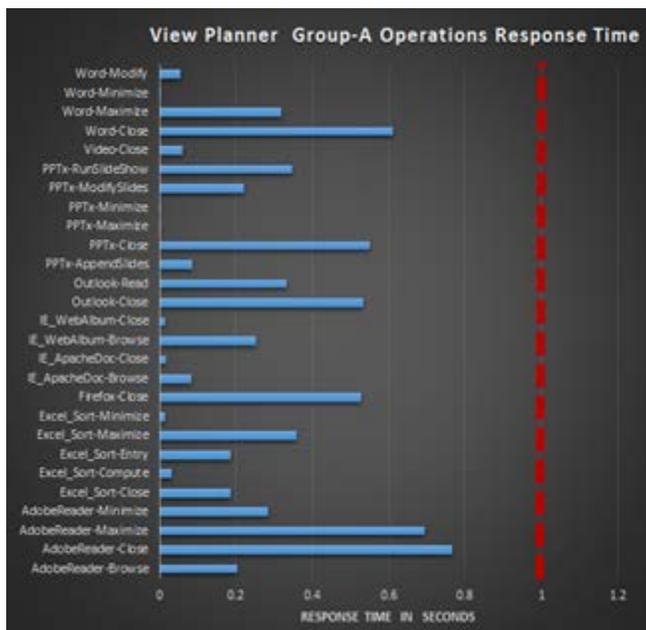


Figure 13. Response time of Group-A Operations for 3000 desktops



Figure 14. Response time of Group-B Operations for 3000 desktops

It is also worth noting the performance at scale of Cisco UCS C240 servers and Pure Storage FA-420. We were seeing close to 20,000 IOPS during the steady state with about 70% writes, and we observed the I/O latency to be less than a millisecond, which is quite good. This demonstrates how we can use View Planner 3.5 to characterize an all-flash storage array.

Custom Applications for Different Verticals

The **Custom App** framework lets you register the applications that you know will be actively used in your VDI environments. Thus, VMware View Planner 3.5 is capable of targeted characterization of VDI infrastructure by measuring performance that is application specific.



Figure 15. New workloads **Notepad** and **Visio** after configuring them as **Custom Apps**.

A classic example as seen in the above figure is Microsoft Visio and Notepad. As part of the **Custom App** framework, a generic autoIT module is provided that has a skeletal implementation of functions that model the life-cycle of a typical Microsoft application. You may implement these functions and register this autoIT module with the View Planner appliance. When configuring a new workload profile, you can see your custom application listed among the other available ones.

An important use-case for **Custom App** is to analyze the impact of 3D workloads like CAD or Google Earth in a VDI environment. Using VMware View Planner 3.5, we can demonstrate the scalability of a VDI solution that uses vSGA to support 3D graphics while focusing on two different workloads that stress the vSGA solution in different ways. Further information and a detailed performance study on this feature can be found in the *VMware Horizon View 6.0 and Hardware Accelerated 3D Graphics* [6] performance white paper.

As an example of a **Custom App** scale study, we configured a Visio custom application to run as the workload. This test used an RDSH virtual machine, which was a 4-vCPU Windows 2008 R2 server with 10GB virtual RAM. Visio operations were run as seamless applications and the scale was increased from 16 to 64.

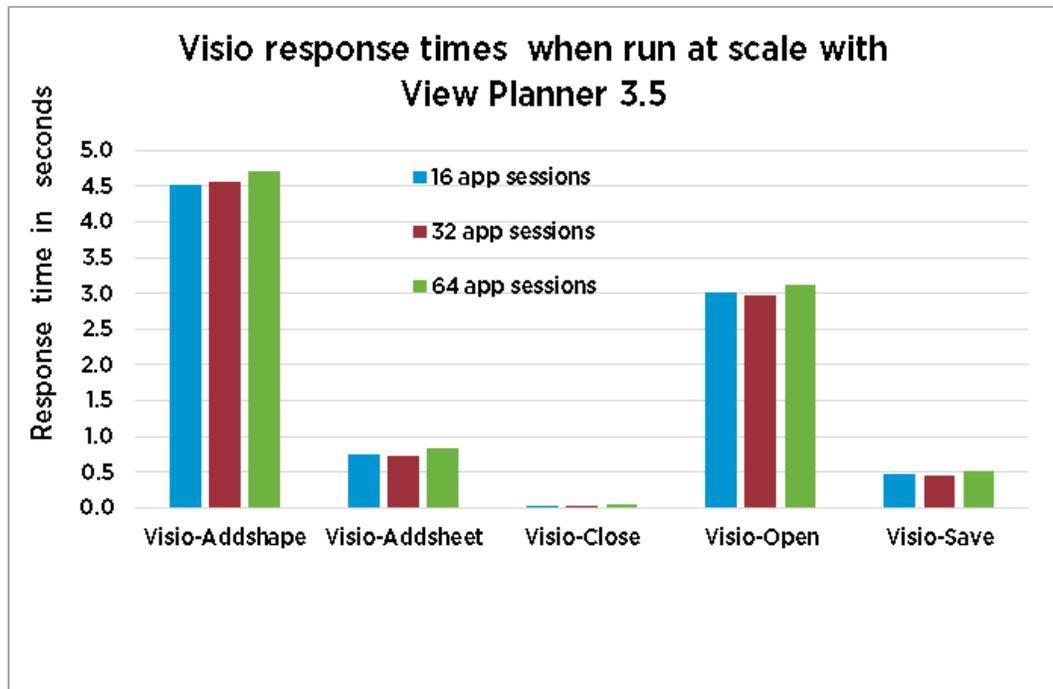


Figure 16. Visio response times with View Planner 3.5 when scaling out application sessions

This test shows the performance of some common activities taken place in Visio remote application sessions. Figure 16 shows how scaling the application sessions from 16, to 32, to 64, does not affect performance very much. There is only about a 5% increase in response time when moving up from 32 sessions to 64 sessions. This shows that a typical Horizon 6 remote application like Visio scales well.

Solutions Characterizations

Virtual SAN

Virtual SAN is highly leveraged in VDI deployments. Virtual SAN is a new technology and differs from the existing SAN solutions that are available today. VMware View Planner 3.5 can be instrumental in comparing VDI performance in a Virtual SAN deployment, to that of a standard SAN storage backend. The standardization of workload gives us a level playing field while comparing multiple storage platforms.

Experimental Setup

The host running the desktop virtual machines has 16 Intel Xeon E5-2690 cores running @ 2.9GHz. The host has 256GB physical RAM, which is more than sufficient to run 100 1GB Windows 7 virtual machines. For Virtual SAN, each host has two disk groups where each disk group has one PCI-e solid-state drive (SSD) of 200GB and six 300GB 15,000 RPM SAS disks.

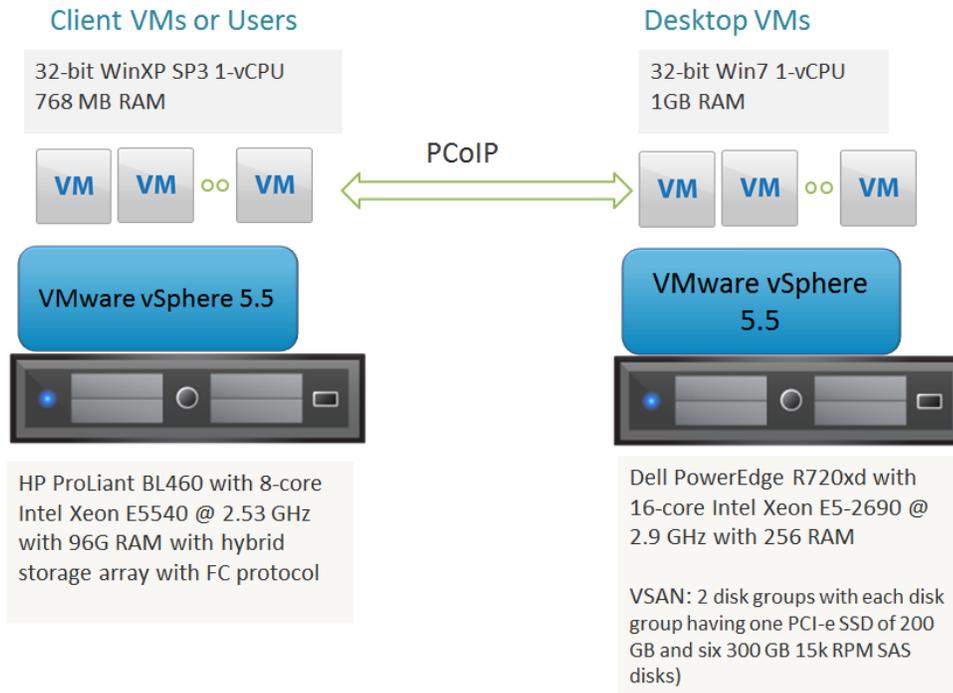


Figure 17. Experimental setup for Virtual SAN (one host's information is shown in the 3-node cluster)

VSAN Characterization

The View Planner standard benchmark is ran on a 3-node cluster to find the maximum number of virtual machines that can be run and meet the QoS criteria. With Virtual SAN 5.5 on Horizon 6, a VDI mark score of 341 was achieved, which is about 10% higher than Virtual SAN 5.5 on View 5.3.2. This improvement is primarily due to the PCoIP default changes, which provide better host consolidation and lower bandwidth usage.

VMware Horizon Mirage

VMware Mirage is an image management solution that can be used for managing virtual machine images as well as physical desktops. VMware Mirage uses a reference machine and through Mirage agent software running in the operating system, captures the reference image into multiple layers such as core operating system layer, the driver software layer, and so on. It can also be used to capture application software layers. These layers can be applied to other virtual machines or physical desktops that are managed by the Mirage server.

VMware Mirage and VMware View can interoperate where VMware View can be used for provisioning and session management, and VMware Mirage can be used for image management. View Planner 3.5 is used to measure the impact of VMware Mirage's management operation's overhead on user experience.

Suppose a pool of 1000 desktops is being actively used and a subset of them synchronize their states with the Mirage server (steady state). In another scenario, the Mirage server can push an application or base layer update such as pushing Microsoft updates or service packs. This can impact user experience across the pool because underlying infrastructure is shared between them. The way we measure the impact follows:

The View Planner workload is started in passive mode in a pool of 1000 VDI desktops. On 20% of desktops in the pool, a base layer update, and then an application layer update are run, and these are compared with the QoS metric (Group-A and Group-B) on 80% of the desktops. Similarly, the impact on user experience generated by other Mirage management operations such as “centralize endpoints:” and “sync now” are measured.

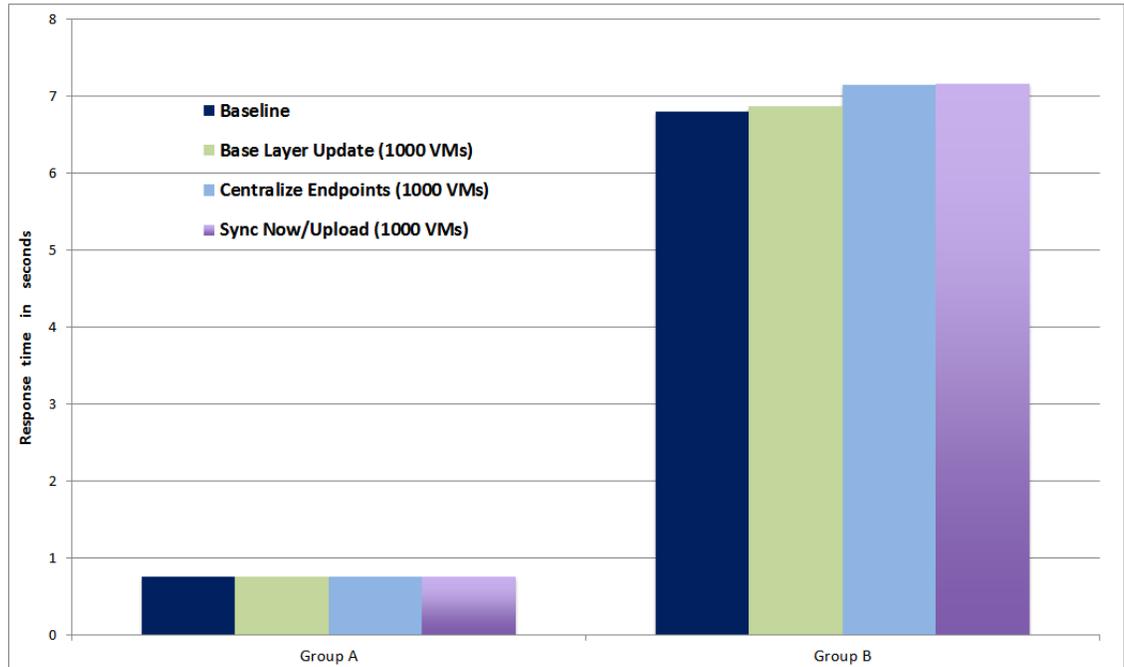


Figure 18. Performance impact of Mirage management operations

VMware App Volumes

VMware App Volumes delivers applications to end users in a matter of seconds and eases application provisioning and update management in a desktop environment. One or more “App stacks” are pre-recorded that comprise single or multiple applications. The “App stacks” are packaged as VMDK files that are dynamically attached based on the policy defined in the VMware App Volume server.

This ensures the right applications are delivered to the appropriate groups of people. The policy-based application delivery helps enforce security and compliance regarding which users can have access to which applications.

This distributed nature of application delivery may have impact on user experience. VMware View Planner 3.5 is instrumental in measuring end user experience. We measured QoS (Group-A and Group-B) metrics when applications are hosted along with the guest operating system. This provided us with a baseline number. Later, we compared the same metric when applications are distributed using VMware App Volumes. Figure 18 shows the performance comparison of both the configurations and only a minimal increase in response time is seen when App Volume is used. VMware View Planner 3.5 was also used to study how VMware App Volume scaled up in delivering applications while increasing the desktop pool size.

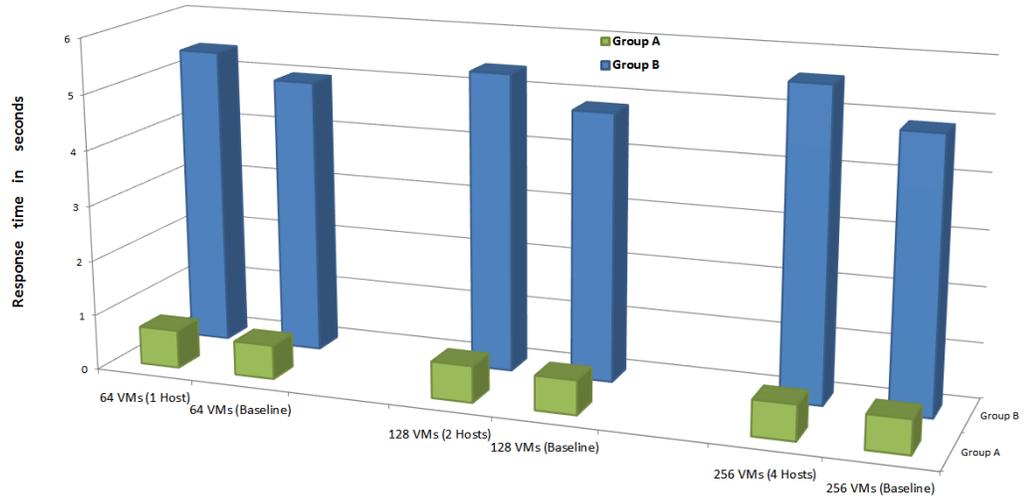


Figure 19. Performance impact of VMware App Volumes solution

Conclusion

This paper presented new features and use-cases covered by VMware View Planner 3.5. It also presents an insight into advancements in scalability at which this latest release of View Planner can operate upon. View Planner 3.5 improves user friendliness and ease of deployment. In View Planner 3.5, more workloads are added that innovatively solve unique problems of quantifying audio fidelity, and spatial and temporal variance in a consolidated VDI environment. Support for cutting-edge innovation like Virtual SAN in the virtualization platform is demonstrated in this release. This empowers customers to size the hardware of their choice, and help them better prepare for adopting VMware Horizon 6 on the VMware vSphere platform of their choice.

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