Perforce Server on VMware® vSphere

May 2012

DEPLOYMENT AND TECHNICAL CONSIDERATIONS GUIDE

vmware®

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VMware, Inc. 3401 Hillview Avenue Palo Alto CA 94304 USA Tel 877-486-9273 Fax 650-427-5001 www.vmware.com

Introduction

This document provides information to the users who want to run Perforce Server on VMware® vSphere™. The results of recent testing done jointly by VMware and Perforce are covered, where the performance and functionality of Perforce on VMware are characterized. Finally, a set of best practices are described for utilizing the two product sets together in your datacenter.

VMware and Perforce Overview

This section describes the VMware and Perforce products at a high level and explores the value proposition of using them together.

Perforce Overview

The Perforce software version management (SVM) system is one of the most popular products used today for version control and source code management of a wide variety of software assets. It is in use at many major institutions for controlling the versioning and releases of many different artifacts, including software development content and assets used for digital game development. Users check in their original files and then further changes to their software in all forms to the Perforce Server or servers. They or others can then check those versioned items out to make further refinements to them in a safe way. The Perforce software is essential for smooth functioning of any team of developers or designers which need product to be stored at different versions in its development and deployment lifecycle.

The architecture of the Perforce system allows it to be deployed in many different configurations for different customer needs. Some customers depend on one "central instance" of the Perforce server to control all of their enterprise version management needs. Other customers dedicate a unique Perforce Server to each development project or to each department within the company. There are cache servers that complement the main Perforce Server so that some work can be offloaded from it. These architectural approaches are described further in the Architecture and Deployment Strategy Section below.

VMware vSphere

VMware's leading virtualization solutions provide multiple benefits to IT administrators and users. VMware virtualization creates a layer of abstraction between the resources required by an application and operating system, and the underlying hardware that provides those resources. A summary of the value of this abstraction layer includes the following:

- **Consolidation**: VMware technology allows multiple application servers to be consolidated onto one physical server, with little or no decrease in overall performance.
- **Ease of Provisioning**: VMware virtualization encapsulates an application into an image that can be duplicated or moved, greatly reducing the cost of application provisioning and deployment.
- **Manageability**: Virtual machines may be moved from server to server with no downtime using VMware® VMotion™, which simplifies common operations like hardware maintenance and reduces planned downtime.
- **Availability**: Unplanned downtime can be reduced and higher service levels can be provided to an application. VMware® High Availability (HA) ensures that in the case of an unplanned hardware failure, any affected virtual machines are restarted on another host in a VMware cluster.

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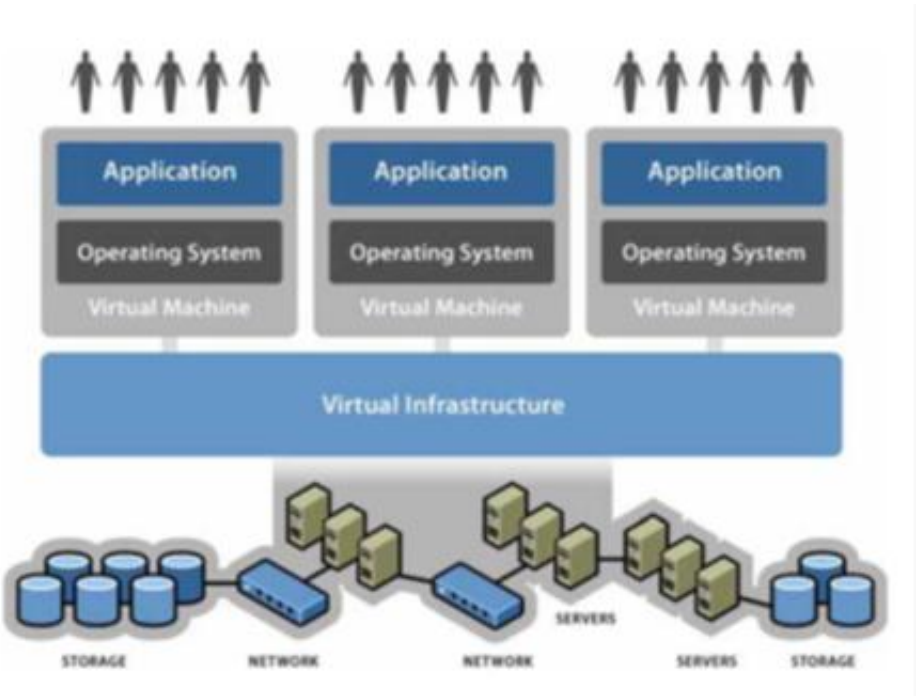
Figure 1: VMware vSphere Virtual Infrastructure



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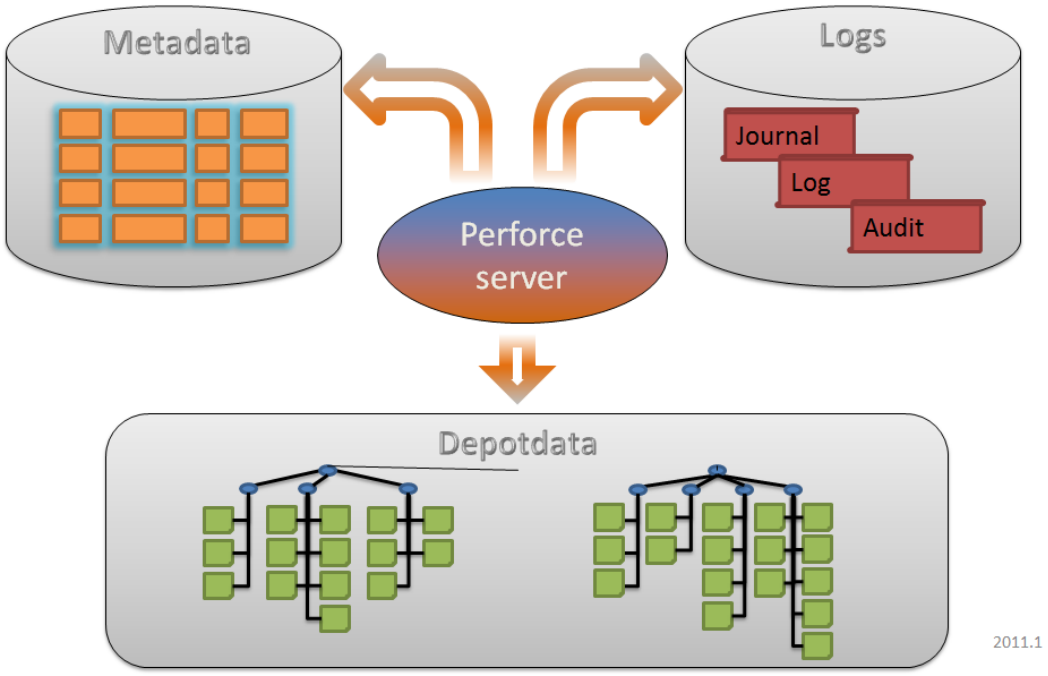
Perforce Architecture and Deployment Strategy

The Perforce server is comprised of a database, one or more *depots*, and a set of files used for monitoring and backup/recovery procedures.

Figure 2: Perforce Server Architecture



The depots contain the actual versioned file content. Several depots can be created to contain different types of data with different storage requirements, or simply to provide convenient organization.

A Perforce server should have three file systems for the components shown in Figure 2. Maintaining three file systems helps prevent data loss in the event of disk failure, and enables advanced deployment mechanisms with simple, near zero down-time backups.

Table 1: Example volume locations and contents

VOLUME	SAMPLE LOCATION	CONTENTS	PERFORMANCE CONSIDERATIONS
Metadata	/metadata	P4ROOT with database files.	Optimize I/O for random read/write. Vulnerable to high latency or low bandwidth.
Logs	/logs	Server logs and active journal.	High performance demands.

VOLUME	SAMPLE LOCATION	CONTENTS	PERFORMANCE CONSIDERATIONS
Depot Data	/depotdata	Archive files.	Typically more sequential read/write. Potentially very large amount of data.

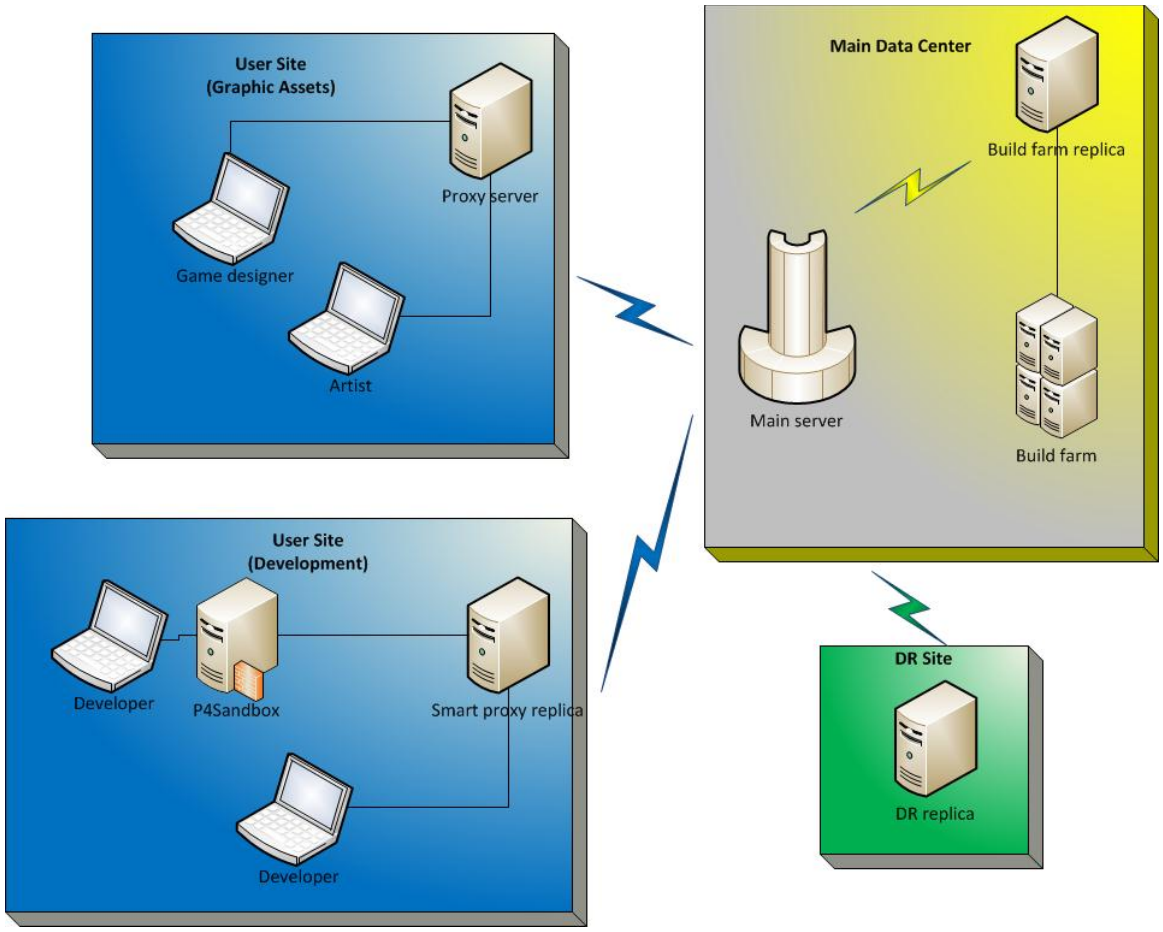
A Perforce server may be deployed on several platforms, including Windows and popular Linux distributions. For best performance a 64-bit platform is recommended.

Backup and recovery procedures are well documented, and a white paper on High Availability and Disaster Recovery is available.

The Perforce server executable is a single binary, *p4d*, which normally runs as a background process and spawns additional processes and threads to service requests.

Several additional components are available to support remote teams, high data volume, and distributed development, as shown in Figure 3.

Figure 3: Perforce Deployment Architecture



Testing Process and Results

To characterize the performance of Perforce on VMware vSphere, a series of performance tests were carried out by Perforce. The configuration tested and the results are summarized below.

Testing Methodology and Overview

The primary objective of testing was to determine Perforce performance characteristics and show that Perforce can run resiliently on vSphere and can scale up to large numbers of concurrent users. The testing performed concentrated mainly on performance characterization and did not validate the operation of VMware features including vMotion, VMware DRS, VMware Fault Tolerance (FT), and VMware HA with Perforce deployments in a virtual environment.

Workload Used

The testing performed used the browse benchmark created by Perforce Software's Performance Lab. This benchmark can be configured to simulate varied numbers of Perforce users. Users browsing a Perforce repository are simulated by the browse benchmark's browsechild application. The browsechild application continuously browses a Perforce repository tree down many different random paths. Because the browsechild application continuously browses, it simulates the actions of many Perforce users working on tasks, Perforce or otherwise, and thinking. Many separate instances of the browsechild application can run on several client machines, simulating a very large number of Perforce users. The resulting simulated load on a Perforce Server can be significant.

Identical suites of the browse benchmark varying the number of browsechild instances were run with the Perforce Server deployed on both virtual and native machines with nearly identical configurations. The number of cores was also varied similarly on both the virtual and native machines, maintaining the nearly identical configurations between virtual and native. The suites used the reference11 dataset distributed by the Performance Lab of Perforce Software. The reference11 dataset contains definitions for Perforce users, groups, and protections modeled after those at a production Perforce site. The results from the browse benchmark suites were then evaluated to determine the performance overhead attributable to deploying a Perforce Server in a virtual machine on vSphere, and to approximate the number of licensed Perforce users that a configuration might support while delivering a consistent user experience.

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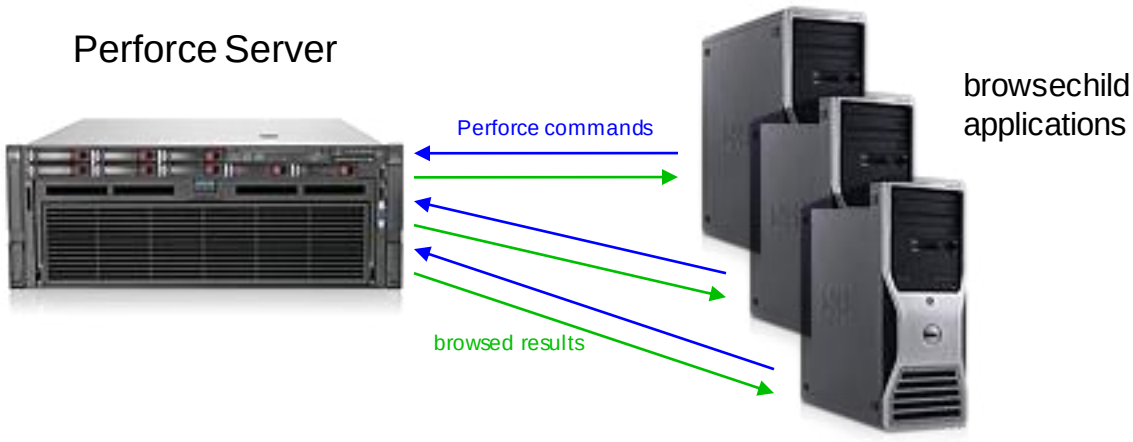
Hardware and Software Configuration

Figure 4 provides an overview of the configuration used for testing Perforce performance.

Figure 4: Overview of Configuration for Perforce Performance Testing



vSphere Host Configuration

The following table details the vSphere host configuration used for testing Perforce performance within vSphere:

Table 2: vSphere Host Configuration

Server	• HP DL580 G7 • 4 Intel X7542 2.66GHz six-core CPUs (24 cores total) • 512GB of physical memory • 2 1Gb Ethernet ports
Storage	• 3 146GB RAID 1+0 LUNs on 6 146GB 15K RPM SAS drives • VMFS-5 used for all LUNs
VMware	• vSphere 5.0.0-469512

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Perforce Server Virtual Machine Configuration

The following table details the configuration of the virtual machine on which the Perforce Server was deployed for testing Perforce performance within vSphere:

Table 3: Perforce Server Virtual Machine Configuration

Server	• 4, 8 vCPUs • 128GB of memory • 1 1Gb Ethernet port
Storage	• 3 146GB RAID 1+0 LUNs on 6 146GB 15K RPM SAS drives • 32GB / partition on LUN 2 • 135.5GB /db partition on LUN 3 • 1GB /boot partition on LUN 2
Operating System	• SUSE Linux Enterprise Server 11 SP1 • VMware vmxnet3 virtual NIC driver version 1.0.36.0
Perforce	• Perforce Server LINUX26X86_64/2010.2/322263

Perforce Server Native Machine Configuration

For a valid performance comparison between Perforce Server on a virtual machine running on vSphere and on a native machine, the same physical HP DL580 G7 was used for both configurations. There were two notable differences in the native machine configuration. First, the native machine was configured with only 128GB of physical memory so that its memory footprint matched that of the virtual machine within vSphere. The reduced memory was achieved by physically removing 384GB of memory from the HP DL580 G7 in the native machine configuration. Second, the operating system was booted from a USB flash drive in the native machine configuration. The MBR of LUN 1 was used by the vSphere installation, so the USB flash drive was used as an alternative for booting the operating system in the native machine configuration.

The following table details the configuration of the native machine on which the Perforce Server was deployed for comparing Perforce performance with that on vSphere:

Table 4: Perforce Server Native Machine Configuration

Server	• HP DL580 G7 • 4 Intel X7542 2.66GHz six-core CPUs (24 cores total) • 4, 8 Hotplug CPUs • 128GB of physical memory • 1 1Gb Ethernet port
Storage	• 2 146GB RAID 1+0 LUNs on 4 146GB 15K RPM SAS drives • 32GB / partition on LUN 4 • 146GB /db partition on LUN 3 • 1GB /boot partition on USB flash drive
Operating System	• SUSE Linux Enterprise Server 11 SP1
Perforce	• Perforce Server LINUX26X86_64/2010.2/322263

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browsechild Client Machine Configuration

The browsechild application is a lightweight P4API C++ application. The browsechild application continuously browses a Perforce repository tree down many different random paths. Because the browsechild application continuously browses, it simulates the actions of many Perforce users working on tasks, Perforce or otherwise, and thinking. And since the browsechild application is lightweight, many separate instances can run on just a few client machines, simulating a very large number of Perforce users connecting from a very large number of client machines.

The browsechild instances communicate with a Perforce Server using TCP/IP. For this performance testing, the Perforce Server and client machines were connected using a single dedicated and isolated 1Gb network switch. No disk I/O activity results from a browsechild execution, other than reading the ~1MB browsechild application from /tmp on the client machine, and perhaps reading from some libraries.

For both the virtual and native machine configurations on which the Perforce Server was deployed, the browsechild client machines were always of native configurations.

The following table details the configuration of a typical native machine on which the browsechild instances were executed for testing Perforce performance:

Table 5: browsechild Client Machine Configuration

Client	• Dell 2950 • 2 Intel X5450 3.00GHz quad-core CPUs (8 cores total) • 32GB of physical memory • 1 1Gb Ethernet port
Storage	• 2 146GB 15K RPM SAS drives • 4GB /tmp partition
Operating System	• SUSE Linux Enterprise Server 10 SP3
Perforce	• browsechild LINUX26X86_64/2010.2/279478

Results Observed

The following graphics show the best execution time of the browse benchmark for various configurations. The results for four and eight cores are presented here as these configurations might be typical of the virtual machines on which the Perforce Server is deployed within vSphere.

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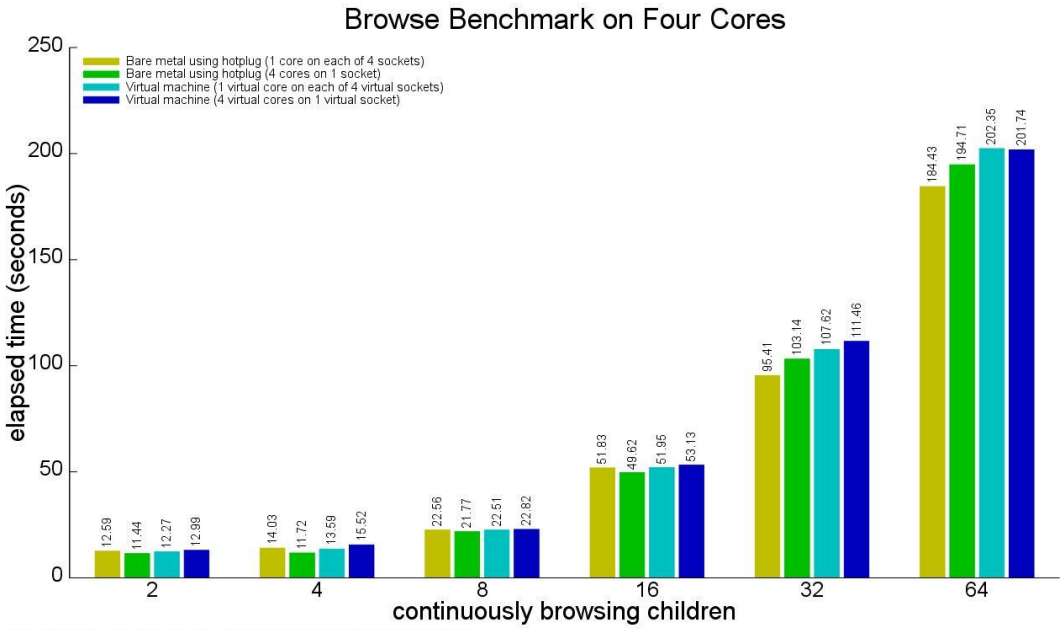
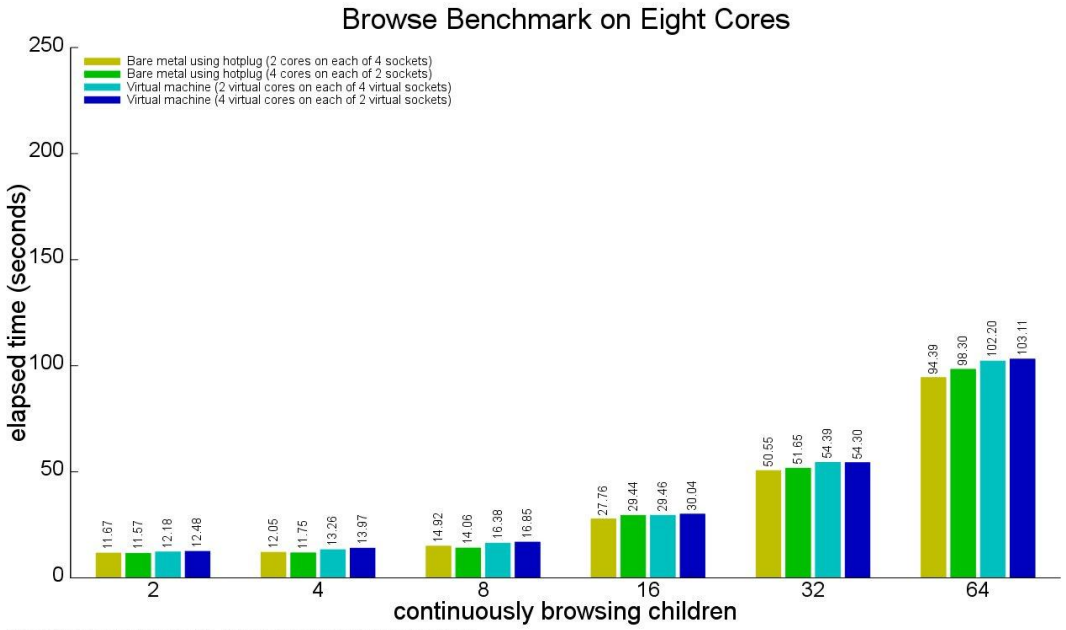
Figure 5: Browse Benchmark on Four Cores



filesystem cache was warm prior to the start of each execution
all bare metal and virtual machines are SLES 11 SP1 with 128 GB physical memory
reference11 dataset with users, groups, and protections modeled after those at a production site
virtual machines using VMware vmxnet3 virtual NIC driver version 1.0.36.0 on VMware vSphere 5

Figure 6: Browse Benchmark on Eight Cores



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virtual machines using VMware vmxnet3 virtual NIC driver version 1.0.36.0 on VMware vSphere 5

The

The following table details the performance overhead attributable to deploying a Perforce Server on a virtual machine within vSphere for all configurations in the preceding graphics. Results in the virtual configuration of using more CPU sockets with a smaller number of cores per socket are highlighted.

Table 6: Performance Overhead Attributable to Deploying a Perforce Server on a Virtual Machine

Total Cores	Browsing Children	Cores per Socket	Number of Sockets	Virtual Run Time	Native Run Time	Percentage Overhead
4	**2**	**1**	**4**	**12.27**	**12.59**	**-2.54**
4	2	4	1	12.99	11.44	13.55
4	**4**	**1**	**4**	**13.59**	**14.03**	**-3.14**
4	4	4	1	15.52	11.72	32.42
4	**8**	**1**	**4**	**22.51**	**22.56**	**-0.22**
4	8	4	1	22.82	21.77	4.82
4	**16**	**1**	**4**	**51.95**	**51.83**	**0.23**
4	16	4	1	53.13	49.62	7.07
4	**32**	**1**	**4**	**107.62**	**95.41**	**12.80**
4	32	4	1	111.46	103.14	8.07
4	**64**	**1**	**4**	**202.35**	**184.43**	**9.72**
4	64	4	1	201.74	194.71	3.61
8	**2**	**2**	**4**	**12.18**	**11.67**	**4.37**
8	2	4	2	12.48	11.57	7.87
8	**4**	**2**	**4**	**13.26**	**12.05**	**10.04**
8	4	4	2	13.97	11.75	18.89
8	**8**	**2**	**4**	**16.38**	**14.92**	**9.79**
8	8	4	2	16.85	14.06	19.84
8	**16**	**2**	**4**	**29.46**	**27.76**	**6.12**
8	16	4	2	30.04	29.44	2.04
8	**32**	**2**	**4**	**54.39**	**50.55**	**7.60**
8	32	4	2	54.30	51.65	5.13
8	**64**	**2**	**4**	**102.20**	**94.39**	**8.27**
8	64	4	2	103.11	98.30	4.89

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There are several potential variables that can affect the number of licensed Perforce users that a configuration can support with a consistent user experience. Some of the variables might include:

- Ratio of licensed users to "active" users
- How "active" is a user
- If SSL is being used at the Perforce layer (if so, the number of "active" users that a given configuration can support might be significantly reduced)
- Speed of the CPUs
- Speed of the I/O subsystem
- Site type - "metadata heavy" or "file content heavy"
- If the interactive users competing with heavy automation

There can also be other variables to consider. In light of these potential variables, determining the number of licensed Perforce users that a configuration can support with a consistent user experience; from observing the performance of an artificial benchmark such as the browse benchmark used in this performance testing is at best an approximation.

For this performance testing, an approximation of the number of licensed Perforce users that a configuration can support with a consistent user experience might be generalized as:

> *Each continuously browsing child in the browse benchmark using the reference11 dataset with users, groups, and protections modeled after those at a production site approximates 250 licensed Perforce users.*

Relative to the graphics shown earlier in this section, this generalization can be used to approximate the number of licensed Perforce users that a virtual machine of a given configuration might support with a consistent user experience. In the graphic showing the results of the browse benchmark on four cores, the user experience begins to degrade between four and eight continuously browsing children. Therefore, the generalization approximates that a virtual machine with four cores might support 1,000 licensed Perforce users with a consistent user experience. And in the graphic showing the results of the browse benchmark on eight cores, the user experience begins to degrade between eight and sixteen continuously browsing children. Therefore, the generalization approximates that a virtual machine with eight cores might support 2,000 licensed Perforce users with a consistent user experience.

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Deployment Best Practices

The following Perforce Knowledge Base articles should be considered when deploying a Perforce Server on a virtual machine within vSphere:

- Planning Your Perforce Server Installation
  http://kb.perforce.com/article/77
- General Performance Recommendations
  http://kb.perforce.com/article/931
- Recommended Server Hardware Configurations
  http://kb.perforce.com/article/5

The following Perforce User Conference presentations might also be helpful when considering deployment of a Perforce Server on a virtual machine within vSphere:

- Scaling Servers and Storage for Film Assets
  http://www.perforce.com/user-conferences/2011/pixar-presentations
- A Perforce Server Dream Machine
  http://info.perforce.com/2011user-conf-video-perforce-server.html

Licensing

There are no relevant exceptions for licensing Perforce on a virtualized platform. A free version of Perforce is available that supports 20 users and 20 workspaces with unlimited files. A commercial license can be purchase to support unlimited users, workspace and files.

Technical Support

Submit a technical support request to Perforce either by email (support@perforce.com) or call one of our offices:

United States

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8:00 AM to 6:00PM, San Francisco
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Fax: +44 (0) 845 345 0117

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Phone: +61 (0)2 8912-4600
Fax: +61 (0)2 9929-5590

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Conclusions

The performance testing results show that deploying the Perforce Server on a virtual machine within VMware vSphere can perform well. Furthermore, it has potential to reduce cost and increase service levels.

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Resources

Customers can find more information about VMware and Perforce products via the links listed below:

VMware Resources

- VMware official website:
  http://www.vmware.com/
- VMware vSphere Web site:
  http://www.vmware.com/products/data_center.html
- VMware Support and Downloads Web site:
  https://www.vmware.com/support/
- VMware Technology Network Web site:
  http://www.vmware.com/vmtn/
- VMware Performance Tuning Paper:
  http://www.vmware.com/pdf/Perf_Best_Practices_vSphere5.0.pdf

Perforce Resources

- Perforce Web site:
  http://www.perforce.com
- Perforce Knowledge Base:
  http://kb.perforce.com
- Perforce System Administrator's Guide:
  http://www.perforce.com/perforce/doc.current/manuals/p4sag/index.html
- Administration Knowledge Base:
  https://kb.perforce.com/article/498/-admin-tasks
- High Availability and Disaster Recovery White Paper:
  http://www.perforce.com/sites/default/files/pdf/perforce-high-availability-disaster-recovery-solutions_0.pdf

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