



VMware Horizon 7 on vSphere 6.0 Test Results

Density and performance testing results

Dell Engineering
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Revisions

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Executive summary

This document describes the testing practices used by engineering for the Dell Wyse Datacenter solutions. It contains detailed test analysis and achieved density limits for VDI solutions based on VMware Horizon 7 on VMware vSphere 6.0 on Dell R730 servers with the latest Intel Broadwell processors.



1 Introduction

1.1 Purpose

The purpose of this testing is to validate and provide density figures for the architectural design for VMware Horizon 7 on VMware vSphere 6.0 and Dell PowerEdge R730 server with the Intel Broadwell processors.

The scope of this paper is to:

- Explain the configuration and testing methodology for the density testing.
- Provide test results and performance analysis for the configurations.
- Provide density limits achieved for the configurations.

Primary objectives for this validation testing were:

- Determine maximum density for pooled desktops using heavy workload.
- Analyse the test results and provide information on the possible resources constraints that limit the density or performances.

1.2 Solution Architecture Overview

The diagram below represents the architectural overview of the systems tested. The complete reference architecture for the solution is located [here](#). The solution is built based on a single management node and a single computer node.

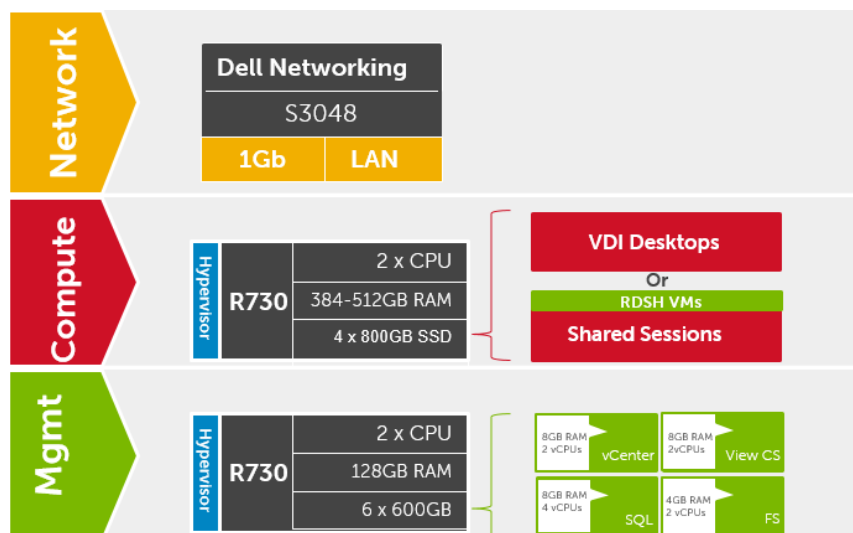


Figure 1 Solutions architecture

1.3 Density and Test Result Summaries

Each test adhered to the Dell Wyse datacenter PAAC testing methodology outlined in this document. Tests initiated with users logging in every 10-30 seconds within 1 hour logon time frame. After all users logged in, tests continue to execute for 30 minutes of steady state activity before users began logging off.

Test metric explanations:

- **Avg CPU %:** The values shown in the tables are the Compute host steady state averages for CPU Usage.
- **Avg Memory utilization:** The figures shown in the tables are the average memory consumed and average active memory (if applicable) values per host over the steady state period (Compute and Management are on the same machine).
- **Avg IOPS:** Results are calculated from the average Disk IOPS figure over the steady state period divided by the number of users.
- **Avg Network utilization:** Network utilization is the average Kilobits/sec/User over the steady state period.

1.3.1 VM Configurations

The following table summarizes the various workload and profile configuration test results performed on the **R730 server using Intel(R) Xeon(R) CPU E5-2698 v4 @ 2.20GHz**.

Workload profile	VM OS	vCPUs	VM RAM	RAM reservation
Light	Windows 8.1 - 32bit	1	2GB	1GB
Medium	Windows 8.1 - 32bit	2	3GB	1.5GB
Heavy	Windows 8.1 - 32bit	2	4GB	2GB

Table 1 VM Profile used in the tests:

1.3.2 Expected density

In order to estimate the number of VM to provision, paper analysis carried out prior to test to estimate the number of VM in the pool. The figure is based on the CPU processing power increment and the density number on previous generation Intel haswell processor Intel E5-2697v3 with the same architectural design solution. Below table shows the expected density figure:

DWD user profile	Intel E5-2697v3	Intel E5-2698v4	Increment %
Standard	230	330	43%
Enhanced	170	238	40%
Professional	130	182	40%

Table 2 Expected density figure

So a 40% increase in density is expected.

1.3.3 Test result summary

The detailed test results analysis is outlined in the next section 2. Over all the result shows the expected density figures are achieved with no significant user experience impact. Due to the increased density number, the amount of memory required on the host is also increased. There was not enough host memory to power on all the VM with the memory reservations outlined in table 1. Above. Hence the actual VM configuration used in test is shown in below table, for both medium and heavy work the memory reservation is reduced by 0.5GB compare to standard VM configuration in PAAC:

Workload profile	VM OS	vCPUs	VM RAM	RAM reservation
Light	Windows 8.1 - 32bit	1	2GB	1GB
Medium	Windows 8.1 - 32bit	2	3GB	1GB
Heavy	Windows 8.1 - 32bit	2	4GB	1.5GB

Table 3 VM configuration used in test

Hence it is recommended from this test to increase the compute host memory from 384GB to 512GB.



2 Solution Testing

2.1 Test Configuration

2.1.1 HW configuration:

As outlined in section 1.2 this test is based on a single computer host that is Dell PowerEdge R730 MLK, with Intel E5-2698v4 processor, 384GB RAM installed provides the resource for VDI VM. Another Dell PowerEdge R720 acting as management resource, provides HW resources for management VMs including the VMware vSphere Appliance (VCSA), VMware Horizon View server and composer server, SQL server, the file server in the solutions. The configuration of the servers are below:

	management host	Compute host
Model	Dell PowerEdge R720	Dell PowerEdge R730 MLK
CPU	2 x Intel e5-2698v4 @ 2.2 GHz	2 x e5-2690 @2.9GHz
RAM	384GB	384GB
NIC	Broadcom BCM 5720	Broadcom QLogic 57800 1Gihabit and Broadcom Qlogic 5780 10Gigabit
RAID controller	Dell PERC H710P mini	Dell PERC H730P mini
disks		4 x 800GB 12bps SSD

2.1.2 SW configurations:

The SW included in the solutions and testings are as below:

- VMware vSphere vCenter 6.0 Update 2 Appliance (2502243)
- VMware ESXi 6.0 Dell Customized-A04 (3380124)
- VMware Horizon with View 7
- VM pool Windows 8.1 (32-bit) virtual machines
- Management VM: windows server 2012 R2

2.1.3 Load Generation - Login VSI 4

Login VSI by Login Consultants is the de-facto industry standard tool for testing VDI environments and server-based computing or RDSH environments. It installs a standard collection of desktop application software (e.g. Microsoft Office, Adobe Acrobat Reader) on each VDI desktop; it then uses launcher systems to connect a specified number of users to available desktops within the environment. Once the user is connected, the workload is started via a logon script which starts the test script once the user environment is configured by the login script. Each launcher system can launch connections to a number

of 'target' machines (i.e. VDI desktops). The launchers and Login VSI environment are configured and managed by a centralized management console.

2.1.4 Profiles and Workloads utilized in the tests

It's important to understand user workloads and profiles when designing a desktop virtualization solution in order to understand the density numbers that the solution can support. At Dell, we use five workload / profile levels, each of which is bound by specific metrics and capabilities with two targeted at graphics-intensive use cases. We present more detailed information in relation to these workloads and profiles below but first it is useful to define the terms "workload" and "profile" as they are used in this document.

- **Profile:** This is the configuration of the virtual desktop - number of vCPUs and amount of RAM configured on the desktop (i.e. available to the user). For this project, instead of using standards Dell Wyse datacenter profiles, we used VM profiles specified by customer as described in Table 3 of section 1.3.3
- **Workload:** This is the set of applications used by performance analysis and characterization (PAAC) of Dell Wyse Datacenter solutions (e.g. Microsoft Office applications, PDF Reader, Internet Explorer etc.) For this POC project, LoginVSI heavy Workload is used

Load-testing on each of the profiles described in the VM profile table 3 is carried out using Light, medium and Heavy workload. Further information for each workloads can be found on LoginVSI's website. It is noted that for Login VSI testing, the following login and boot paradigm is used:

- Users are logged in every 10-30 seconds within overall time frame of 1 hour.
- All desktops are pre-booted in advance of logins commencing.
- For all testing, all virtual desktops run an industry-standard anti-virus solution (currently McAfee VirusScan Enterprise) in order to fully replicate a customer environment.

2.2 Test and Performance Analysis Methodology

2.2.1 Testing Process

In order to ensure the optimal combination of end-user experience (EUE) and cost-per-user, performance analysis and characterization (PAAC) on Dell Wyse Datacenter solutions is carried out using a carefully designed, holistic methodology that monitors both hardware resource utilization parameters and EUE during load-testing. This methodology is based on the three pillars shown below.

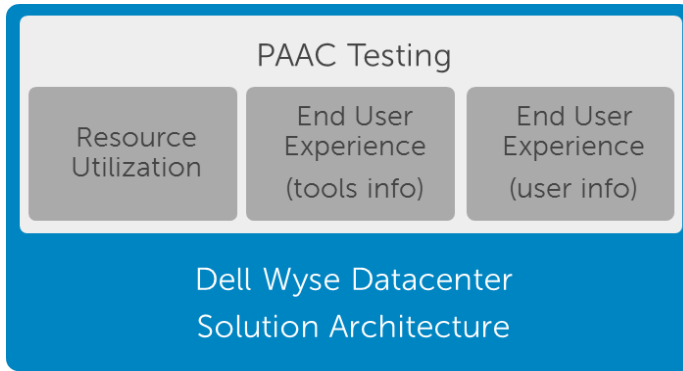


Figure 2 PAAC methodology

Login VSI is currently the load-generation tool used during PAAC of Dell Wyse Datacenter solutions. Each user load is tested against four runs. First, a pilot run to validate that the infrastructure is functioning and valid data can be captured, and then, three subsequent runs allowing correlation of data.

At different times during testing, the testing team will complete some manual "User Experience" Testing while the environment is under load. This will involve a team member logging into a session during the run and completing tasks similar to the User Workload description. While this experience will be subjective, it will help provide a better understanding of the end user experience of the desktop sessions, particularly under high load, and ensure that the data gathered is reliable.

For all workloads, the performance analysis scenario will be to launch a user session every 30 seconds. Once all users have logged in, all will run workload activities at steady-state for 48-60 minutes and then logoffs will commence.

2.2.2 Resource Utilization

Poor end-user experience is one of the main risk factors when implementing desktop virtualization but the root cause for poor end-user experience is resource contention – hardware resources at some point in the solution have been exhausted, thus causing the poor end-user experience. In order to ensure that this has not happened (and that it is not close to happening), PAAC on Dell Wyse Datacenter solutions monitors the relevant resource utilization parameters and applies relatively conservative thresholds as shown in the table below. As discussed above, these thresholds are carefully selected to deliver an optimal combination of good end-user experience and cost-per-user, while also providing burst capacity for seasonal / intermittent spikes in usage. These thresholds are used to decide the number of virtual desktops (density) that are hosted by a specific hardware environment (i.e. combination of server, storage and networking) that forms the basis for a Dell Wyse Datacenter RA.

Table 1 Resource utilization thresholds

Parameter	Pass/Fail Threshold
Physical Host CPU Utilization	85%
Physical Host Memory Utilization	No memory swapping

Network Throughput	85%
Storage IO Latency	20ms

2.2.3 Resource Monitoring

2.2.3.1 ESXi host Performance Monitor

ESXi host resources utilization monitors the ESXi host resources utilizations. The resources monitored include CPU usage, RAM usage. Data are collected in vSphere over the testing period. All data are collected at a 1 min sampling rate over the whole testing period from the first user logon until all users logged off.



3 Solution Performance Results and Analysis

3.1 LoginVSI test results overview

For all 4 VM profiles and workload configurations, loginVSI test are showing VSIMax not reached for estimated density figures, summary in below table

DWD user profile	Intel E5-2698v4	VSIMax
Standard	330	324
Enhanced	238	239
Professional	182	Not reached

Table 4 VSIMax of test result

Below showing the VSI max for each workload

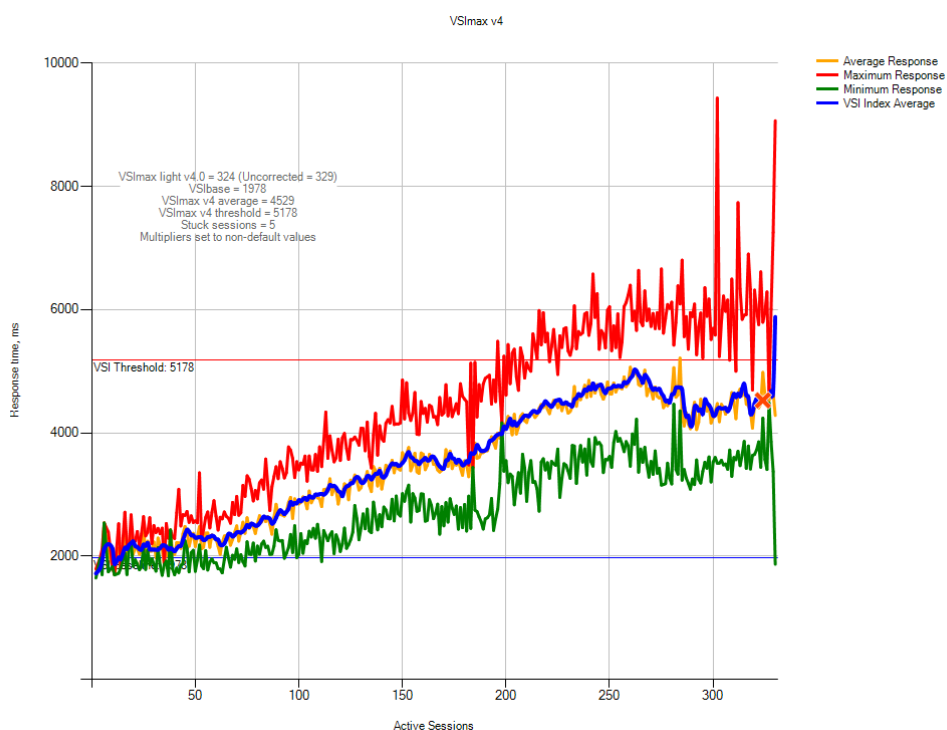


Figure 3 VSIMax of light workload profile

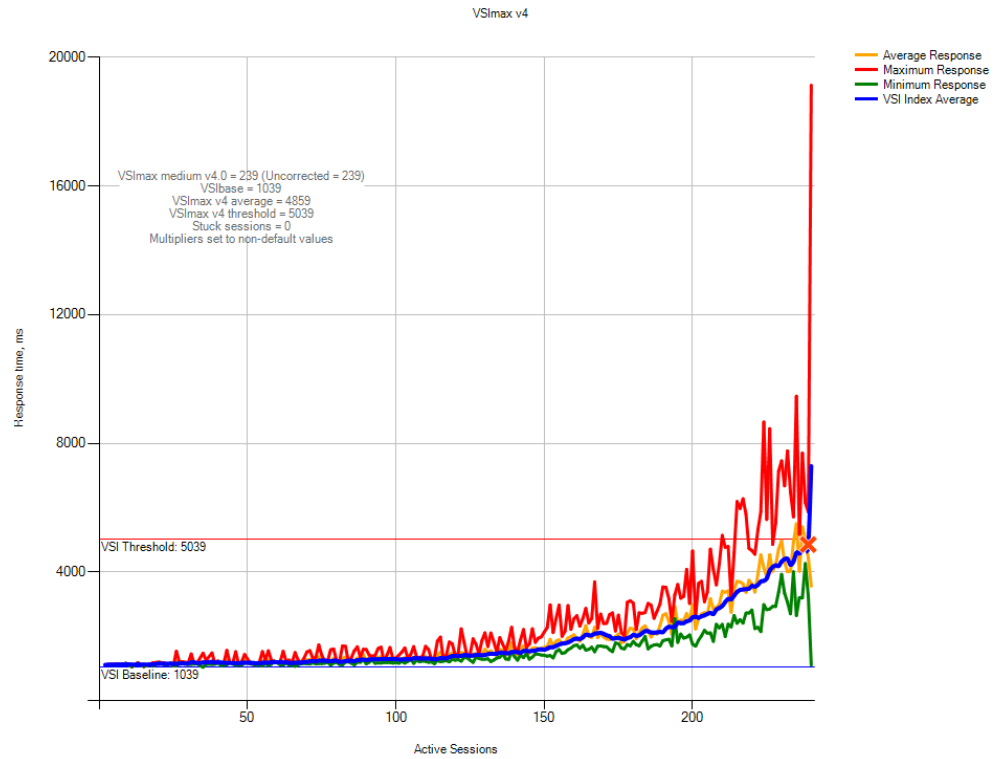


Figure 4 VSI Max of medium workload

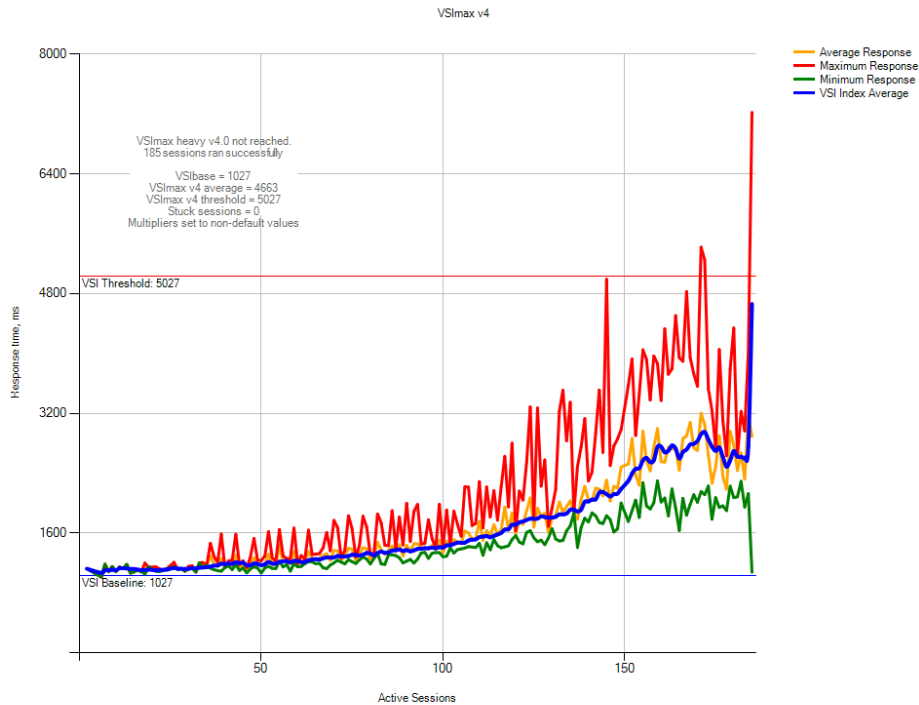


Figure 5 VSIMax of heavy workload

Medium workload VSIMax is 1 above estimation is due to the fact the test used over-launch to ensure enough sessions logged on. The results showing the results are in line with the expected estimation of density figure the host can support.

3.1.1 Resource utilization results

The results below were obtained from the compute host in vSphere.

3.1.1.1 VMware vCenter Host Metrics

CPU Usage

CPU utilization did run over our 85% limit at various times on each test, but it is in line with previous test carry out on Intel E5-2697v3 processors. And since the user experience did not see any impact, we consider it is valid results.

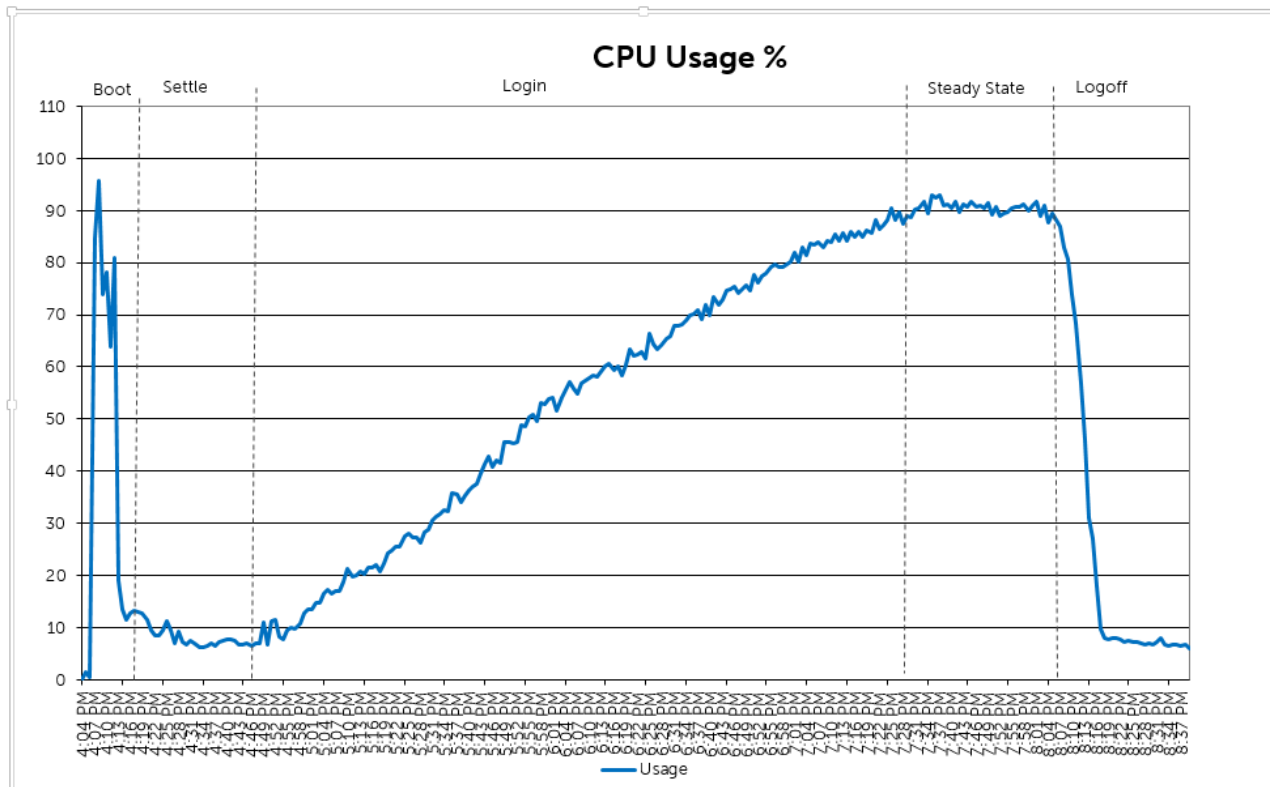


Figure 6 Light workload CPU Usage

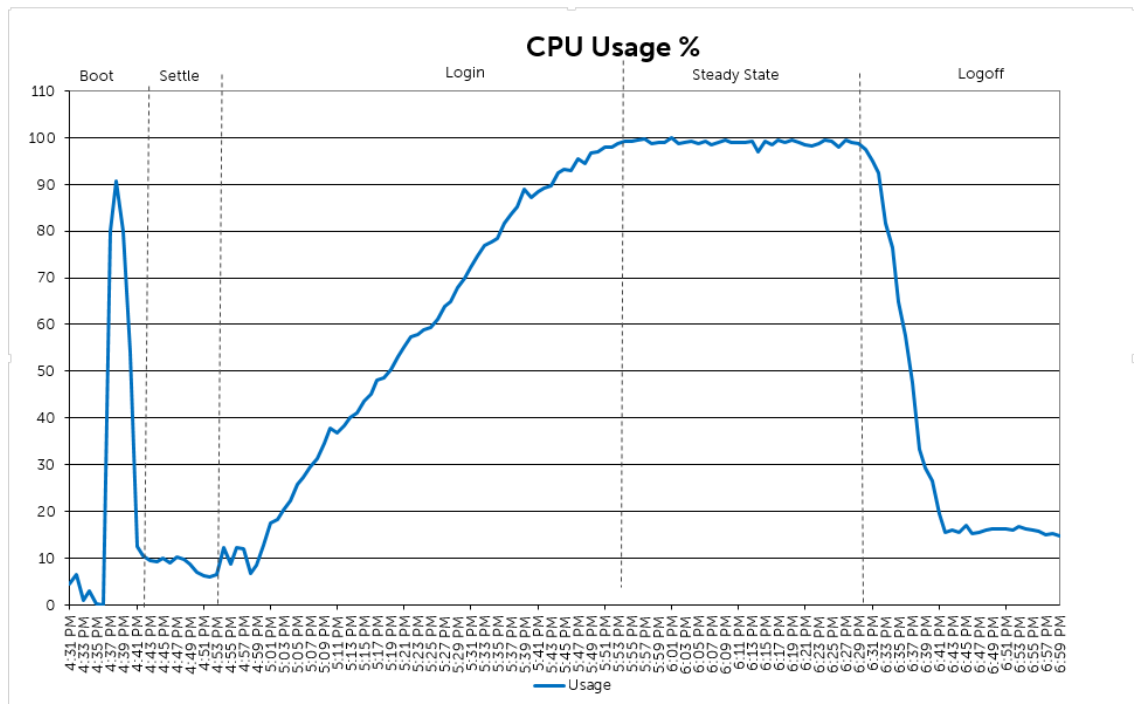


Figure 7 Medium workload CPU usage

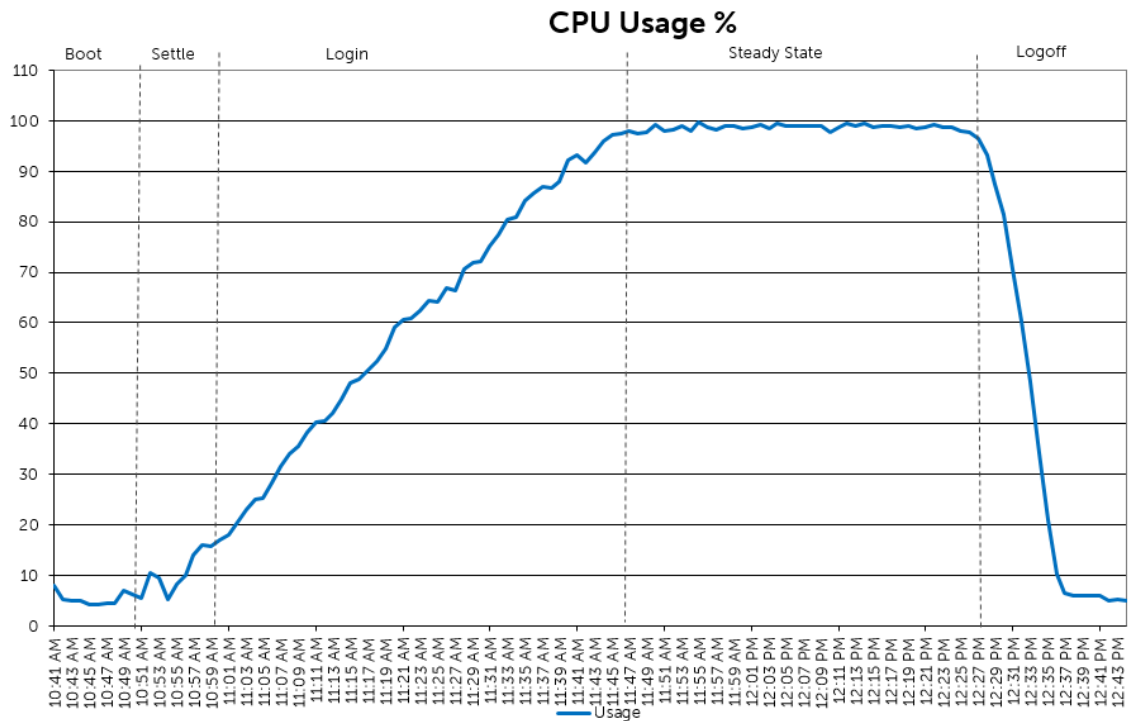


Figure 8 Heavyworkload CPU usage

Datastore IOPS

The IOPS is monitored and obtain using vSphere vCenter matrix. The highest steady state IO is observed during light workload testing peaked around 2000, below graph shows the datastore IO of the datastore. For all tests, The latency reading is well under 20ms mark at around 1-2ms, which indicates the datastore is no in any resource constrain:

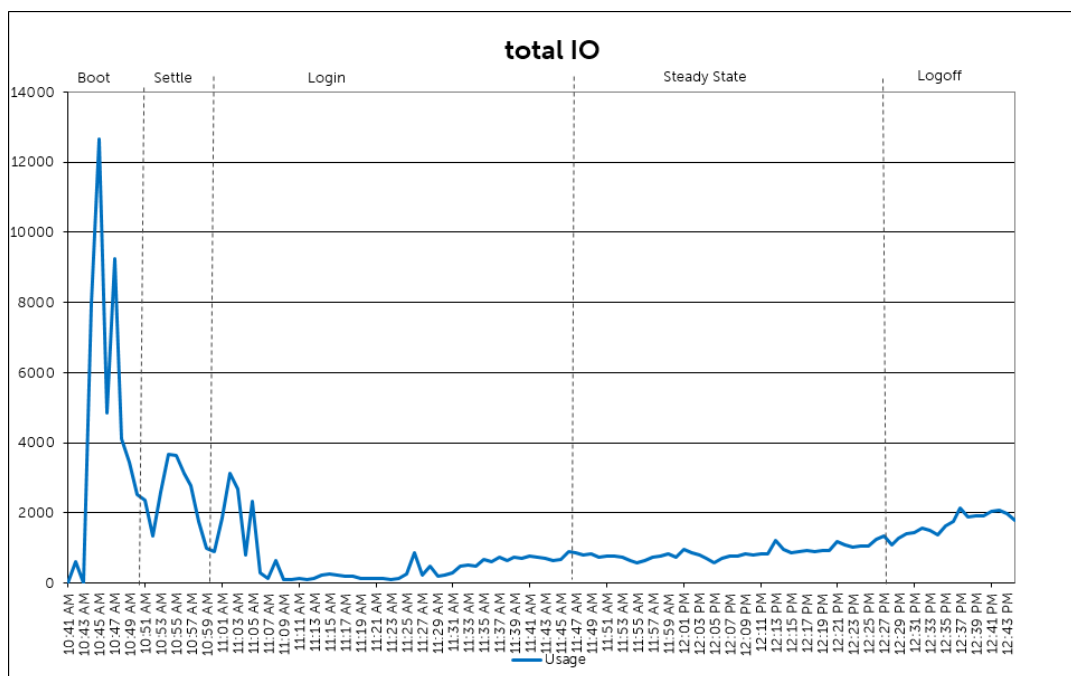


Figure 9 Total IOPS of Light workload

Memory Utilization

Memory usage is monitor on ESXi host, memory usage monitored are granted, consumed, active, balloon and swap used, As swap and ballooning usasge would indicate host memory reached saturation point and the VM performance may start to deteriorating. All tests were carred on host with 384GB physical memory installed. It showing small amount of memory ballooning, since ballooning is indication that further additional VM will cause memory swapping, we concluded the memory usage has reached threshold point. It has been observed during VM pool provisioning, any more VM in the pool will cause VM fail to start up due to lack of physical memory on the hosts

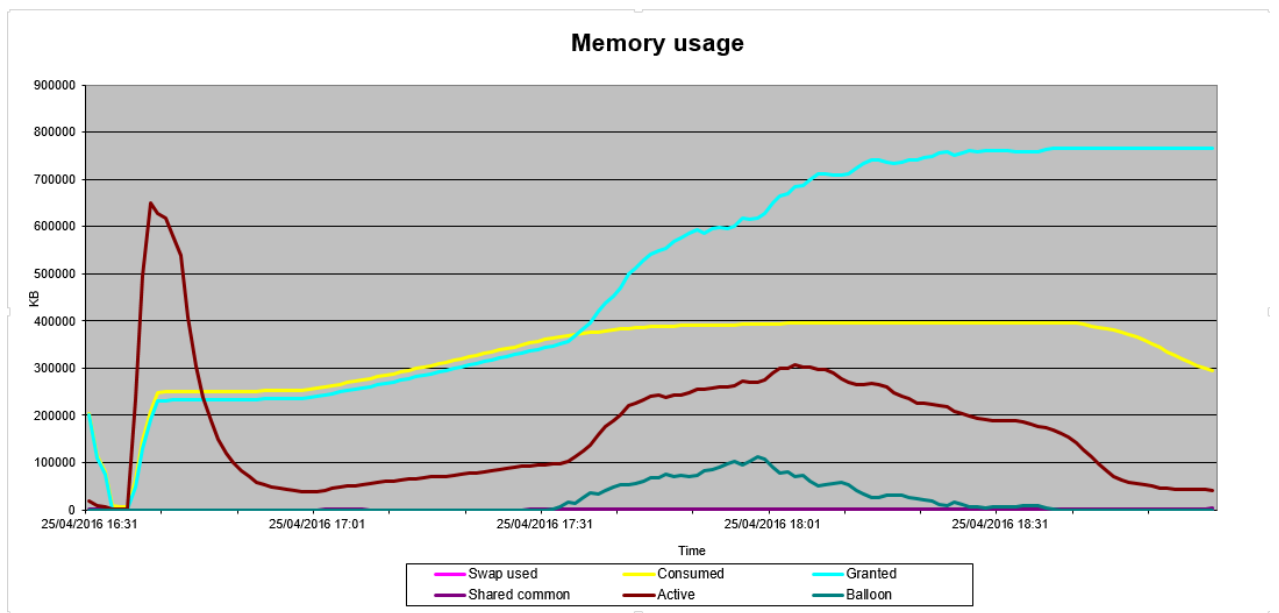


Figure 10 Memory usage of medium workload

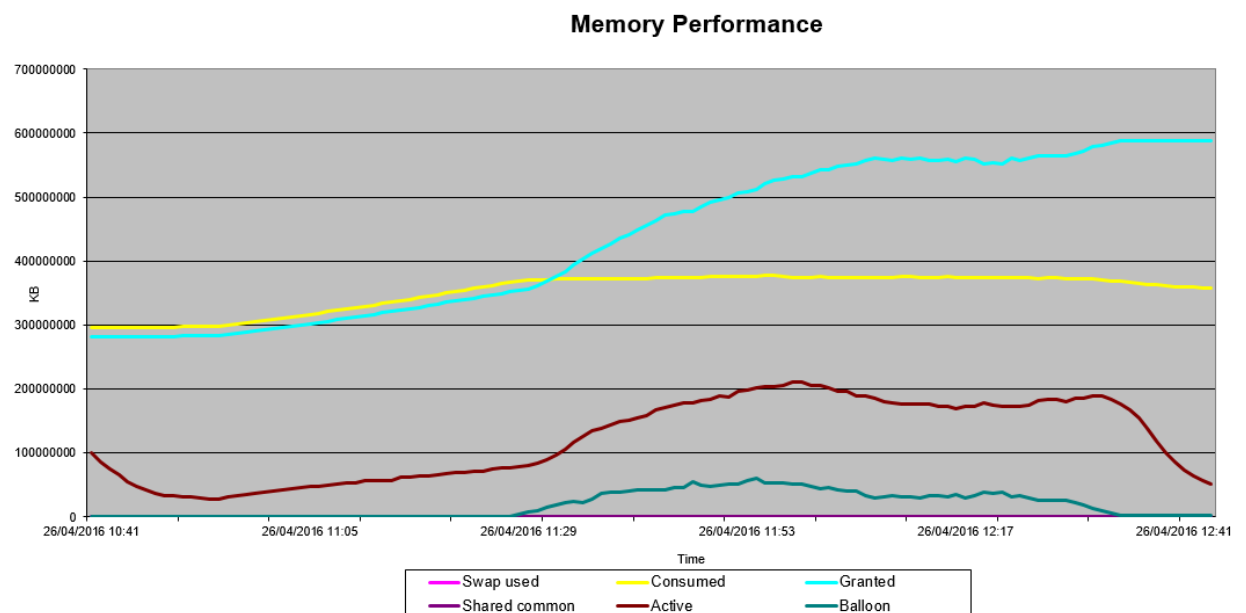


Figure 11 Memory usage of heavy workload

4 Conclusion

4.1 Other observations in tests

During pool provision, it was observed large latency (above 100ms) on the datastore during pool provisioning initially after installing ESXi 6.0 Dell customized ISO image. This caused the pool provisioning operation to fail. After updating the PERC driver vib to lsi_mr3_version6.901.57, issue resolved, for more details, please see below article:

<http://www.dell.com/Support/Article/us/en/19/SLN297261>

4.2 Conclusion

Combine all the tests results outlined in above section. The solutions configuration tested can support the estimated density, with recommendation to increase the host memory to 512GB. Compare to previous generation of CPU, it is 40 increase in density. It is also recommended to update the PERC controller vib in ESXi to ensure pool provisioning operation complete successfully.

