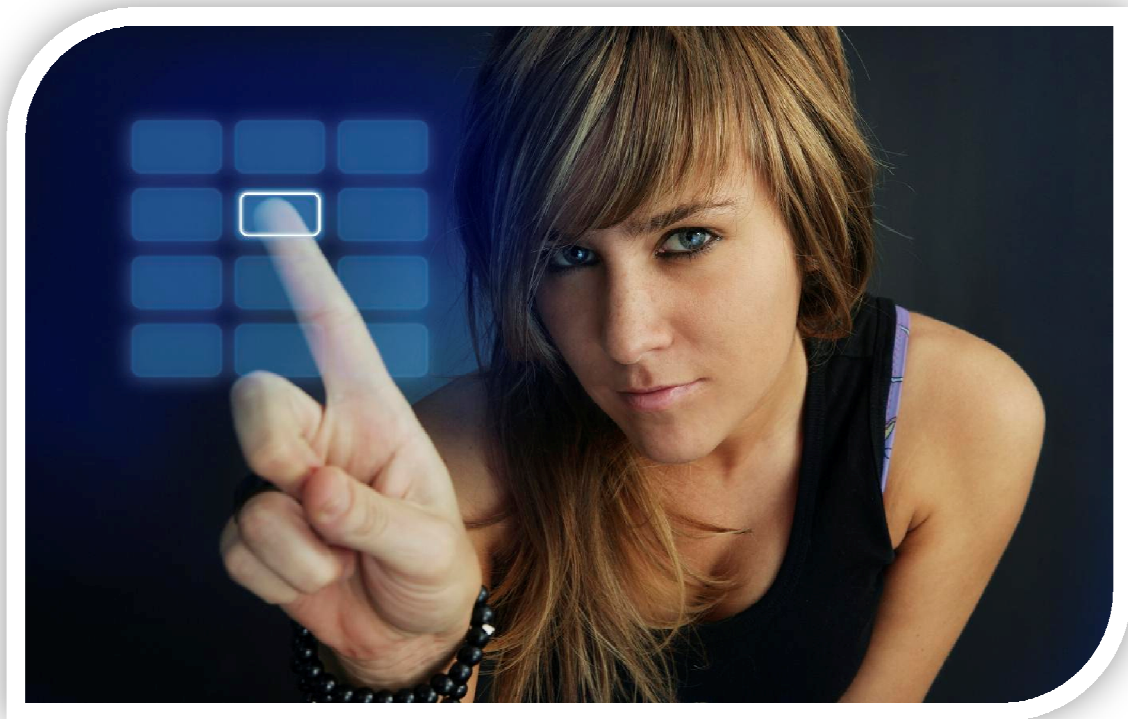


Virtual Reality Check

Platform Performance Index



Whitepaper – Hyper-V Platform Tests

Author(s) :	Ruben Spruijt, Jeroen van de Kamp
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DOCUMENT OVERVIEW

HISTORY

Version	Date	Author(s)	Remarks
1.0	January 2009	Ruben Spruijt & Jeroen van de Kamp	Public Release

REVIEWERS

Version	Date	Reviewers	Company
1.0	January 2009	Rob Stoekenbroek	PQR
1.0	January 2009	Herco van Brug	PQR
1.0	January 2009	Bernhard Tritsch	Immidio
1.0	January 2009	Erwin Vollering	Login Consultants

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1. EXECUTIVE SUMMARY

The primary purpose of this whitepaper is to provide information about the scalability and best practices of virtualized Terminal Server and Virtual Desktop workloads. For all tests the same hardware configuration and freely available Login VSI benchmarking toolset is being used. This whitepaper focuses on virtualizing Windows XP and 32-bit Windows 2003 Terminal Services.

The most notable conclusions are:

- Not having the ability to overcommit virtual machine memory is a clear disadvantage when virtualizing desktops. Such a feature allows much more VM's to be run than physical memory normally would allow, which makes a virtual desktop solution much more economical.
- Using more than one virtual CPU per Terminal Server VM was generally not recommended. However, the tests in project VRC have proven that enabling two vCPU's, allowed more much more users and gave a more consistent user experience.
- When virtualizing Terminal Server workloads, use dedicated hardware, and preferably do not overcommit on vCPU if you plan to maximize the user density a individual server.
- Service Pack 1 of Microsoft Office 2007 has a considerable performance impact. This appears to be a bug in Outlook, when the preview pane is used. However, tests with SP1 installed are still interesting, as they allow the comparison of CPU intensive workloads.

Project VRC is not finished, and probably never will be. Additional publications are planned about virtualizing 2008 and x64 workloads, Hyper-V R2 and the other (Vista and Windows 7) client OS's. Also, we look forward to evaluate new innovations in the hypervisor and hardware arena.

2. INTRODUCTION PROJECT VRC

Welcome to “Project: Virtual Reality Check (VRC)”!

More and more people ask advice about the hardware virtualization solutions, particularly in a Terminal Server and Virtual Desktop Infrastructure context. PQR and Login Consultants have decided to compare the various hardware virtualization platforms in relationship to the end-user performance experience using the freely available benchmarking methodology of Login Consultants, VSI. Jointly they will deliver the outcome of the investigations and benchmarks to a broader audience, as part of the joint venture “Project: Virtual Reality Check (VRC)”.

Running Terminal Server workloads on virtual hardware is generally not recommended, but recent developments give grounds to a re-evaluation of current best practices. By benchmarking these and the Virtual Desktop workloads on physical servers and various virtualization solutions, Project VRC will give you valuable and most importantly unbiased experience and insights.

2.1 PROJECT VRC OBJECTIVES

The goal of Project VRC is to investigate, validate and give answers to the following questions:

- How does various Microsoft Windows Client OS's scale as a virtual desktop?
- How does a VDI infrastructure scale in comparison (virtualized) Terminal Server?
- Which performance optimization on the host and guest virtualization level can be configured, and what is the impact of these settings on user density?
- With the introduction of the latest hypervisor technologies, can we now recommend running large scale TS/CTX workloads on a virtualization platform?
- How do the two usage scenarios compare, that is Microsoft Terminal Server [TS] only, versus TS plus XenApp?
- How do x86 and x64 TS platforms compare in scalability on bare metal and virtualized environments?
- What is the best way to partition (memory and vCPU) the Virtual Machines the hypervisor host, to achieve the highest possible user density?

Project VRC is not finished, and probably never will be. There will be additional publications virtualizing x64 TS workloads and the other (Vista and Windows 7) client OS's. Also, we look forward to evaluate new innovations in the hypervisor arena and hardware level.

Project VRC will publish the whitepapers on www.virtualrealitycheck.net.

2.2 INTENDED AUDIENCE

This document is intended for IT Managers, Architects, (Performance) Analysts, System Administrators and IT-Pro's in general who are responsible for and/or interested in designing, implementing and maintaining virtualized Terminal Server and Virtual Desktop Infrastructures.

2.3 PURPOSE OF THIS DOCUMENT

This document will provide information about the goal of VRC, the joined venture of PQR and Login Consultants, the project team members, the resources-, test platform, the benchmark- results and analysis.

It's important to understand that the vision of “Data and System Availability” and the focus of the vendor in this market space is more important than only comparing the results of each solution with particular workloads. Despite of this, comparing results can help finding the right virtualization solution that suits the business- and technical requirements of your organization.

Frequently customers are asking “Which solution is the best solution?” In general It is impossible to give a clear answer on such a question. This truly depends on the demands of IT management, customer needs, applications being used, the business case and how the ICT infrastructure is organized.

This document is created to help people to understand the mechanics and best practices for virtualizing Desktop and Terminal Server workloads.

2.4 BETTER TOGETHER

“..The two largest and most focused competitors in the Dutch Virtualization and Application Delivery market space are working together on project: Virtual Reality Check...” PQR and Login Consultants started this joined-venture to share insights with the virtualization community with Project: Virtual Reality Check. There are several reasons for PQR and Login consultants to execute this project together:

- The Project leaders, Ruben Spruijt and Jeroen van de Kamp know each other for a long time from the virtualization community and share the same passion for these technologies.
- Project VRC is a huge undertaking, PQR and Login consultants individually do not have the resources, or time, to execute this project on their own. Thus is it logical to cooperate, share the workload and deliver the results together;
- Both organizations share the same technical vision, which is critically important in complicated projects like these.

2.5 VENDOR INVOLVEMENT

All major vendors whose products are covered by Project: Virtual Reality Check, such as VMware, Microsoft and Citrix have been approached in advance to create awareness of Project VRC and discuss the results.

2.6 CONTACT

All information about Virtual Reality Check can be found at www.virtualrealitycheck.net Contact details are:

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We try to provide accurate, clear, complete and usable information. We appreciate your feedback. If you have any comments, corrections, or suggestions for improvements of this document, we want to hear from you! Please send e-mail to Jeroen van de Kamp (j.kamp@loginconsultants.nl) or Ruben Spruijt (rsp@pqr.nl). Include the product name and version number, and the title of the document in your message.

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3. ABOUT THE AUTHORS

3.1 ABOUT LOGIN CONSULTANTS

Founded in 2002, Login Consultants has grown to become one of the leading IT infrastructure consulting firms in access, virtualization and deployment solutions. Currently Login employs up to 100 skilled and motivated team members in the US, Germany, Belgium and the Netherlands.

Login Consultants started in the Netherlands as a consulting firm with 100% focus on virtualization solutions. Although the Dutch IT market lost its pace at the time, Login Consultants was able to grow rapidly. This was in large part because of many organizations launching strategic projects to lower IT costs through centralization and consolidation. This proved more challenging in practice than originally expected. Login Consultants contributed its vast virtualization expertise, skills and knowledge to help customers achieve true success.

Over the years Login Consultants has become a well-respected partner to many IT organizations and vendors. This has driven growth and enabled expanding operations to Belgium (2004), Germany (2005) and the United States (2006), allowing Login to extend its services and success to international oriented organizations.

In the application-centric infrastructure, there are many strategic technologies that help IT departments to introduce agility in their internal service delivery. Login Consultants has embraced these technologies for access, virtualization and deployment, thus fulfilling the promise of a dynamic infrastructure.

Many technology vendors and strategic partners subscribe to the success Login Consultants achieves for its customers. Citrix, Microsoft & VMware all have accredited Login as a consulting partner.

With no specific focus on hardware or software selling, Login is an independent solution provider for many IT organizations who trust Login for objective advice and quality consulting. The ability to help define and realize a comprehensive strategy for application delivery, makes Login unique and of great value to its customers.

3.2 ABOUT PQR

"It is easy to complicate simple matters" Very few people have the ability to simplify something that is complicated. Consider the rubber band created by the British inventor Stephen Perry in 1845, for example. Complex and yet straightforward at the same time. PQR stands for the same straightforwardness. But in a different field, namely ICT infrastructures, with the focus on:

- Server & Storage Solutions;
- Application and Desktop delivery;
- Virtualization.

"Simplicity in ICT", experience how PQR can make ICT manageable and predictable via solutions that are linked to one another, geared to the future, flexible, inventive and solid at the same time. Work together with a company that likes the result-oriented approach and with personnel who ensure that a solution simply works. ICT has never been that straightforward!

PQR delivers advanced infrastructures with a focus on Server & Storage and Application & Desktop Delivery solutions and the associated migration, consolidation and virtualization paths including network and security. PQR is a Cisco Partner, a Citrix Platinum Solution Advisor, a CommVault Value Added Reseller, and HP Enterprise Specialist Partner, an HP ProCurve Elite Partner, a threefold Microsoft Gold Partner, a NetApp Gold Reseller, an RES Platinum Partner, a VMware Premier Partner and a Websense Platinum Partner. PQR's customers are active in all sectors of society and a significant part of the sales is realized with non-profit organizations, the health care sector, education and local and national government.

PQR is headquartered in De Meern and counts meanwhile over 100 employees. In fiscal year 2007/2008 the company posted sales of € 80.3 million and a net after tax profit of € 5.8 million. PQR's clients are active in all sectors of society. A significant part of our sales is achieved by non-profit organizations, the health care industry, education and local and federal government. www.pqr.com

3.3 TEAM MEMBERS

Ruben Spruijt, Solutions Architect PQR

Ruben Spruijt, born in 1975, studied Computer science and started his career as a Systems Engineer at A-Tree Automatisering. He has been working as a Solutions Architect at PQR since 2002.

Focusing on Server & Storage, Virtualization and Application Delivery solutions, PQR implements and migrates advanced ICT-infrastructure and has achieved the highest certifications of its most important partners: HP Preferred Partner Gold, Microsoft Gold Certified Partner, Citrix Platinum Solution Advisor, VMware Premier and Consultancy Partner.

In his job, Ruben is primary focused on Application and Desktop Delivery, hardware and software Virtualization. He is a Citrix Certified Integration Architect (CCIA), Citrix Certified Enterprise Administrator (CCEA) as well as Microsoft Certified Systems Engineer (MCSE+S). Ruben has been awarded with the Microsoft Most Value Professional (MVP), Citrix Technology Professional (CTP) and RES Software Value Professional (RSVP) title.

At various local and international conferences Ruben presents his vision and profound knowledge of 'Application- and Desktop Delivery' and Virtualization solutions. He is initiator of PQR's conceptual modes of 'Application and Desktop Delivery solutions' and 'Data and System Availability solutions' and originator of www.virtuall.eu, the solutions showcase of PQR. He has written several articles that have been published by professional magazines and informative websites. To contact Ruben directly send an email to rsp@pqr.nl

Jeroen van de Kamp, CTO Login Consultants

As Chief Technology Officer, Jeroen van de Kamp is responsible for defining and executing the technical strategy for Login Consultants. From the start, Jeroen has played a critical role in the technical growth and accreditation Login has accumulated over the years. He has developed several core solutions which allow Login Consultants to easily differentiate in the infrastructure consulting market. The most important ones are Infrastructure 2.0; this is the unconventional strategy for IT services to establish the agile IT infrastructure foundation to support the constant changing business demands and Solution4 which is the best practice and automation methodology for enterprise Citrix environments in high density data centers. Jeroen is also responsible for several well-known publications like the Flex Profile Kit, TCT templates & "The black hole effect". Because of his contribution to the technical community Van de Kamp is recognized as a thought-leader in the application delivery industry and has become a residential speaker for seminars like BriForum, Citrix Solution Summit and many others. He is one of the 20 members worldwide who participate in the exclusive "Citrix Technology Professional" program.

Jeroen is still engaged with strategic key accounts for Login Consultants, defining and realizing an all encompassing strategy for the application, desktop and server delivery infrastructure. Previous to his position as CTO at Log*in Consultants Jeroen held positions as Infrastructure Architect at Login Consultants; IT Consultant at QFace ICT and IT specialist at ASG de Veer. To contact Jeroen send an email to j.kamp@loginconsultants.nl

The Team

Only through the effort and persistence of the VRC team members and reviewers we achieved the goals of project VRC, a big thanks!

Name	Position	Role within VRC
Mark Plettenberg	Consultant Login	Creator Login VSI
Henk Hofs	Consultant Login	Creator Login VSI
Koen Huntink	Intern Login Consultants	Execute benchmarks
Stefan Raben	Intern Login Consultants	Execute benchmarks
Niels Ballis	Consultant PQR	Build infrastructure, execute benchmarks
Peter Jong	Consultant PQR	Execute benchmarks
Peter Sterk	Consultant PQR	Execute benchmarks
Jon Jager	Consultant Login	Execute benchmarks
Barry Schiffer	Consultant Login	Execute benchmarks
Jorne Meijer	Consultant Login	Produce documentation
Remco Vrolijk	Consultant Login	Produce documentation
Stefan Steinfort	Consultant Login	Produce documentation
Herco van Brug	Solution Architect PQR	Review benchmarking analysis
Bernard Tritsch	VP R&D Immidio	Review benchmarking analysis
Rob Stoekenbroek	Solution Manager PQR	Review whitepaper
Erwin Vollering	Solution Architect	Review whitepaper

4. THE VRC PLATFORM

Login Consultants and PQR have built the benchmark platform for Project VRC at PQR in de Meern, The Netherlands. Login VSI was used to create transparent, reproducible and stable performance tests on Terminal Server and virtualized desktop workloads. To effectively demonstrate the scalability of the Hypervisor platforms the benchmark environment has been built-up with the latest hardware- and software technologies.

4.1 HARDWARE CONFIGURATION

The bare-metal, Citrix XenServer, Microsoft Hyper-V and VMware ESX platforms are tested on the following server hardware.

Component	Details
Server Brand/Model	HPDL385R05
BIOS version	A09 05/29/2008
CPU	2 x AMD Quad core 2356@2.30GHz (75W)
CPU cache	2Mb L2, 2Mb L3
Memory	8 x 4 Gb, 32 Gb PC2-5300 DDR2 (667MHz)
Disk	8 x 146Gb, 820.2Gb, dual port 10.000RPM Serial SCSI
RAID level	RAID-5 with online spare (75% Read / 25% Write)
RAID controller	HP Smart Array P400i, with 512Mb and Battery Backed Write Cache
RAID controller	Firmware 5.20
Integrated Lights Out (iLO) v2	Firmware v1.60
Network Interface	NC373i Gigabit Adapters, Broadcom 5708





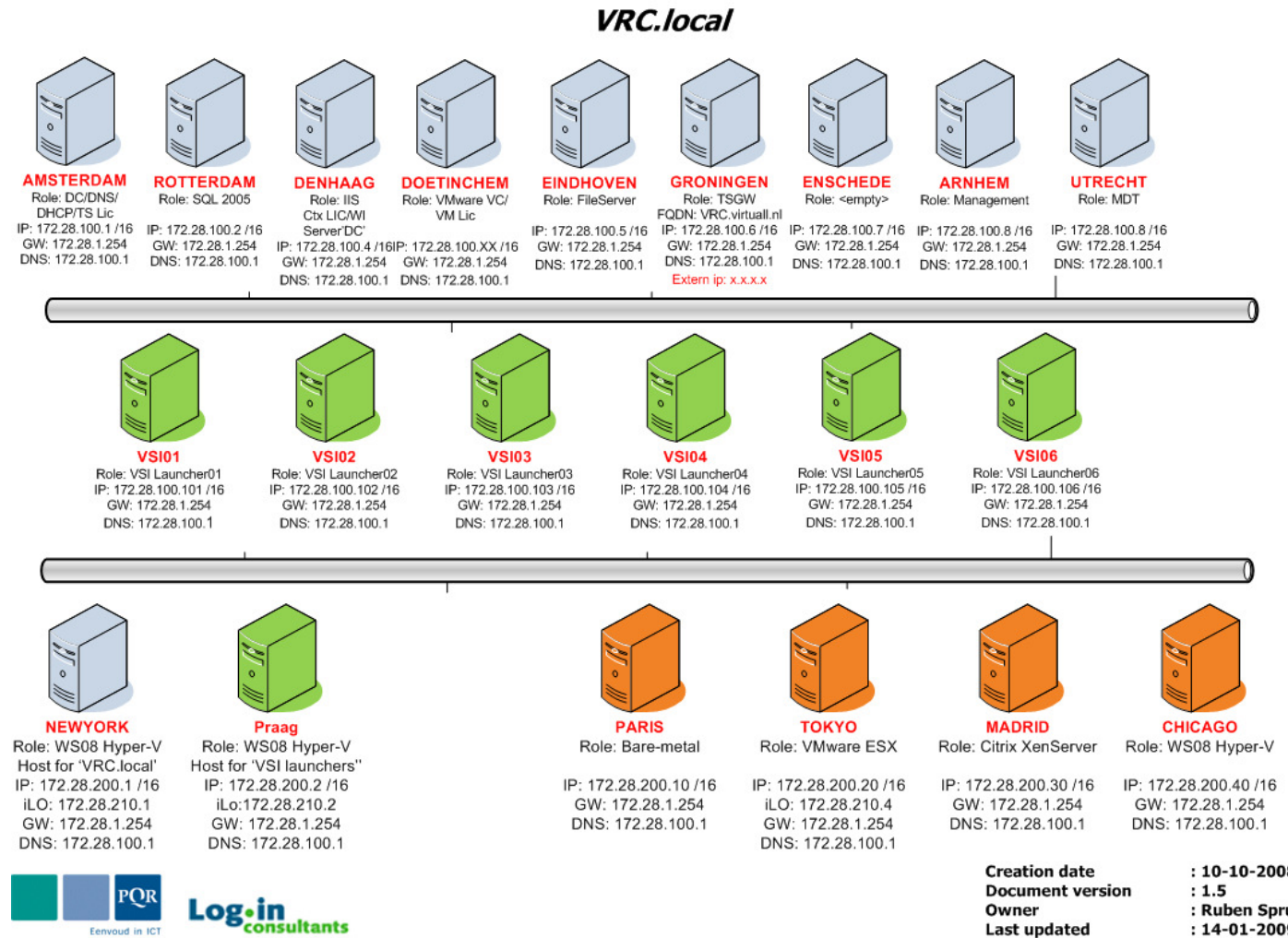
4.2 SOFTWARE OVERVIEW PROJECT VRC

The Physical and Virtual Infrastructure is built with the following software components. All Windows Operating Systems are updated with the Windows Security updates of October 2008.

Vendor	Applications	Details
Microsoft	Windows Server 2008 x64 Datacenter edition	6.0.6.6001 SP1 Build 6001
Microsoft	Windows Server 2003 x64 Datacenter edition	SP2
Microsoft	Windows Server 2008 x86 Enterprise edition	---
Microsoft	Windows Server 2003 x86 Enterprise edition	SP2
VMware	ESX 3.5	3.5.0, 110268
Citrix	XenServer 5.0	---
Microsoft	Windows XP Pro x86	SP3
Citrix	XenApp 5.0 x86 and x64	---
Citrix	XenApp 4.5 x86 and x64	Hotfix Rollup Pack 3
Microsoft	SQL 2005 Enterprise	SP2
Microsoft	Office 2007 UK	With and without SP1
Adobe	Acrobat Reader 8 UK	8.1.0

Important: Unless explicitly mentioned in the Project VRC documentation, all software is configured with default settings and only the required components are installed.

4.3 INFRASTRUCTURE OVERVIEW



4.3.1 VRC Infrastructure detailed overview

The VRC infrastructure has been designed and implemented to run multiple tests on the four (Bare metal, Hyper-V, XenServer & VMware), different platforms simultaneously. This was essential, as over 150 VSI test-runs have been performed in total.

All the VRC core components such as Domain Controller, FileServer and related management machines, are installed and configured within Virtual Machines running Microsoft Windows Server 2008 x64 Enterprise Edition. These virtual machines are executed by Hyper-V, configured as a role within Microsoft Windows Server 2008 Datacenter. The Hyper-V role is installed on the physical server 'New York', a HP DL385R05 server with 8 CPU cores, 32Gb RAM and 8 Harddisks in RAID5.

The domain VRC.local is a Windows Server 2008 Active Directory domain running in 2008 native mode. The DC, with related FSMO roles, DHCP and DNS roles are installed on the server 'Amsterdam'. Login VSI takes care of the creation of Active Directory user accounts and Group Policy Objects, which are described in the appendix of this whitepaper.

The virtual machine 'Eindhoven' stores the Login VSI performance information. The Windows Server 2008 fileserver role is enabled and configured default on the virtual machine 'Eindhoven'.

Terminal Server Gateway functionality provides the VRC project team with remote access functionality. This Windows Server 2008 role is enabled on the virtual machine 'Groningen'.

Deployment of target (virtual) machines is automated where possible. Microsoft Desktop Toolkit 2008 and the various deployment solutions within the Virtual Infrastructure solutions have been used to create an automated deployment solution.

On machine 'Arnhem', Terminal Server role, running in application mode has been activated. All the different Management Consoles have been installed on the virtual machine 'Arnhem' and are accessible to the VRC team members.

All the physical machines are well connected to a 24-port HP Procurve Gigabit switch.

4.3.2 Launcher Configuration

All the VSI launchers are installed and configured within Virtual Machines running on Microsoft Windows Server 2008 x64 Enterprise Edition. These virtual machines run on Hyper-V, configured as a role within Microsoft Windows Server 2008 Datacenter. The Hyper-V role is installed on the physical server 'Praag', a HP DL385R05 server with 8 CPU cores, 32Gb RAM and 8 Hard-drives in a RAID5 configuration. The virtual machine 'VSI01' is the master VSI, the subsequent VSI launchers are VSI02-VSI06.

All the VSI launchers have been installed on Windows Server 2008 x86 Enterprise Edition.

The Microsoft Remote Desktop Client is included in the OS, no special configuration settings are applied.

The Citrix XenApp plug-in for hosted apps (ICA Client) version 11.0.0.5357 has been installed. The VSI launchers are configured to use 2GB of internal memory.

The screen resolution for the RDP/ICA connection to the target machines was set to:

- 1024x786 Resolution
- 16 Bit Color Depth
- Speed Screen accelerators disabled
- Client Drives are disabled
- Client Printing is disabled
- Clear Type is not configured

5. TESTING METHODOLOGY

For Project VRC, the free Login Virtual Session Indexer (Login VSI 1.0) methodology was used. Login VSI is a benchmarking methodology which calculates index numbers based on the amount of simultaneous sessions that can be run on a single physical machine, running either bare metal or virtualized operating systems. To keep the results representative it is imperative that identical tests are run on different types of systems. Therefore Login VSI does not allow any customization of the load scripts.

Login Virtual Session Indexer is freeware and can be downloaded from: www.loginconsultants.com.

Login VSI allows you to compare platforms and technologies, specifically not to predict the exact amount of sessions you can run in your own production environment. Such predictions are impossible, since this completely depends on the application set and how these applications are used in practice.

Login VSI generates a realistic, emulated, user workload. Therefore, every session will simulate a medium-heavy workload user (knowledge worker) running generic applications like Office, Internet Explorer including Flash applets and Adobe Acrobat Reader. Like real users, the scripted session will leave multiple applications open at the same time. Every session will average about 20% minimal user activity, similar to real world usage. The workload may be considered future proof and can be categorized to simulate medium/heavy load of a typical knowledge worker (this is in comparison to average Terminal Server deployments):

- The CPU workload is may be categorized as medium/heavy (clearly above average);
- The Memory workload is now medium (slightly above average).

The workload is performed by scripts (AutoIT based) on the target operating system. This makes Login VSI independent of virtualization platform and presentation protocol used. The overhead of the AutoIT scripts used will never exceed 5% and averages below 1% per session.

Sessions are always started through a remoting protocol (ICA, RDP or other) at a resolution of 1024x768 with a 16bit color depth. Every session must remain connected for the duration of the tests since the overhead of the protocol does influence system performance and the workload scripts can only function within a connected session.

The optimal performance index will characterize test results by measuring application response times within all active sessions. An “optimal performance index”, describing the amount of sessions that can be run on single machine without serious performance degradation. A variance of 5-10% per identical test run is normal.

Login VSI is platform independent, which allows testing of other and new platforms in the future:

- Support for Windows based Presentation Virtualization platforms (Server Based Computing);
- Support for Windows based Desktop Virtualization platforms;
- Support for Windows based Application Virtualization technologies (Application Streaming);
- Support for both Windows 32 bit and Windows x64;
- Support for Windows XP, 2003, Vista and 2008;
- Support for Office 2003 and 2007;
- Support for VMware, Microsoft, Citrix, Provision IT and other presentation or desktop virtualization vendors through a custom command-line to launch session.

User sessions will start every 30 seconds for Terminal Server environments and 60 seconds for VDI. Typically, VDI solutions have a much lower user density as opposed to SBC solutions; the interval for new sessions on VDI is therefore lower (i.e. to allow for starting/resuming workstations).

All sessions will run completely locally: there are no connections to back-end services or external applications (client printers, home/group drives, roaming profiles, exchange, printers, databases, webpage's, etc...) with the exception of a file share for logging and controlling purposes. This ensures the result is not dependant on backend services or influenced by other external factors.

When running Login VSI on a Terminal Server, unique test user accounts are created for each session. Using a single user for multiple sessions on a Terminal or Citrix would impact performance as the user environment is shared for each session.

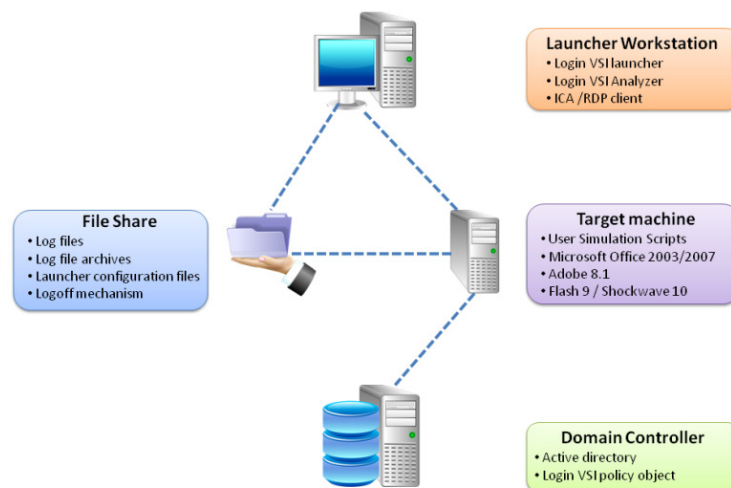
The user profiles (local profiles) are created before the actual benchmark run is performed. This is to prevent an extreme load during the logon process of each user; the creation of new profiles requires too much system resources. Furthermore, it is not a typical practice in production environments to always create a brand new profile for every logon attempt. Also, the use of local profiles eliminates the risk of profile conflicts and corruption which are inherent to using roaming profiles and tests with multiple platforms.

In virtual desktop environment where de-duplication of memory pages on a virtualization platform is enabled, unique test accounts and therefore unique profiles need to be pre-created in the workstation image. This prevents unrealistic de-duplication of memory pages by using a single data set.

5.1 LOGIN VSI OVERVIEW

Login VSI consists of 4 components:

- AD Domain controller for user accounts and standard policies;
- A file share for central configuration and logging;
- Launcher workstations (Master and Slaves) to initiate the sessions;
- Target platform (VDI or SBC) where the user load script are installed and executed.



5.2 RANDOMIZATION

Since Beta 0.5 of Login VSI, randomization is introduced within the user load simulation. This is an important feature, as optimizers on a memory or network level operate on the principle of de-duplicating and compressing repeated patterns. If every single session is doing the exact same thing, de-duplication of memory and compression on a presentation protocol level will produce unrealistic results. For a more realistic load testing, randomization is crucial. This prevents overly optimistic benchmark results caused by unrealistic optimization of the workload.

Building randomization into a benchmark needs special consideration. From a system resource load and execution timing perspective, randomization would harm the repeatability of the results. This will not make sense from a performance benchmarking perspective as this is one of the first requirements of Login VSI.

Therefore, only the dataset for each session is randomized. As a result, the workload, including all applications, how and when they are executed is exactly the same for each session. Only the documents, presentations, mailboxes and excel sheets are randomized. All random paragraphs and

pictures used in each document, presentation or e-mail are generated to have the same size and structure.

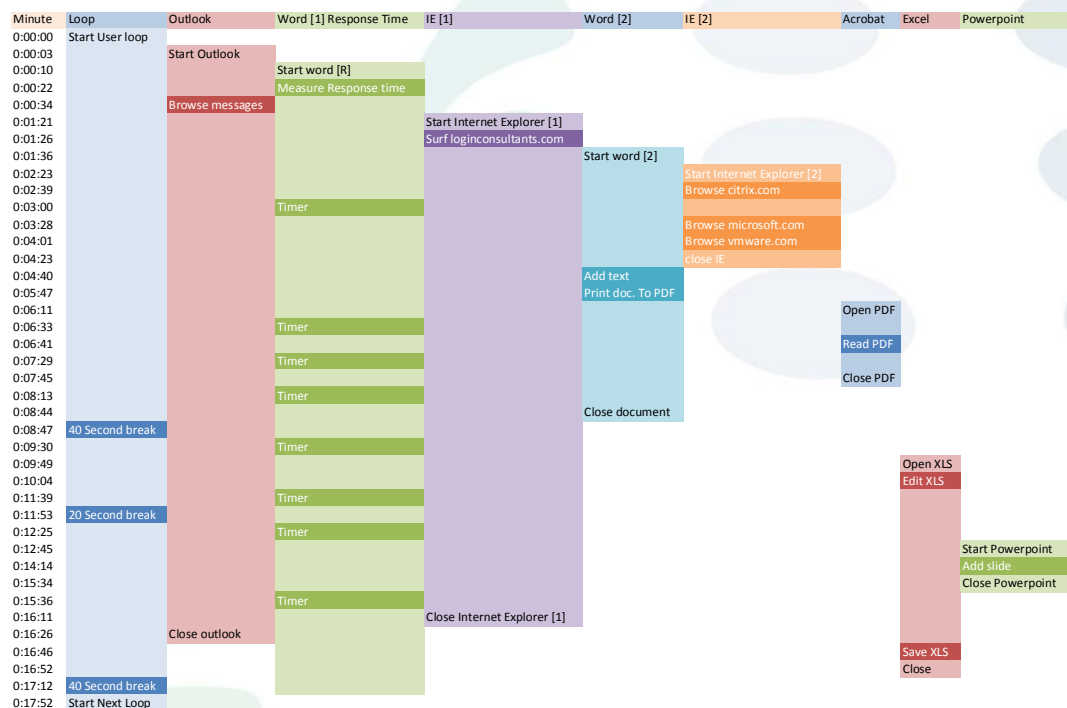
Login VSI has a pool of 150 randomly generated documents, presentations and pst files which differ no more than 5% in size.

Item	Pool Size	Refreshed at each loop start	File Size Range (KB)
Word Document	100	Yes	+/- 265 KB
PowerPoint	100	Yes	+/- 1195 KB
Outlook inbox (PST file)	100	No, only refreshed after login.	1257 KB
Excel Sheet	1	Yes, each cell uses the "Random" function. Every time the sheet is opened completely different values are generated.	1325 KB
Internet Explorer	No Randomization	n/a	n/a

5.3 USER LOAD OVERVIEW

In the chart below the actions and events within each 18 minute user loop are displayed. Like real world usage, multiple applications are kept open simultaneously. Each loop will open and use:

- Outlook 2007, browse 10 messages & type new message.
- Internet Explorer, one instance is left open, one instance is browsed to MS, VMware and Citrix (locally cached copies of these websites).
- Word 2007, one instance to measure response time (9 times), one instance to review, edit and print a random document.
- Solidata PDF writer & Acrobat Reader, the word document is printed to PDF and reviewed.
- Excel 2007, a very large randomized sheet is opened and edited.
- PowerPoint 2007, a random presentation is reviewed and edited.
- 3 Breaks (40, 20 & 40 seconds) are included to emulate real world usage.



Review the HD video of Login VSI 1.0 on <http://vimeo.com/2749006>.

5.4 CORRECTED OPTIMAL PERFORMANCE INDEX

In project VRC, Login VSI is used to perform all benchmark tests. Login VSI uses AutoIT scripts to simulate user workload in a loop that repeats every 18 minutes. After a thorough process of fine-tuning, the majority of tests executed properly. Occasionally timing issues occurred, resulting in stuck sessions.

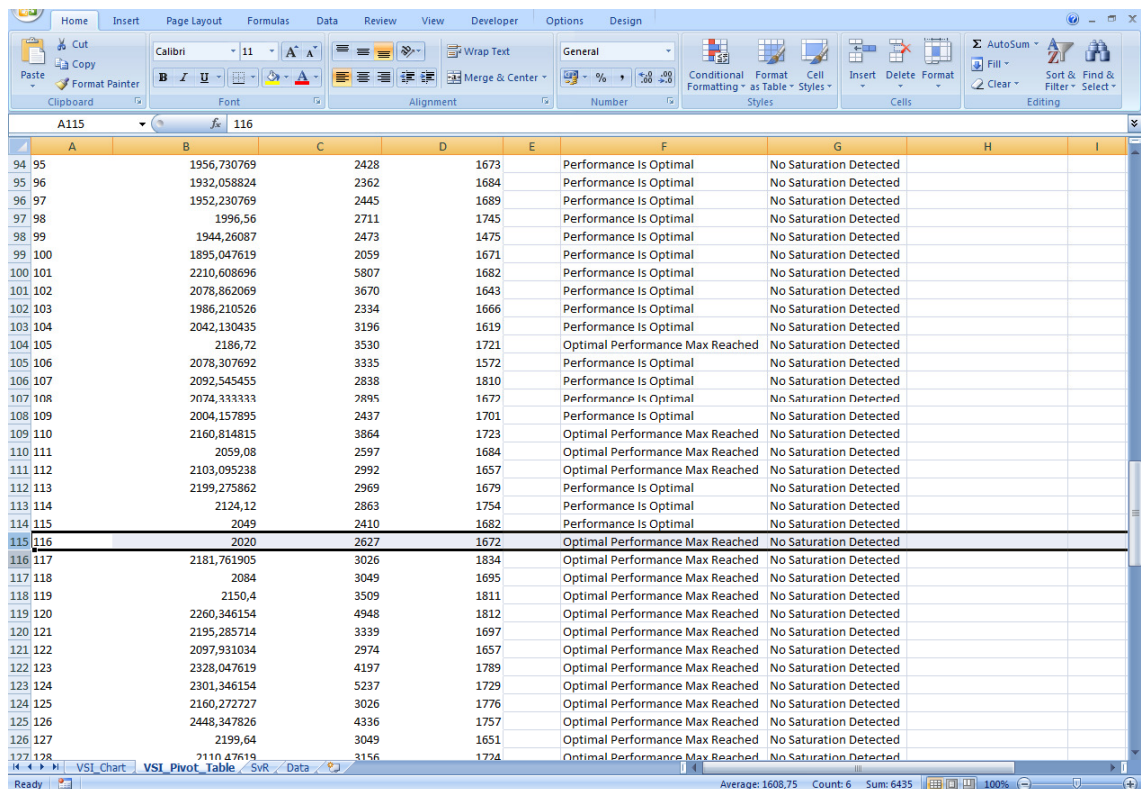
Unfortunately this cannot be prevented completely, especially when there is a high load on the system. This is also understandable, the script communicates and manipulates with the applications through the Windows GDI. This method is suited for performance tests with user emulation, but is generally sensitive to timing issues and unexpected message boxes.

Stuck sessions occur only when the VSI script is out of sync with what is happening on a desktop or application level. For instance, the VSI script is waiting for an application to focus, while the application is already in that state. Checking individual sessions that were seemingly stuck, it was always possible to continue the VSI workload tests when the application was refocused manually.

When a system is fully saturated, it is reasonable and likely that sessions do not continue and get “stuck”. This is normal behavior as the AutoIT script and applications interact on the basis of Windows events, which is specifically sensitive to timing issues under high system load. Lab tests concluded that Login VSI is able run the scripted workload seemingly indefinitely (250+ loops) when it is running as a isolated session.

On a Windows 2008 Terminal Server (both 32-bit and x64) individual sessions sometimes halted earlier than seen on other operating systems, before the system resources were saturated. It seems that AutoIT scripted workloads are a little bit more sensitive to timing issues on Windows 2008.

Reviewing the amount of “stuck” sessions can be done through counting the log files that were not updated before the optimal performance index was reached. In order to keep all results fairly comparable, these “stuck” sessions are only weighted for 50% in the corrected optimal performance index.



	A	B	C	D	E	F	G	H	I
94	95	1956,730769	2428	1673	Performance Is Optimal	No Saturation Detected			
95	96	1932,058824	2362	1684	Performance Is Optimal	No Saturation Detected			
96	97	1952,230769	2445	1689	Performance Is Optimal	No Saturation Detected			
97	98	1996,56	2711	1745	Performance Is Optimal	No Saturation Detected			
98	99	1944,26087	2473	1475	Performance Is Optimal	No Saturation Detected			
99	100	1895,047619	2059	1671	Performance Is Optimal	No Saturation Detected			
100	101	2210,608696	5807	1682	Performance Is Optimal	No Saturation Detected			
101	102	2078,862069	3670	1643	Performance Is Optimal	No Saturation Detected			
102	103	1986,210526	2334	1666	Performance Is Optimal	No Saturation Detected			
103	104	2042,130435	3196	1619	Performance Is Optimal	No Saturation Detected			
104	105	2186,72	3530	1721	Optimal Performance Max Reached	No Saturation Detected			
105	106	2078,307692	3335	1572	Performance Is Optimal	No Saturation Detected			
106	107	2092,545455	2838	1810	Performance Is Optimal	No Saturation Detected			
107	108	2074,333333	2895	1677	Performance Is Optimal	No Saturation Detected			
108	109	2004,157895	2437	1701	Performance Is Optimal	No Saturation Detected			
109	110	2160,814815	3864	1723	Optimal Performance Max Reached	No Saturation Detected			
110	111	2059,08	2597	1684	Optimal Performance Max Reached	No Saturation Detected			
111	112	2103,095238	2992	1657	Optimal Performance Max Reached	No Saturation Detected			
112	113	2199,275862	2969	1679	Performance Is Optimal	No Saturation Detected			
113	114	2124,12	2863	1754	Performance Is Optimal	No Saturation Detected			
114	115	2049	2410	1682	Performance Is Optimal	No Saturation Detected			
115	116	2020	2627	1672	Optimal Performance Max Reached	No Saturation Detected			
116	117	2181,761905	3026	1834	Optimal Performance Max Reached	No Saturation Detected			
117	118	2084	3049	1695	Optimal Performance Max Reached	No Saturation Detected			
118	119	2150,4	3509	1811	Optimal Performance Max Reached	No Saturation Detected			
119	120	2260,346154	4948	1812	Optimal Performance Max Reached	No Saturation Detected			
120	121	2195,285714	3339	1697	Optimal Performance Max Reached	No Saturation Detected			
121	122	2097,931034	2974	1657	Optimal Performance Max Reached	No Saturation Detected			
122	123	2328,047619	4197	1789	Optimal Performance Max Reached	No Saturation Detected			
123	124	2301,346154	5237	1729	Optimal Performance Max Reached	No Saturation Detected			
124	125	2160,272727	3026	1776	Optimal Performance Max Reached	No Saturation Detected			
125	126	2448,347826	4336	1757	Optimal Performance Max Reached	No Saturation Detected			
126	127	2199,64	3049	1651	Optimal Performance Max Reached	No Saturation Detected			
127	128	2110,47619	3156	1724	Optimal Performance Max Reached	No Saturation Detected			

The response time is the measurement of the time required to focusing/switching to the (minimized) Word document “openfile.doc” and selecting the open dialogue. The scripted pause of 4 seconds is deducted from the actual measurement. The remaining time consist of the build in auto-it idle time (1200ms) and the actual time to focus and open the openfile.doc windows (+/- 400ms), typically this totals around 1600-1700 ms. Hitting 2000ms would be an actual doubling of the response time, something a user would notice as being slower. Over 400 tests were performed in the development of VSI and within Project VRC in total. As a result, it was possible to conclude that typically performance is degrading quickly after the 2000ms barrier has been reached.

The formula for the corrected optimal performance index is:

- The **Uncorrected Optimal Performance Index (UOPI)** is based on the first 5 consecutive sessions which are weighted “Optimal Performance Max Reached”.
- The “Optimal Performance Max Reached” value is calculated on the response time average of four sessions higher than 2000ms (4 session average response time > 8000 ms).
- The Uncorrected Optimal Performance Index can be retrieved from the VSI_Pivot_Table worksheet in the VSI_analysys.xlsx Excel sheet included with Login VSI (review the example screenshot, the UOPI is 116 in the example);
- However, sometimes sessions get stuck or are missing completely before UOPI, therefore the Optimal Performance Index must be corrected. By weighting all sessions that stopped logging before UOPI has occurred, it is possible to calculate the Corrected Optimal Performance Index. To find out the time of UOPI, select the Data worksheet in VSI_analysys.xlsx, and sort on time;
- Using Windows explorer, sort the individual log files on modified date, and count how many log files were not updated after UOPI was achieved. The number of stuck sessions are described as **Stuck Session Count (SSC)**. Stuck session are weighted 50% after correction;
- Separately count completely missing log files as they are weighted differently. This is called the **Lost Session Count (LSC)**, and these tests must be discarded completely in the corrected index;
- The **Corrected Optimal Performance Index (COPI)** is then calculated:
COPI=UOPI - (SSC*50%) - LSC .

Incorporating the SSC and LSC into a corrected index ensures that the test results are fair and comparable.

The Corrected Optimal Performance Index proved to be consistent within a 5-10% margin when the tests were repeated several times within project VRC. These re-runs of the test are documented in the test details.

Even though it is attractive to review, the Saturation Index fluctuates much stronger than the Optimal Performance Index, and is not taken into consideration when comparing platforms within Project VRC. Because the system is not capable of accurately registering performance metrics during a extreme system load (overloaded) it is logical that the Saturation Index shows more than 20% deviation per test run and no conclusions can be drawn from those figures.

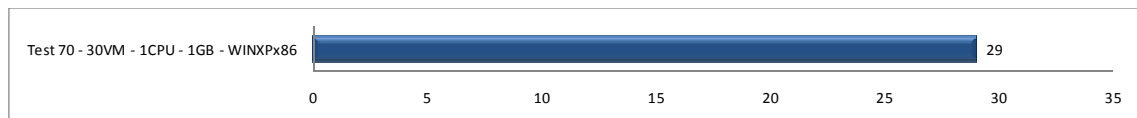
6. HYPER-V PLATFORM TEST

In all our tests (both VDI and Terminal Server/Citrix XenApp) sessions are launched with direct RDP or ICA connections equally distributed with the use of a predefined CSV file.

A deliberate choice has been made not to use connection brokers for the virtual desktop and terminal services tests within the first phase of project VRC. Using brokers would complicate the already very elaborate tests. The focus of project VRC is investigating the Hyper-v platform and, in this phase, not the addition of a broker. Including connection brokers in the tests is currently being investigated. Check www.virtualrealitycheck.net frequently for updates on this subject.

6.1 VIRTUAL DESKTOP WORKLOAD

For the virtual desktop test, all VM's are pre-booted. On Hyper-v The maximum amount of VM's is limited to the amount of physical memory available. Since Hyper-v 1.0 does not have any specific memory optimization features, it is not possible to overcommit on memory. The HP DL385R05 used for project VRC was maxed out on its physical memory with 32GB. As a result, the maximum was 30 Windows XP VM's with 1GB of memory.



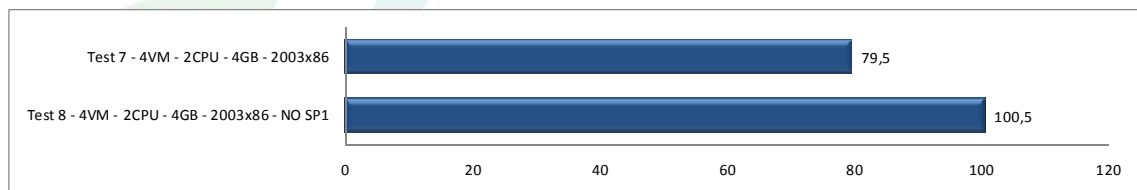
When Login VSI is ran, it was clear there were no specific bottleneck encountered during the test. The amount of VM's could be increased by lowering the memory used per VM.. However, configuring less than 1 GB per Windows XP is not recommended for business and knowledge workers. Vista would require at least an additional 512MB memory per VM, resulting in 50% less VM's in comparison to Windows XP.

To learn about potential bottlenecks, and generate more interesting data, server hardware with at least 64GB or 128GB is required. Project VRC is a continuous effort and the Windows XP (and Windows Vista & Windows 7) tests will be revisited in the future on more hardware with sufficient memory.

6.2 TERMINAL SERVER WORKLOAD

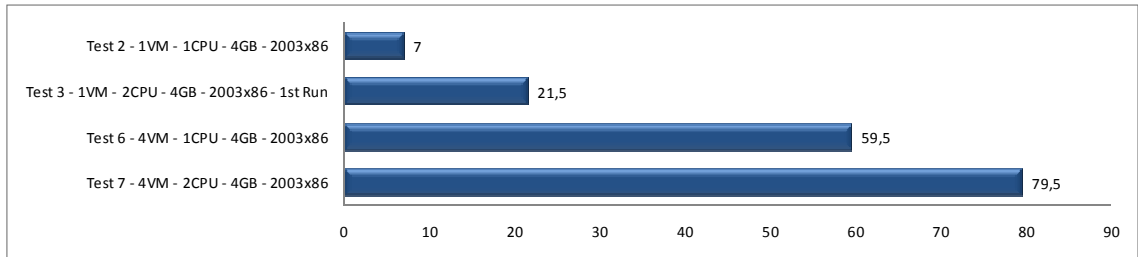
Until recently, virtualizing resource intensive Terminal Server or XenApp workloads was not always recommended because of the limited scalability and sometimes inconsistent user experience. In the past, many virtualized Terminal Server workloads proved to be sluggish from an end-user point of view. This was especially true with Virtual Server 2005. After the tests in project VRC, it is safe to conclude that this insight is changing with Hyper-v. There is room for improvement, however, when set-up correctly, and running on dedicated hardware, it is possible to virtualize TS workloads with acceptable user experience on Hyper-v.

It is not realistic to expect bare metal performance with Terminal Server and XenApp workloads. These workloads seem to be more sensitive to CPU hungry applications. This was very visible when the Office 2007 SP1 tests ran. They caused a higher CPU load when browsing the Outlook preview pane for messages which resulted in a severe degradation of system performance and scalability.. The impact of this is clearly noticed in all testing scenarios that included Office 2007 SP1.



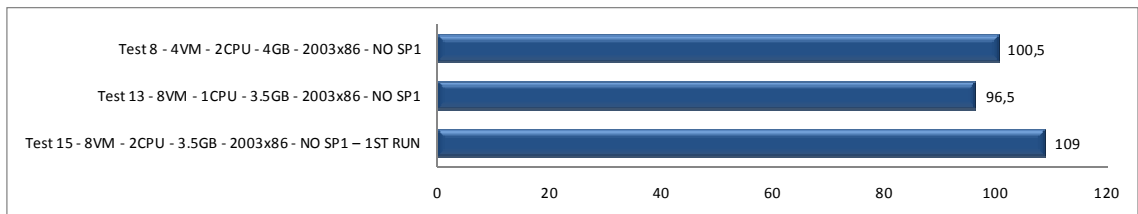
It is important to realize that the Terminal Server workload is unique. No other workload has that many active processes and threads within a single instance of Windows. Therefore, configuring only one vCPU per Terminal Server/XenApp VM is not recommended. The result is similar to having an extremely busy single lane highway. The slightest congestion will have immediate impact on all users. Having two vCPUs

per VM can be compared to a two lane highway. It is possible to overtake on the second lane when a car breaks down on the first. As a result, small congestions on one vCPU do not immediately impact other users.



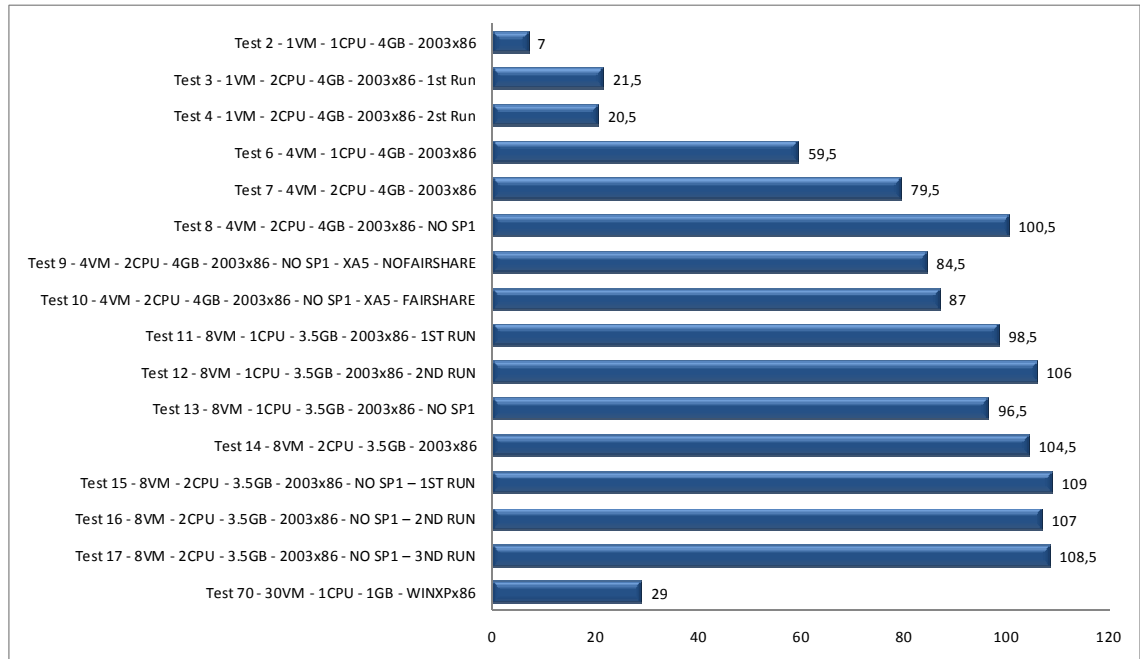
For long, it has been a best practice to not enable more than one vCPU per Terminal Server VM. Interestingly, the tests in project VRC prove differently as long as the total amount of vCPUs in all VMs combined do not exceed the physical amount of CPU cores. Enabling more vCPUs than physically available does not bring huge performance gains, and could even work counterproductive.

As an intermediate solution, it is interesting to see how using the commonly used Windows 2003 x86 standard edition Terminal Services with a 4GB memory limit scales reasonably well when virtualized. In project VRC, the most efficient and economical method to virtualize the still widespread 32-bit Windows 2003 Terminal Services on a two Quad core server is with 20 GB (4x 4GB + room for Hyper-v overhead) of physical memory running dedicatedly 4 virtual machines with 4GB of memory with 2 vCPUs.



6.3 HYPER-V TEST OVERVIEW

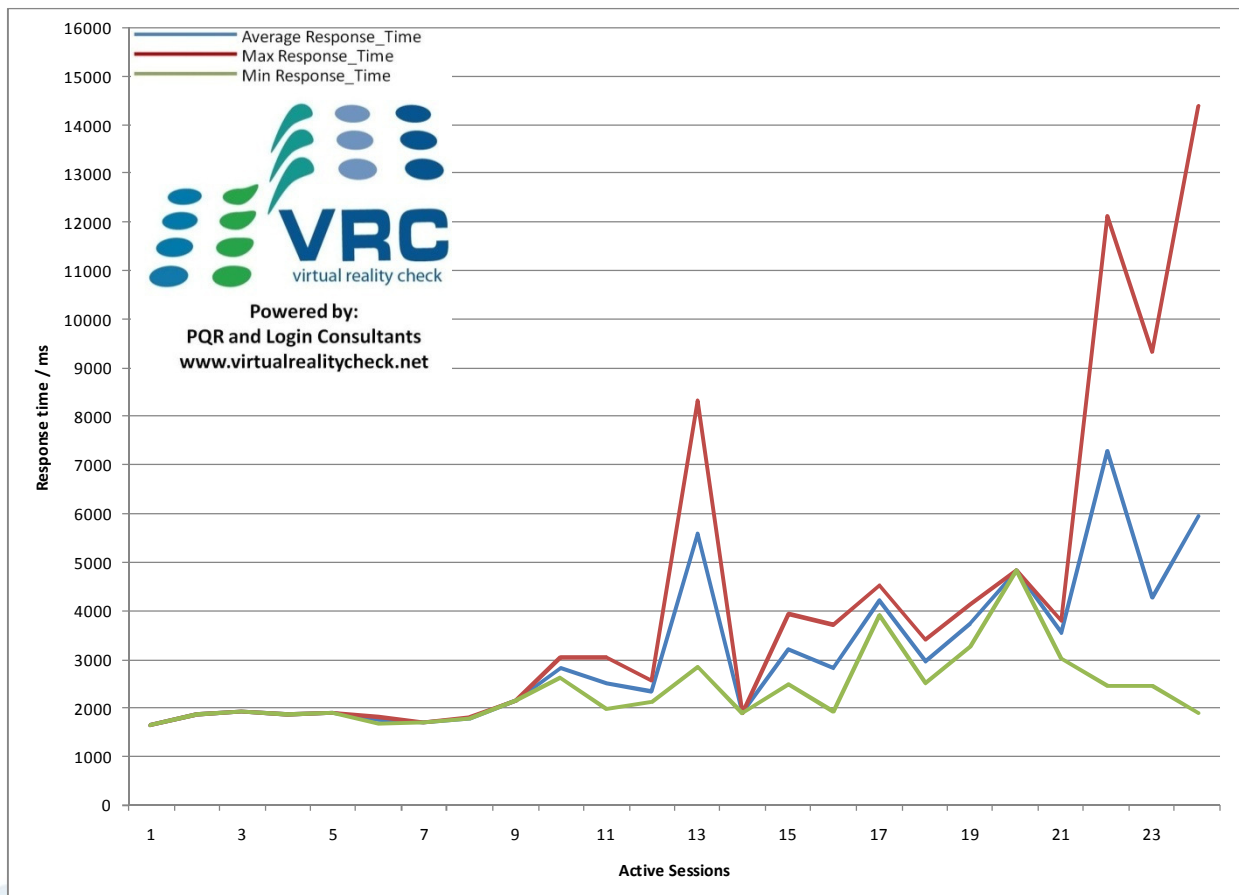
This is an overview of all Hyper-v tests performed in phase one of project VRC.



7. TEST DETAILS

7.1 TEST 2 - 1VM - 1vCPU - 4GB - 2003x86

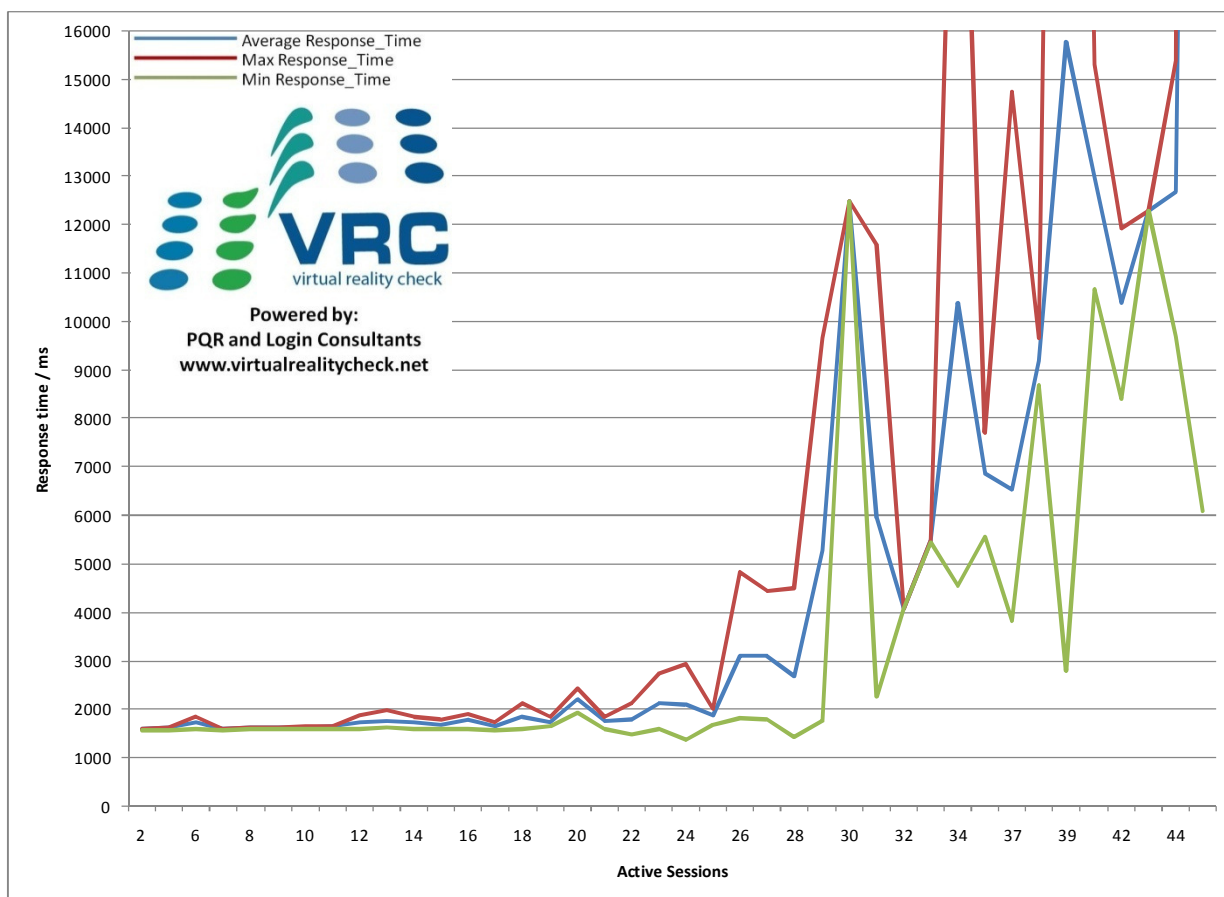
Project VRC Test ID	2
Amount of Virtual Machines	1
Amount of Cores	1
Memory available	4 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	Page File on system disk
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	30 Seconds



Total Session Launched	25
Uncorrected Optimal Performance Index (UOPI)	7
Stuck Sessions Count before UOPIT (SSC)	0
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	7

7.2 TEST 3 - 1VM - 2vCPU - 4GB - 2003x86 - 1ST RUN

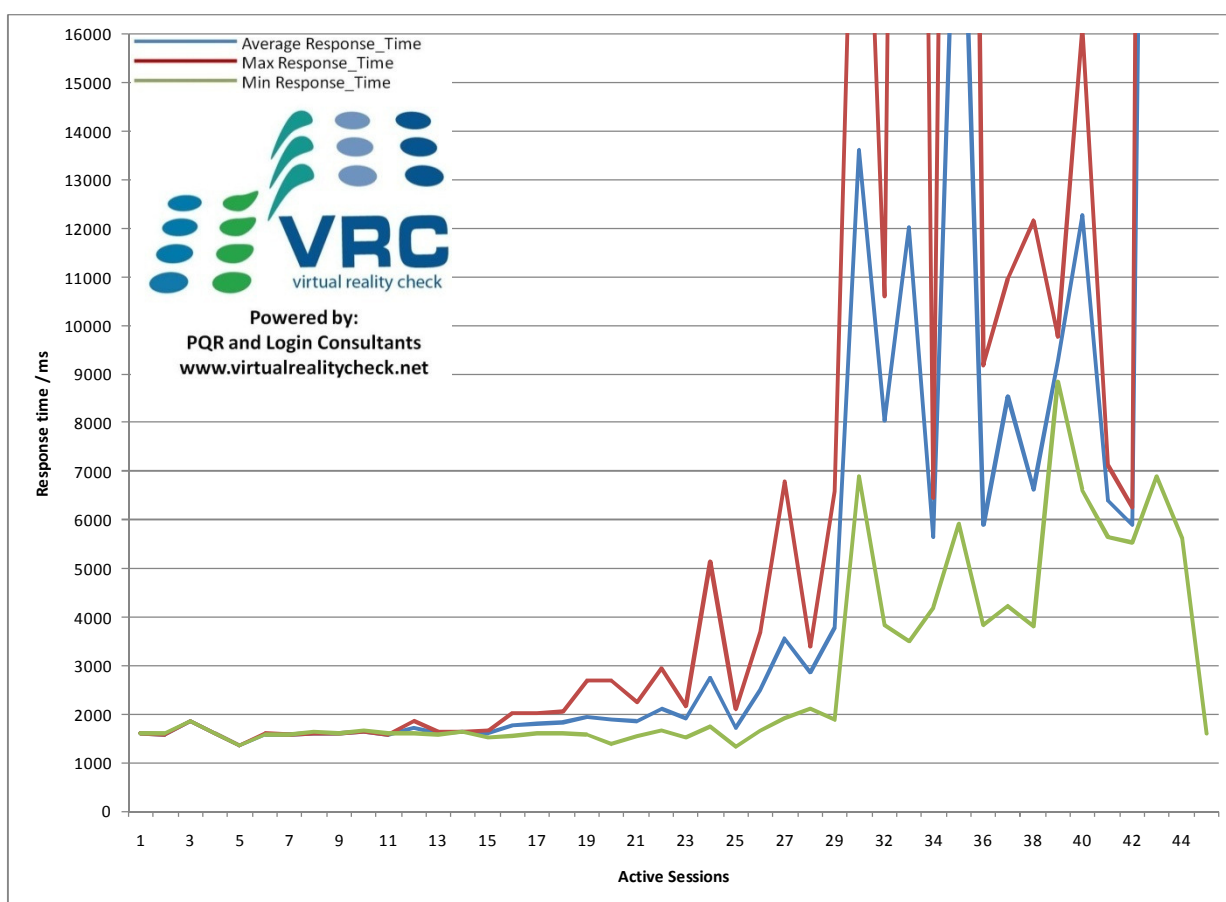
Project VRC Test ID	3
Amount of Virtual Machines	1
Amount of Cores	2
Memory available	4 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	Page File on SCSI disk
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	30 Seconds



Total Session Launched	45
Uncorrected Optimal Performance Index (UOPI)	23
Stuck Sessions Count before UOPIT (SSC)	3
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	21.5

7.3 TEST 4 - 1VM - 2vCPU - 4GB - 2003x86- 2ND RUN

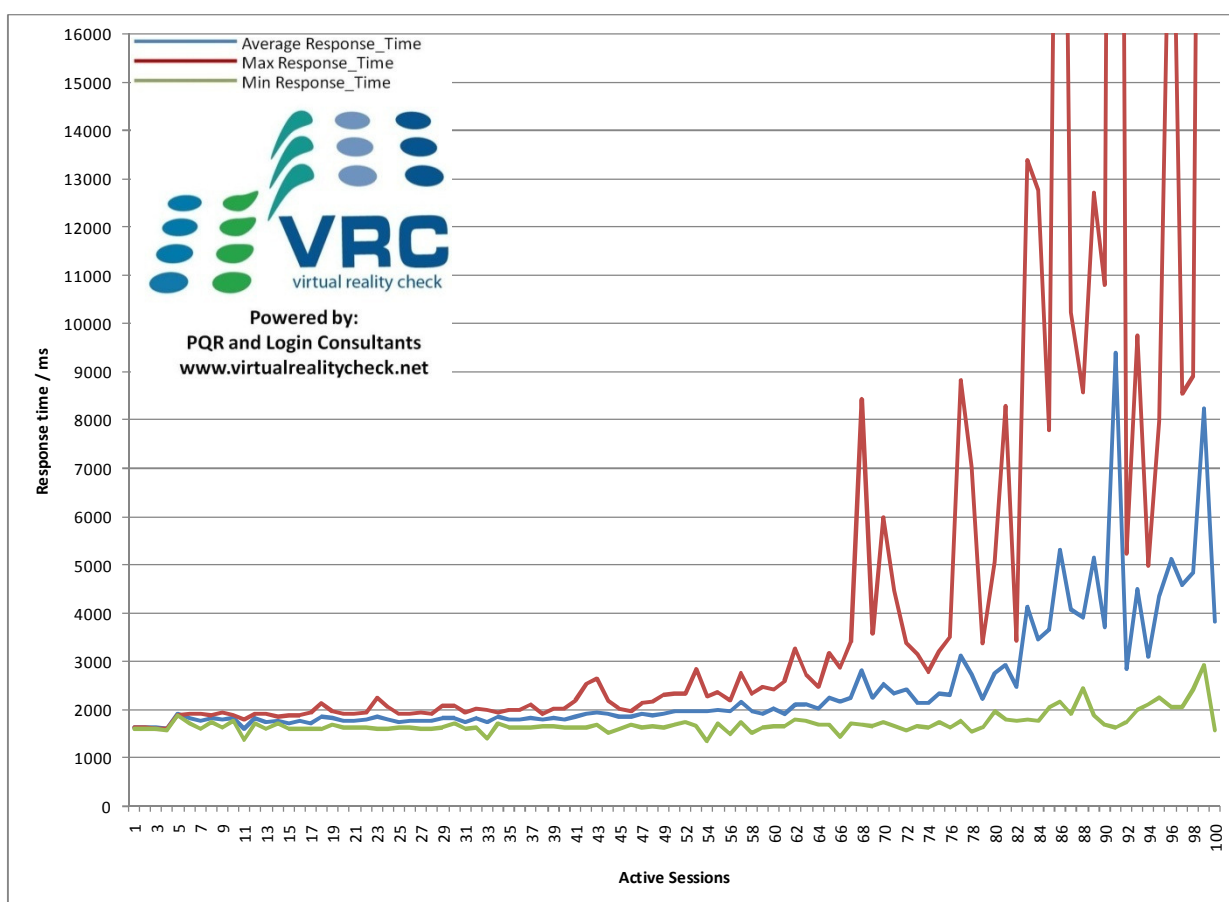
Project VRC Test ID	4
Amount of Virtual Machines	1
Amount of Cores	2
Memory available	4 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	Page File on system disk
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	30 Seconds



Total Session Launched	45
Uncorrected Optimal Performance Index (UOPI)	21
Stuck Sessions Count before UOPIT (SSC)	1
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	20.5

7.4 TEST 6 - 4VM - 1vCPU - 4GB - 2003x86

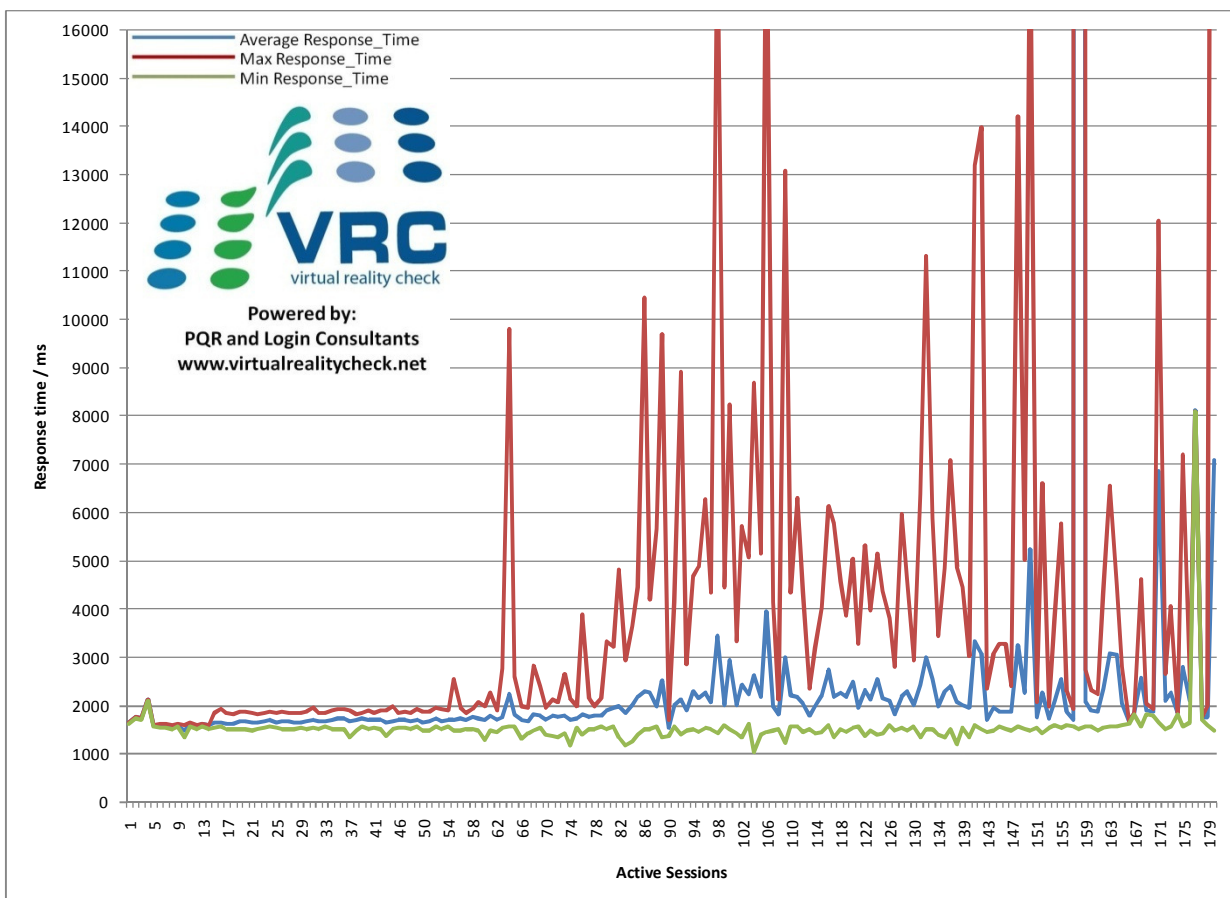
Project VRC Test ID	6
Amount of Virtual Machines	4
Amount of Cores	1
Memory available	4 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	No
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	120 Seconds



Total Session Launched	100
Uncorrected Optimal Performance Index (UOPI)	60
Stuck Sessions Count before UOPIT (SSC)	1
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	59.5

7.5 TEST 7 - 4VM - 2vCPU - 4GB - 2003x86

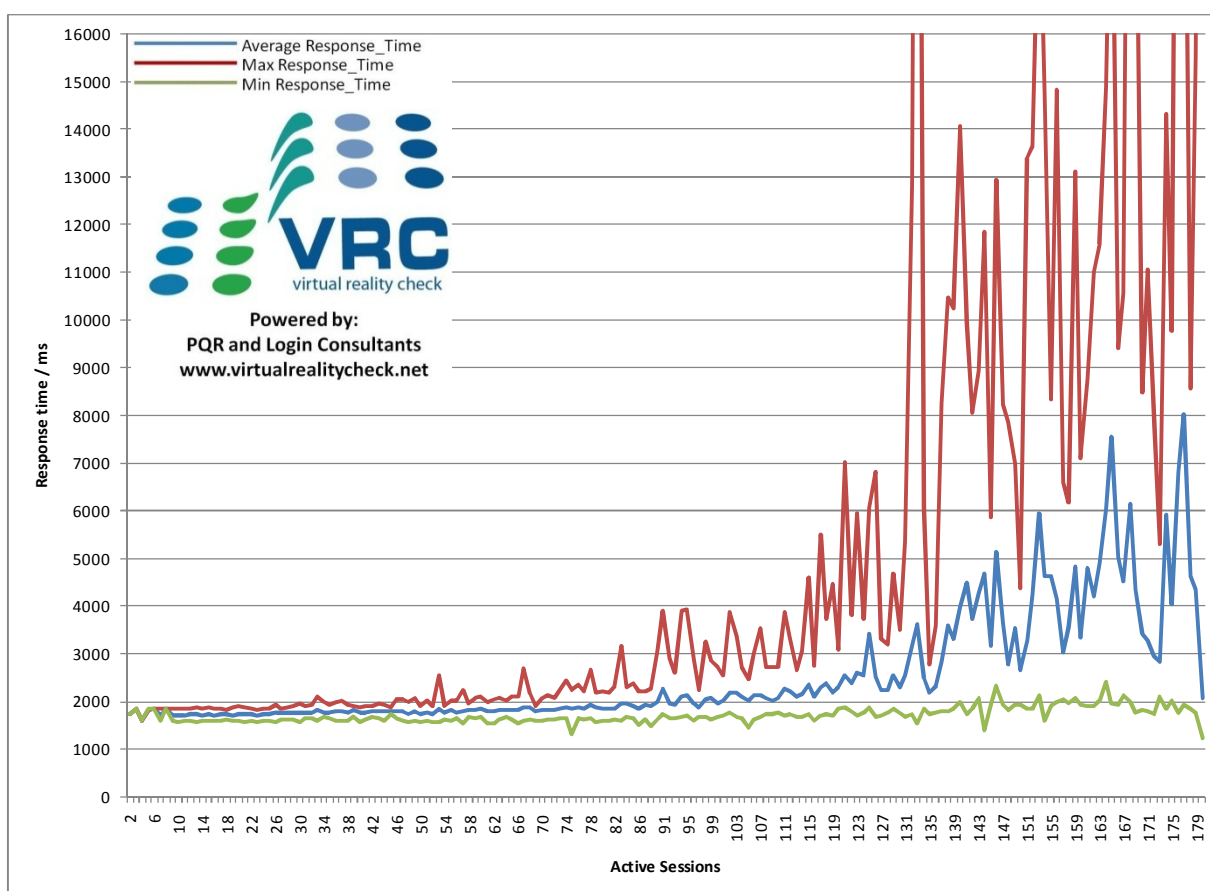
Project VRC Test ID	7
Amount of Virtual Machines	4
Amount of Cores	2
Memory available	4 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	No
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	120 Seconds



Total Session Launched	180
The Last Session Which Started Logging	161
Uncorrected Optimal Performance Index (UOPI)	82
Stuck Sessions Count before UOPIT (SSC)	5
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	79.5

7.6 TEST 8 - 4VM - 2vCPU - 4GB - 2003x86 - No SP1

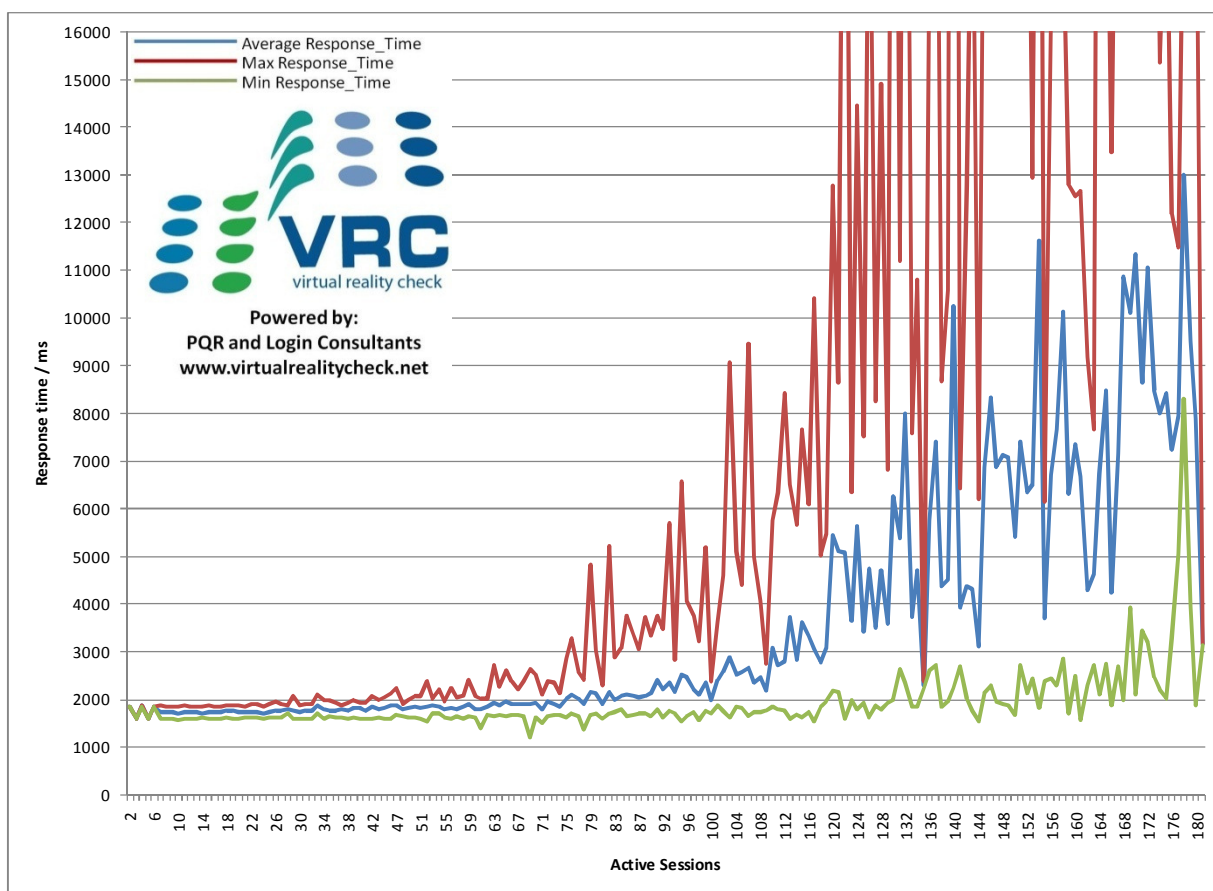
Project VRC Test ID	8
Amount of Virtual Machines	4
Amount of vCPU's	2
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 sp1 installed
Specific Virtualization Settings	
Launching interval	30 Seconds
Launching interval per VM	120 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	108
Stuck Sessions Count before UOPIT (SSC)	15
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	100.5

7.7 TEST 9 - 4VM - 2vCPU - 4GB - 2003x86 - No SP1 - XA5 - NOFAIRSHARE

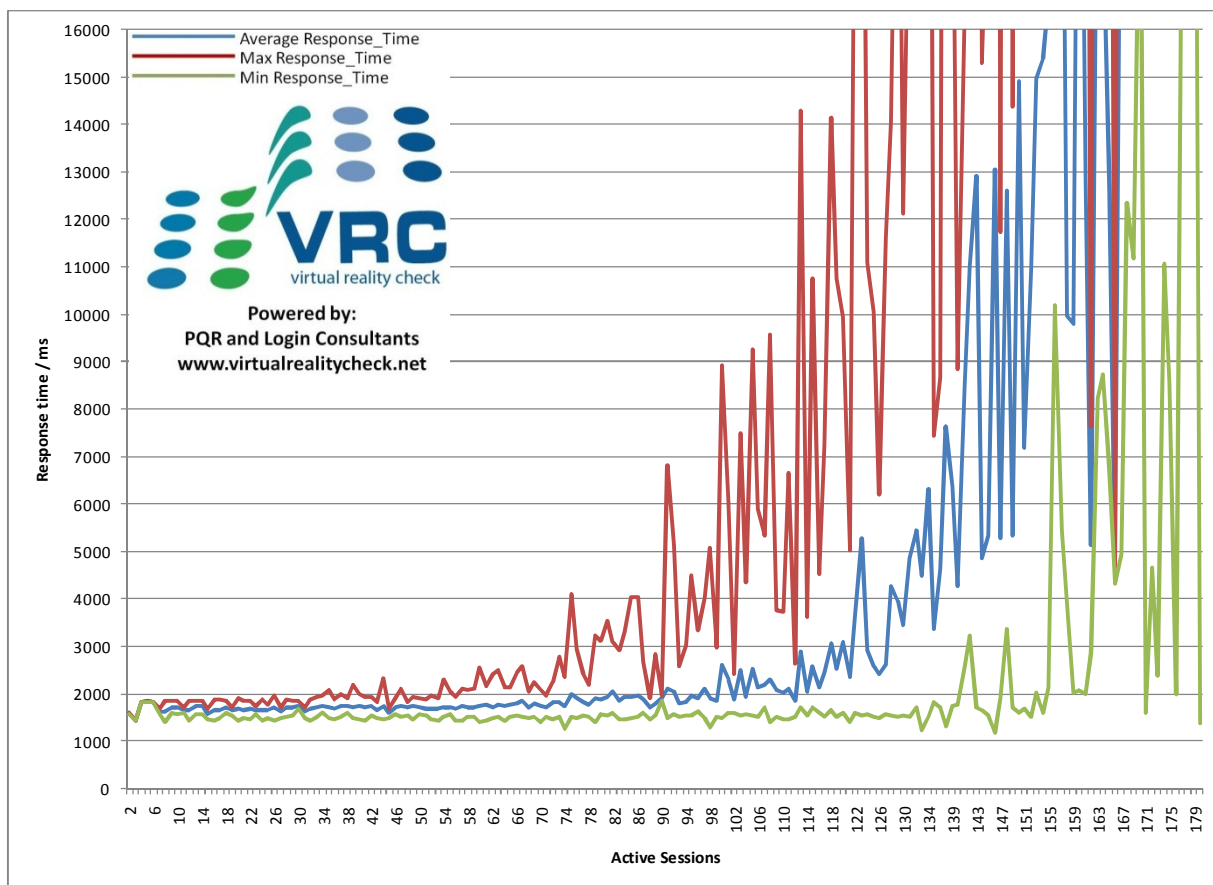
Project VRC Test ID	9
Amount of Virtual Machines	4
Amount of vCPU's	2
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 sp1 installed
Specific Virtualization Settings	XenApp 5.0, CPU fairshare Disabled
Launching interval	30 Seconds
Launching interval per VM	120 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	87
Stuck Sessions Count before UOPIT (SSC)	5
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	84.5

7.8 TEST 10 - 4VM - 2vCPU - 4GB - 2003x86 - No SP1 - XA5 - FAIRSHARE

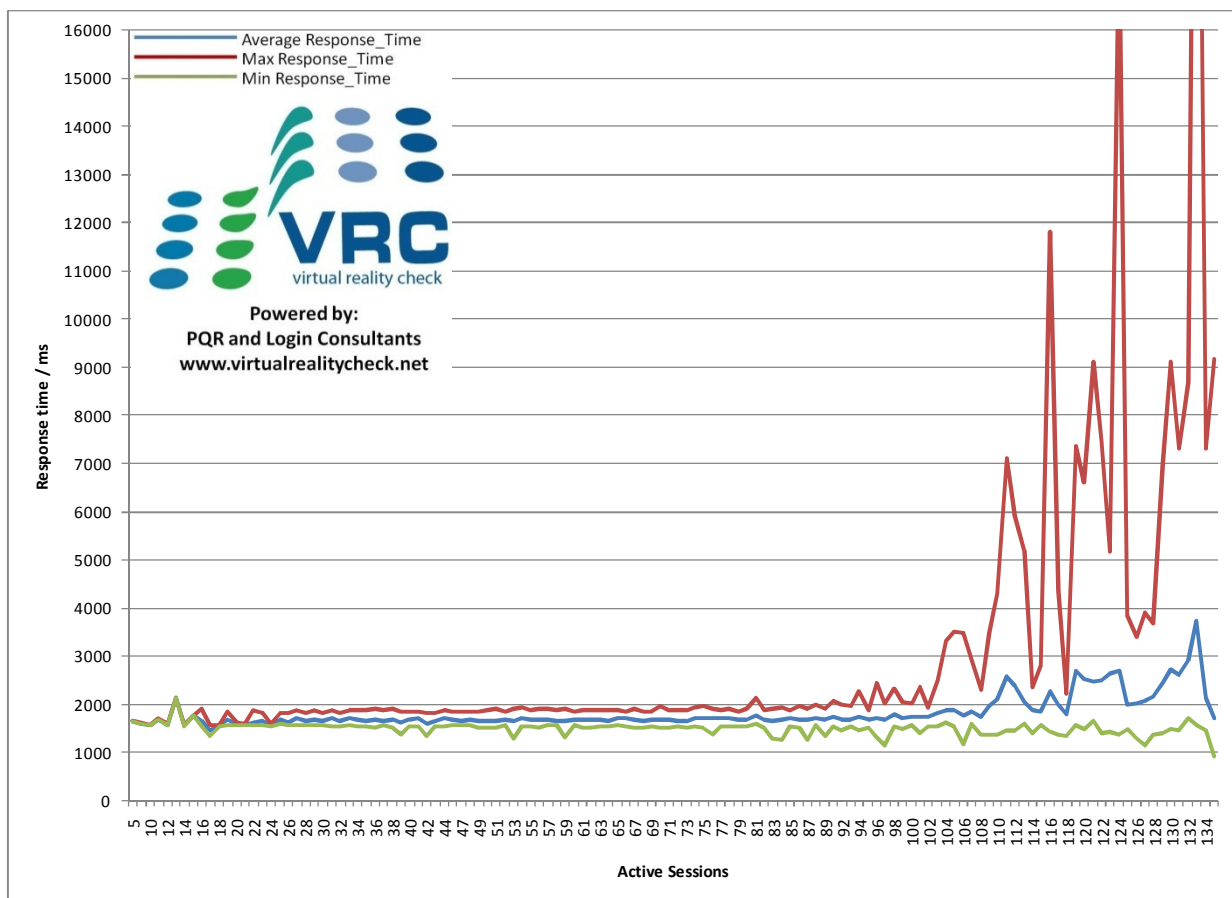
Project VRC Test ID	10
Amount of Virtual Machines	4
Amount of vCPU's	2
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 SP1
Specific Virtualization Settings	XenApp 5.0, CPU fairshare Enabled
Launching interval	30 Seconds
Launching interval per VM	120 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	97
Stuck Sessions Count before UOPIT (SSC)	20
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	87

7.9 TEST 11 - 8VM - 1vCPU - 3.5GB - 2003x86 - 1ST RUN

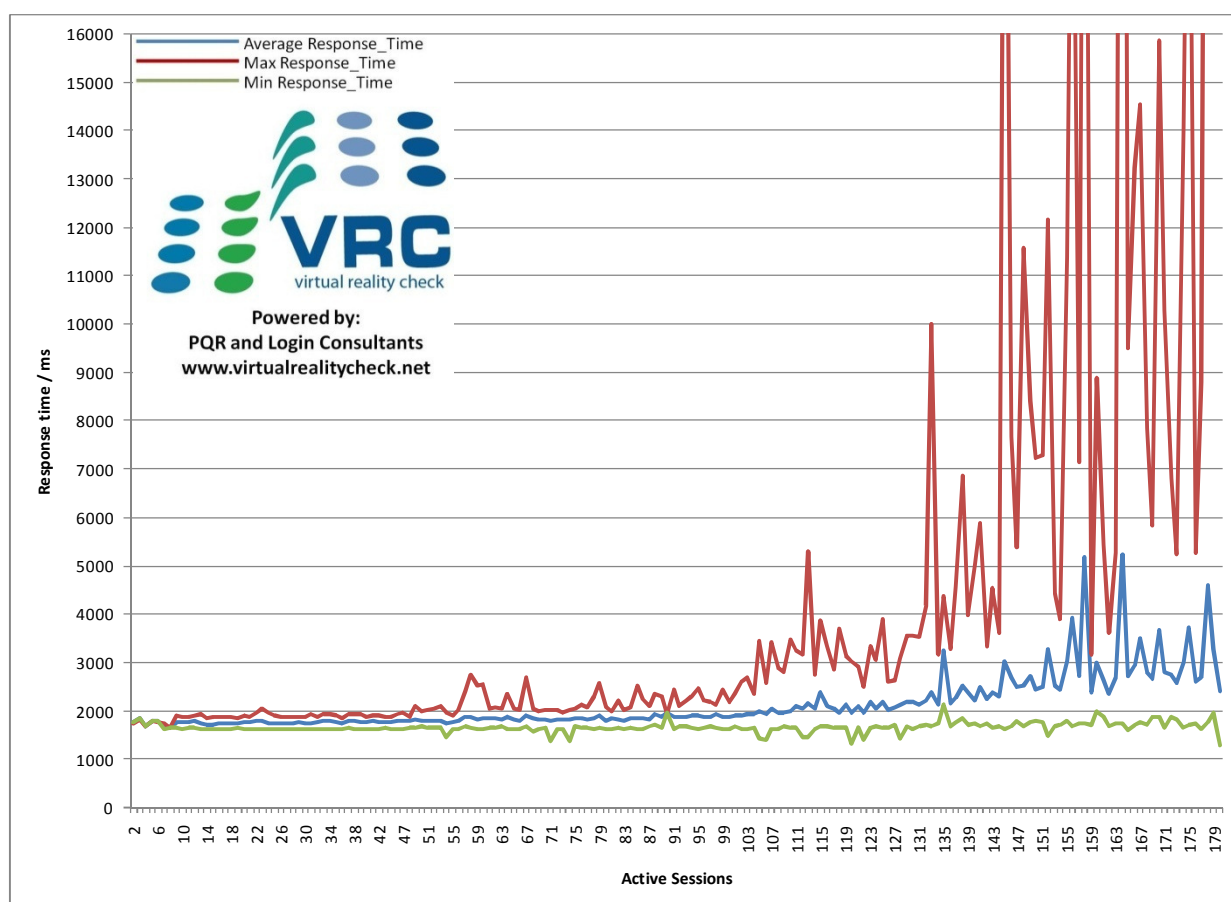
Project VRC Test ID	12
Amount of Virtual Machines	8
Amount of Cores	1
Memory available	3.5 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	No
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	135
The Last Session Which Started Logging	135
Uncorrected Optimal Performance Index (UOPI)	108
Stuck Sessions Count before UOPIT (SSC)	15
Lost Session Count before UOPIT (LSC)	2
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	98.5

7.10 TEST 12 - 8VM - 1vCPU - 3.5GB - 2003x86 - 2ND RUN

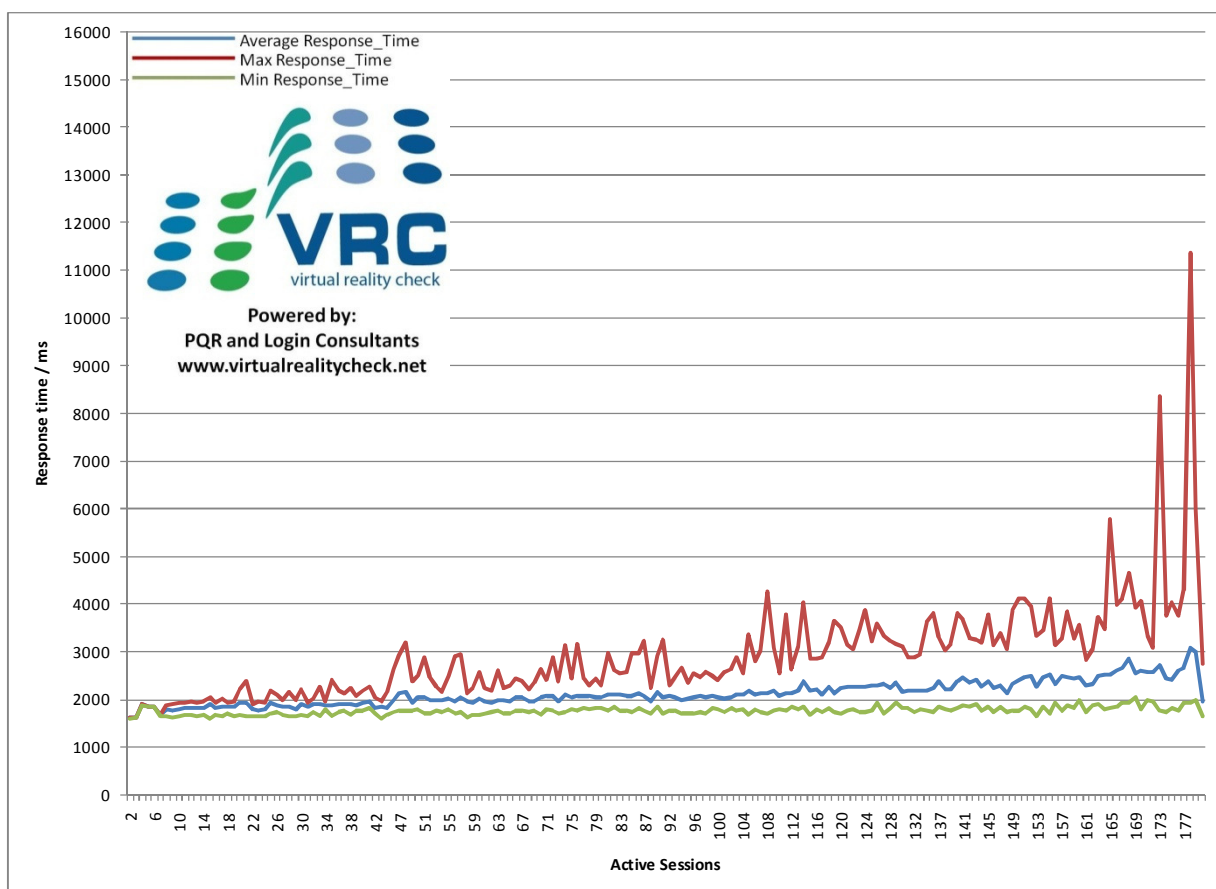
Project VRC Test ID	12
Amount of Virtual Machines	8
Amount of Cores	1
Memory available	3.5 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	No
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	180
The Last Session Which Started Logging	174
Uncorrected Optimal Performance Index (UOPI)	108
Stuck Sessions Count before UOPIT (SSC)	4
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	106

7.11 TEST 13 - 8VM - 1vCPU - 3.5GB - 2003x86 - No SP1

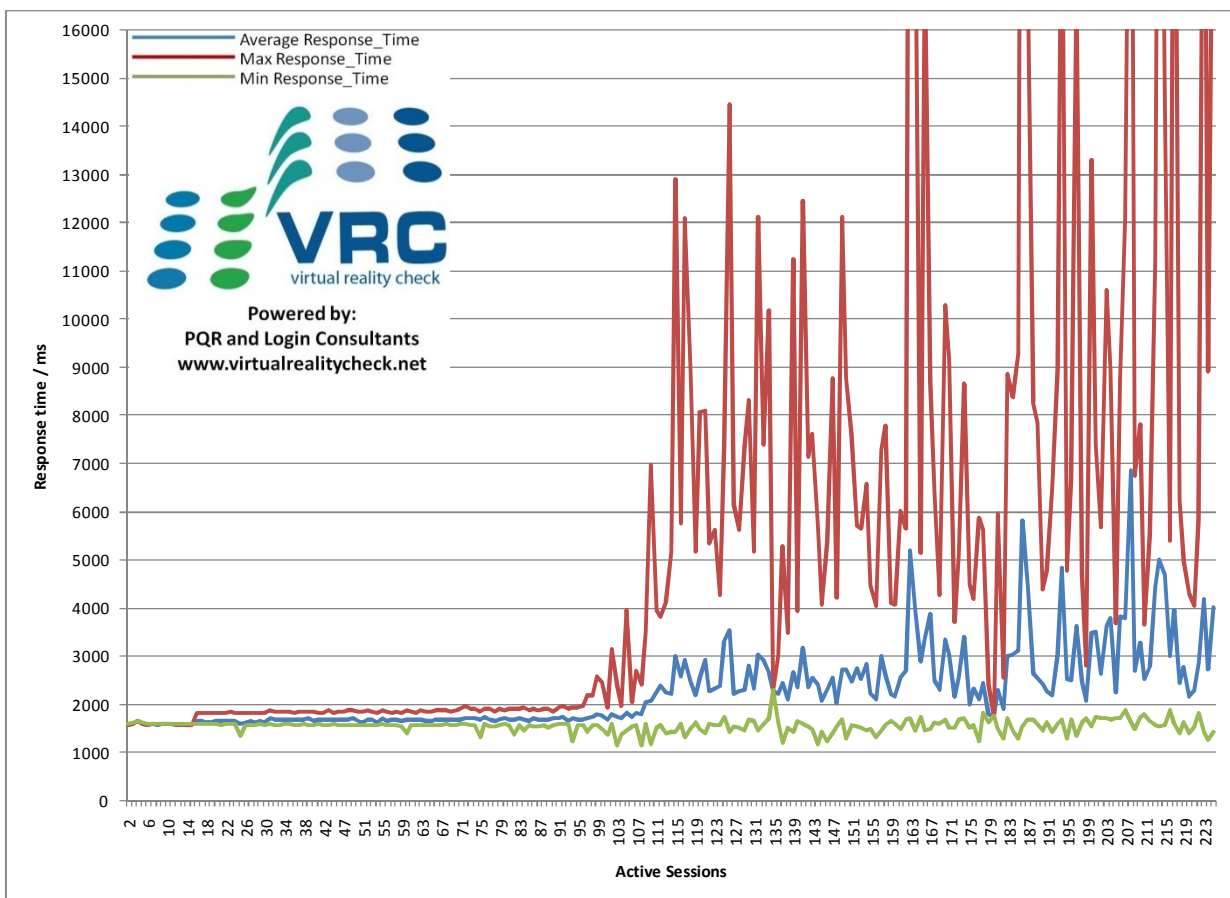
Project VRC Test ID	6
Amount of Virtual Machines	8
Amount of vCPU's	13
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 sp1 installed
Specific Virtualization Settings	
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	102
Stuck Sessions Count before UOPIT (SSC)	11
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	96.5

7.12 TEST 14 - 8VM - 2vCPU - 3.5GB - 2003x86

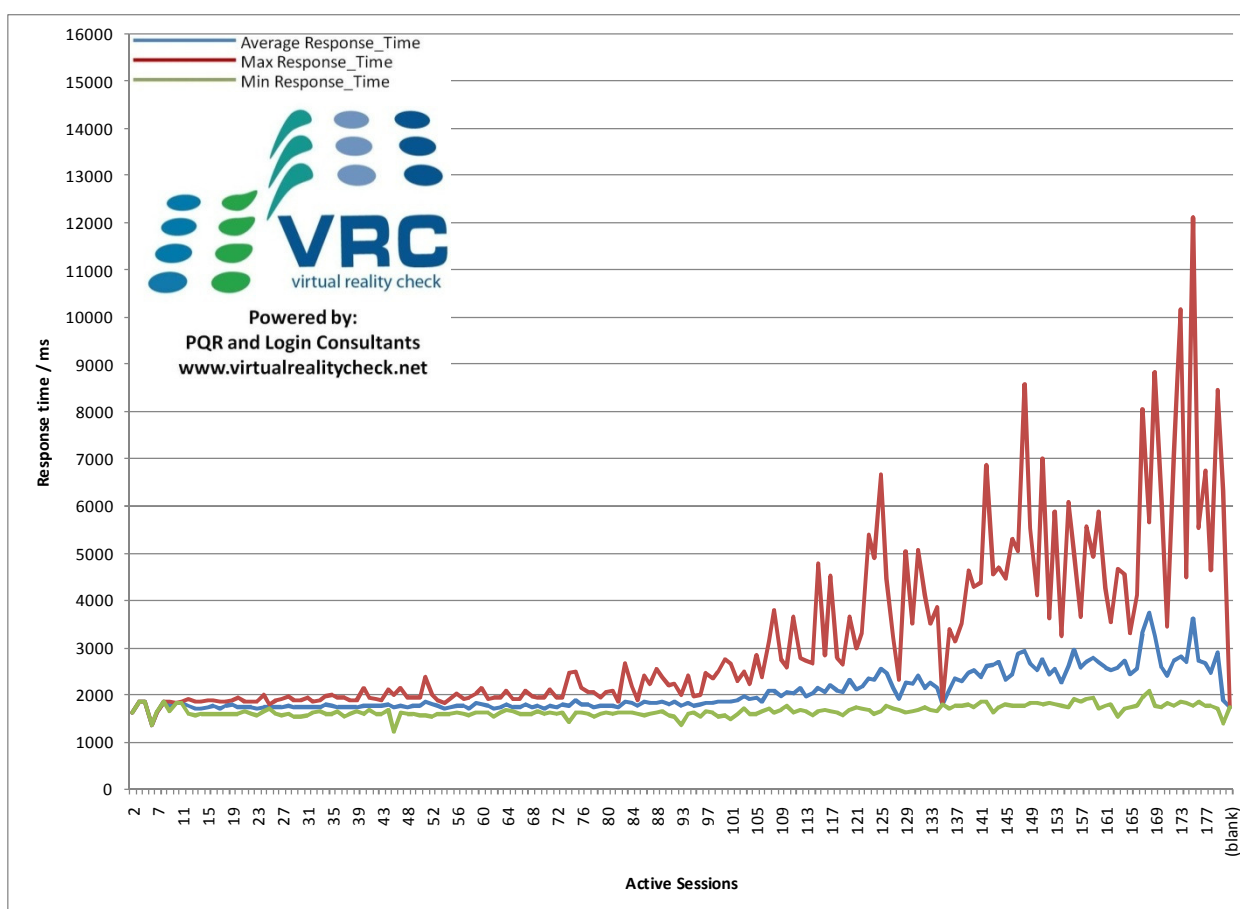
Project VRC Test ID	14
Amount of Virtual Machines	8
Amount of Cores	2
Memory available	3.5 GB
Target Operating System	Windows 2003 x86
Specific Virtualization Settings	No
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	225
Uncorrected Optimal Performance Index (UOPI)	108
Stuck Sessions Count before UOPIT (SSC)	7
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	104.5

7.13 TEST 15 - 8VM - 2vCPU - 3.5GB - 2003x86 - No SP1 – 1ST RUN

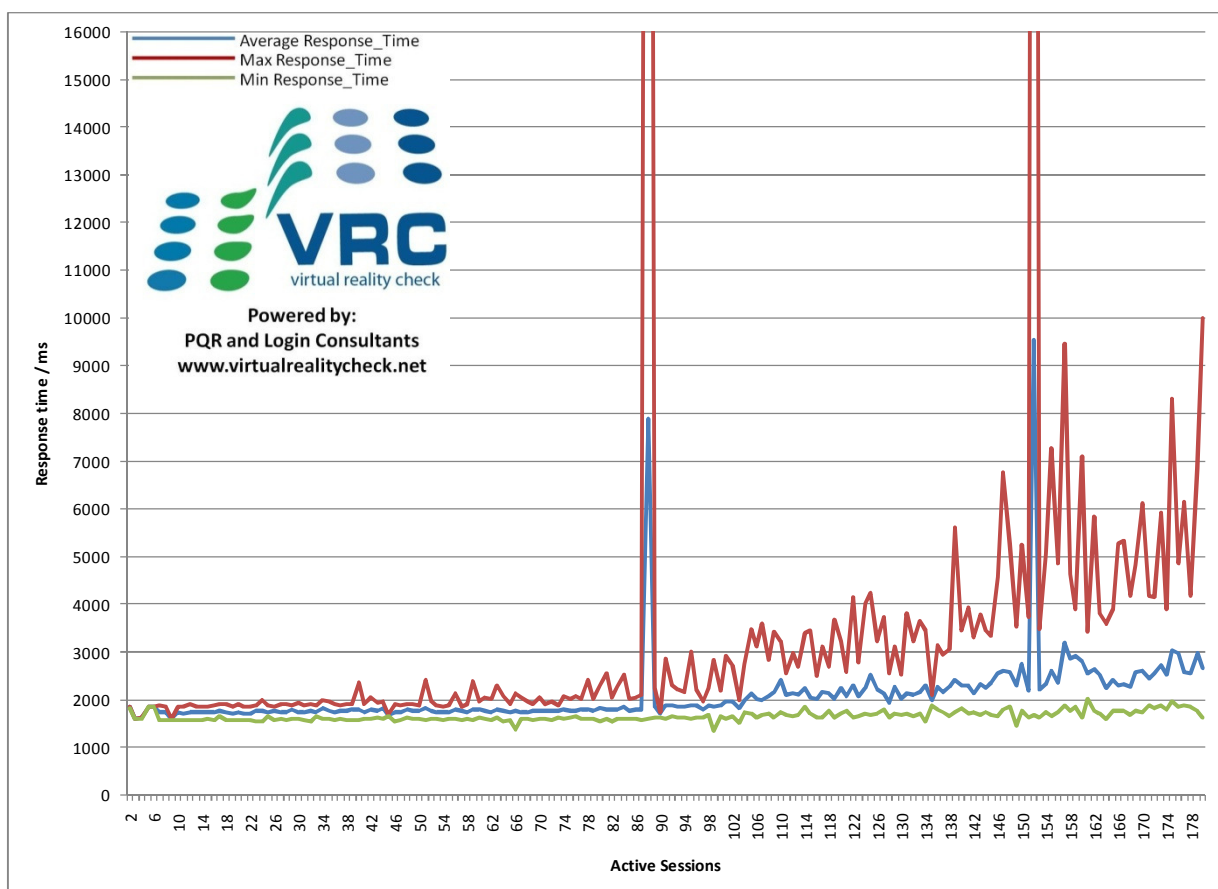
Project VRC Test ID	15
Amount of Virtual Machines	8
Amount of vCPU's	2
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 SP1
Specific Virtualization Settings	
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	117
Stuck Sessions Count before UOPIT (SSC)	17
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	109

7.14 TEST 16 - 8VM - 2vCPU - 3.5GB - 2003x86 - No SP1 – 2ND RUN

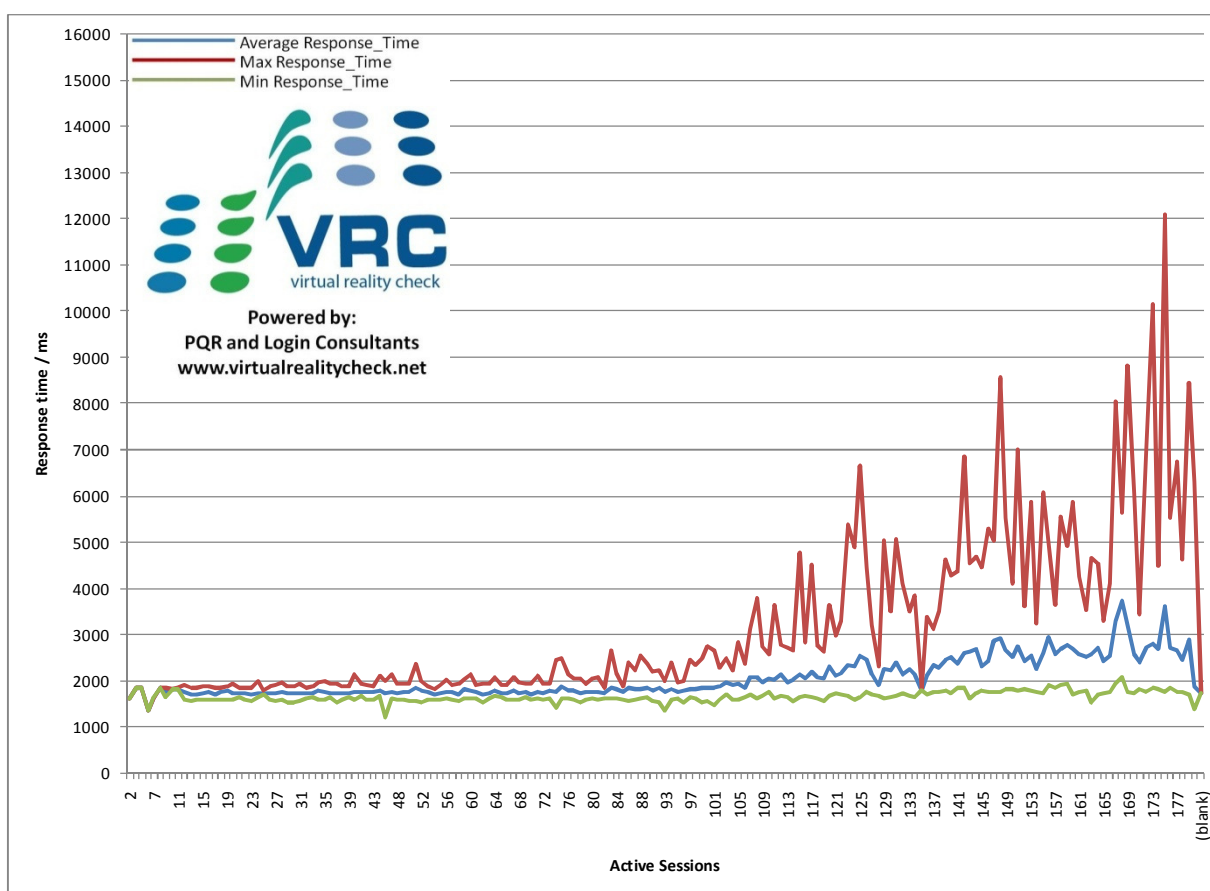
Project VRC Test ID	16
Amount of Virtual Machines	8
Amount of vCPU's	2
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 sp1 installed
Specific Virtualization Settings	
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	117
Stuck Sessions Count before UOPIT (SSC)	20
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	107

7.15 TEST 17 - 8VM - 2vCPU - 3.5GB - 2003x86 - No SP1 – 3ND RUN

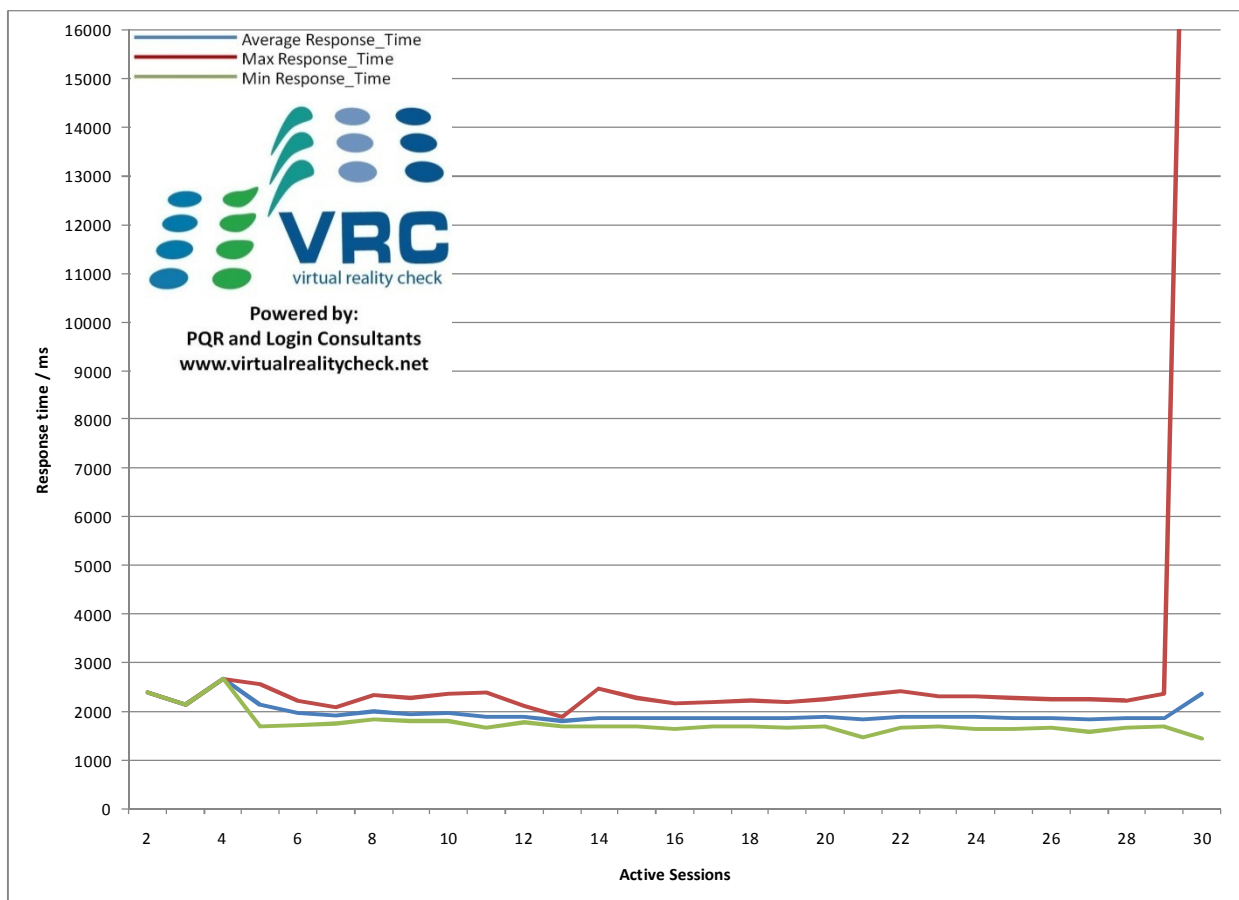
Project VRC Test ID	17
Amount of Virtual Machines	8
Amount of vCPU's	2
Memory available	4 GB mem
Target Operating System	Windows 2003 x86
Other specific configuration	No Office 2007 sp1 installed
Specific Virtualization Settings	
Launching interval	30 Seconds
Launching interval per VM	240 Seconds



Total Session Launched	180
Uncorrected Optimal Performance Index (UOPI)	117
Stuck Sessions Count before UOPIT (SSC)	17
Lost Session Count before UOPIT (LSC)	0
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	108,5

7.16 TEST 70 - 30VM - 1vCPU - 1GB - WINXPx86

Project VRC Test ID	70
Amount of Virtual Machines	30
Amount of Cores	1
Memory available	1 GB
Target Operating System	Windows XP x86
Specific Virtualization Settings	No
Other specific configuration	Office 2007 sp1 installed
Launching interval	30 Seconds
Launching interval per VM	900 Seconds



Total Session Launched	30
Uncorrected Optimal Performance Index (UOPI)	30
Stuck Sessions Count before UOPIT (SSC)	0
Lost Session Count before UOPIT (LSC)	1
Corrected Optimal Performance Index (COPI=UOPI - (SSC*50%) - LSC)	29

8. CONFIGURATION DETAILS

8.1 ACTIVE DIRECTORY GROUP POLICIES

Computer Configuration	
Policieshide	
Windows Settingshide	
Security Settingshide	
Local Policies/Security Optionshide	
User Account Controlhide	
Policy	Setting
User Account Control: Admin Approval Mode for the Built-in Administrator account	Disabled
User Account Control: Behavior of the elevation prompt for administrators in Admin Approval Mode	Elevate without prompting
User Account Control: Detect application installations and prompt for elevation	Disabled
User Account Control: Only elevate executables that are signed and validated	Disabled
User Account Control: Run all administrators in Admin Approval Mode	Disabled
User Account Control: Switch to the secure desktop when prompting for elevation	Disabled
Otherhide	
Policy	Setting
User Account Control: Allow UIAccess applications to prompt for elevation without using the secure desktop	Disabled
User Account Control: Only elevate UIAccess applications that are installed in secure locations	Disabled
Administrative Templatehide	
Policy definitions (ADMX files) retrieved from the local machine.	
System/Group Policyhide	
Policy	Setting
Allow asynchronous user Group Policy processing when logging on through Terminal Services	Disabled
User Group Policy loopback processing mode	Enabled
Mode:	Replace
System/Logonhide	
Policy	Setting
Always wait for the network at computer startup and logon	Enabled
Don't display the Getting Started welcome screen at logon	Enabled
System/Scriptshide	
Policy	Setting
Run logon scripts synchronously	Enabled
Windows Components/Internet Explorerhide	
Policy	Setting
Disable showing the splash screen	Enabled

Windows Components/Terminal Services/Terminal Server/Device and Resource	
Redirectionhide	
Policy	Setting
Allow audio redirection	Disabled
Allow time zone redirection	Disabled
Do not allow clipboard redirection	Enabled
Do not allow COM port redirection	Enabled
Do not allow drive redirection	Enabled
Do not allow LPT port redirection	Enabled
Do not allow smart card device redirection	Enabled
Windows Components/Terminal Services/Terminal Server/Licensinghide	
Policy	Setting
Set the Terminal Services licensing mode	Enabled
Specify the licensing mode for the terminal server.	Per User
Policy	Setting
Use the specified Terminal Services license servers	Enabled
License servers to use:	
Separate license server names with commas.	
Example: Server1,Server2.example.com,192.168.1.1	
Windows Components/Terminal Services/Terminal Server/Printer Redirectionhide	
Policy	Setting
Do not allow client printer redirection	Enabled
Do not set default client printer to be default printer in a session	Enabled
Windows Components/Terminal Services/Terminal Server/Temporary foldershide	
Policy	Setting
Do not delete temp folder upon exit	Disabled
Do not use temporary folders per session	Enabled
User Configuration (Enabled)hide	
Policieshide	
Windows Settingshide	
Scriptshide	
Logonhide	
Name	Parameters
%programfiles%\Login Consultants\Login_VSI\logon.cmd	
Administrative Templateshide	
Policy definitions (ADMX files) retrieved from the local machine.	
Control Panel/Displayhide	
Policy	Setting
Screen Saver	Disabled
Microsoft Office Outlook 2007/Tools Options.../Other/AutoArchivehide	

Policy	Setting
AutoArchive Settings	Enabled
Turn on AutoArchive	Disabled
Run AutoArchive every <x> days	14
Prompt before AutoArchive runs	Disabled
During AutoArchive:	
Delete expired items (e-mail folders only)	Disabled
Archive or delete old items	Disabled
Show archive folder in folder list	Disabled
Clean out items older than	6
	Months
Permanently delete old items	Disabled
Policy	Setting
Disable File Archive	Enabled
Systemhide	
Policy	Setting
Windows Automatic Updates	Disabled
System/Scriptshide	
Policy	Setting
Run legacy logon scripts hidden	Disabled
Run logon scripts synchronously	Enabled
Run logon scripts visible	Enabled
Windows Components/AutoPlay Policieshide	
Policy	Setting
Turn off Autoplay	Enabled
Turn off Autoplay on:	All drives
Windows Components/Internet Explorerhide	
Policy	Setting
Disable changing home page settings	Enabled
Home Page	
Policy	Setting
Disable Internet Connection wizard	Enabled
Windows Components/Internet Explorer/Administrator Approved Controlshide	
Policy	Setting
Shockwave Flash	Enabled
Shockwave Flash	Enabled
Windows Components/Internet Explorer/Internet Control Panel/Advanced Pagehide	
Policy	Setting

Allow active content from CDs to run on user machines	Enabled
Allow Install On Demand (Internet Explorer)	Enabled
Allow software to run or install even if the signature is invalid	Enabled
Allow third-party browser extensions	Enabled
Play animations in web pages	Enabled
Play sounds in web pages	Enabled
Play videos in web pages	Enabled
Windows Components/Internet Explorer/Internet Control Panel/Security Page/Local Machine Zonehide	
Policy	Setting
Allow Scriptlets	Enabled
Scriptlets	Enable
Windows Components/Internet Explorer/Internet Control Panel/Security Page/Locked-Down Intranet Zonehide	
Policy	Setting
Allow Scriptlets	Enabled
Scriptlets	Enable
Policy	Setting
Display mixed content	Enabled
Display mixed content	Enable
Policy	Setting
Download signed ActiveX controls	Enabled
Download signed ActiveX controls	Enable
Policy	Setting
Download unsigned ActiveX controls	Enabled
Download unsigned ActiveX controls	Enable
Policy	Setting
Initialize and script ActiveX controls not marked as safe	Enabled
Initialize and script ActiveX controls not marked as safe	Enable
Policy	Setting
Run ActiveX controls and plugins	Enabled
Run ActiveX controls and plugins	Enable
Policy	Setting
Script ActiveX controls marked safe for scripting	Enabled
Script ActiveX controls marked safe for scripting	Enable
Windows Components/Internet Explorer/Internet Control Panel/Security Page/Locked-Down Local Machine Zonehide	
Policy	Setting
Allow Scriptlets	Enabled
Scriptlets	Enable
Windows Components/Internet Explorer/Security Features/Information Barhide	

Policy	Setting
Internet Explorer Processes	Disabled
Windows Components/Internet Explorer/Security Features/Local Machine Zone Lockdown	
Securityhide	
Policy	Setting
Internet Explorer Processes	Disabled
Windows Components/Internet Explorer/Security Features/Restrict ActiveX Installhide	
Policy	Setting
Internet Explorer Processes	Disabled
Windows Components/Windows PowerShellhide	
Policy	Setting
Turn on Script Execution	Enabled
Execution Policy	Allow all scripts

8.2 USER LOGON SCRIPT

The following settings are configured within the login script. The majority of settings are focused on a seamless and uninterrupted operation of the AutoIT script which emulates the load of users.

```
@ECHO OFF
REG ADD HKCU\Software\Microsoft\Windows\CurrentVersion\Run /v Locallogon /t REG_SZ /d
"%programfiles%\Login Consultants\Login_VSI\locallogon.cmd" /f
REG DELETE "HKCU\Software\Microsoft\Internet Explorer\Main" /v "First Home Page" /F
DEL /F /Q "%temp%\VSI\LOG\VSI_LOG.VSI"

IF NOT EXIST "%systemroot%\SysWOW64\" (
regedit /s "%programfiles%\Login
Consultants\Login_VSI\Files\Scripts\Exe\AdvancedExplorer.reg"
)
IF EXIST "%systemroot%\SysWOW64\" (
%systemroot%\SysWOW64\regedit.exe /s "%programfiles%\Login
Consultants\Login_VSI\Files\Scripts\Exe\AdvancedExplorer.reg"
)

IF EXIST "%temp%\VSI\" (
RD /S /Q "%temp%\VSI"
)

MKDIR %temp%\VSI
MKDIR %temp%\VSI\log
md %temp%\VSI\Userhome

XCOPY "%programfiles%\Login Consultants\Login_VSI\UserHome" %temp%\VSI\Userhome\ /Y /E
/Q
XCOPY "%programfiles%\Login Consultants\Login_VSI\Files" %temp%\VSI\Files\ /Y /E /Q

subst H: %temp%\VSI\Userhome
subst B: %temp%\VSI\Files
subst G: "%programfiles%\Login Consultants\Login_VSI\GroupHome"

REG ADD "HKCU\Software\Microsoft\Internet Explorer\PhishingFilter" /v Enabled /t
REG_DWORD /d 1 /f
REG ADD "HKCU\Software\Microsoft\Internet Explorer\PhishingFilter" /v ShownVerifyBalloon
/t REG_DWORD /d 1 /f

REG ADD HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\Advanced /v HideFileExt
/t REG_DWORD /d 0 /f

::REG ADD HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\Advanced /v
StartMenuInit /t REG_DWORD /d 2 /f
IF NOT EXIST "%systemroot%\SysWOW64\" (
IF EXIST "%programfiles%\Microsoft Office\OFFICE12\" (
regedit /s B:\UserSettings\outlook12.reg
PUSHD %APPDATA%\Microsoft\Word
```

```

DEL *.asd
CD %APPDATA%\Microsoft\Excel
DEL *.asd
CD %APPDATA%\Microsoft\Powerpoint
DEL *.asd
CD %APPDATA%\Microsoft\Outlook
DEL *.asd
REG DELETE HKCU\Software\Microsoft\Office\12.0\Excel\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\12.0\Powerpoint\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\12.0\Word\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\12.0\Outlook\Resiliency /f
POPD
)
IF EXIST "%programfiles%\Microsoft Office\OFFICE11\" (
regedit /s B:\UserSettings\Outlook11.reg
echo outlook11.reg
PUSHD %APPDATA%\Microsoft\Word
DEL *.asd
CD %APPDATA%\Microsoft\Excel
DEL *.asd
CD %APPDATA%\Microsoft\Powerpoint
DEL *.asd
CD %APPDATA%\Microsoft\Outlook
DEL *.asd
REG DELETE HKCU\Software\Microsoft\Office\11.0\Excel\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\11.0\Powerpoint\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\11.0\Word\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\11.0\Outlook\Resiliency /f
POPD
)
)
IF EXIST "%systemroot%\syswow64\" (
IF EXIST "%programfiles(x86)%\Microsoft Office\OFFICE12\" (
%systemroot%\syswow64\regedit.exe /s B:\UserSettings\outlook12.reg
PUSHD %APPDATA%\Microsoft\Word
DEL *.asd
CD %APPDATA%\Microsoft\Excel
DEL *.asd
CD %APPDATA%\Microsoft\Powerpoint
DEL *.asd
CD %APPDATA%\Microsoft\Outlook
DEL *.asd
REG DELETE HKCU\Software\Microsoft\Office\12.0\Excel\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\12.0\Powerpoint\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\12.0\Word\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\12.0\Outlook\Resiliency /f
POPD
)
IF EXIST "%programfiles(x86)%\Microsoft Office\OFFICE11\" (
%systemroot%\syswow64\regedit.exe /s B:\UserSettings\Outlook11.reg
echo outlook11.reg
PUSHD %APPDATA%\Microsoft\Word
DEL *.asd
CD %APPDATA%\Microsoft\Excel
DEL *.asd
CD %APPDATA%\Microsoft\Powerpoint
DEL *.asd
CD %APPDATA%\Microsoft\Outlook
DEL *.asd
REG DELETE HKCU\Software\Microsoft\Office\11.0\Excel\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\11.0\Powerpoint\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\11.0\Word\Resiliency /f
REG DELETE HKCU\Software\Microsoft\Office\11.0\Outlook\Resiliency /f
POPD
)
)
)

```

8.3 GENERAL SETTINGS

These general registry settings are configured for each test user
(Lib\Files\Scripts\Exe\AdvancedExplorer.reg).

```
[HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\CabinetState]
"FullPath"=dword:00000001
"FullPathAddress"=dword:00000001

[HKEY_CURRENT_USER\Software\Microsoft\Internet
Explorer\Main\FeatureControl\FEATURE_LOCALMACHINE_LOCKDOWN]
"iexplore.exe"=dword:00000000

[HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\User Shell
Folders]
"Personal"="H:\\"
"My Pictures"="H:\My Pictures"
"My Music"="H:\My Music"

[HKEY_CURRENT_USER\Software\Microsoft\Internet Explorer\Main]
"RunOnceComplete"=dword:00000001
"RunOnceHasShown"=dword:00000001
"Start Page"="file:///g:\dummy\IE\loginconsultants.com\index.htm"

[HKEY_CURRENT_USER\Software\100dof\kidkeylock\Setup]
"lock_mouse_left"="1"
"lock_mouse_middle"="1"
"lock_mouse_right"="1"
"lock_mouse_double"="1"
"lock_mouse_wheel"="1"
"lock_keyboard"="0"
"password_setup"="vsisetaup"
"password_quit"="vsiquit"

[HKEY_CURRENT_USER\Software\CUSTPDF Writer]
"ViewPDF"="1"

[HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\Advanced]
"StartMenuInit"=dword:00000002
"ServerAdminUI"=dword:00000000
"Hidden"=dword:00000002
"ShowCompColor"=dword:00000001
"HideFileExt"=dword:00000000
"DontPrettyPath"=dword:00000000
"ShowInfoTip"=dword:00000001
"HideIcons"=dword:00000000
"MapNetDrvBtn"=dword:00000000
"Webview"=dword:00000001
"Filter"=dword:00000000
"SuperHidden"=dword:00000000
"SeparateProcess"=dword:00000000
"StartButtonBalloonTip"=dword:00000002

[HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Runonce]
"Locallogon"=""
```


8.4 MICROSOFT OFFICE 2007 SETTINGS

These registry settings are configured for Office 2007:

```
[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Setup]
"importPRF"="b:\\UserSettings\\outlook.prf"
"MigratePrefs"=dword:00000001
"SetBalloonOn"=dword:0001E666
"ImportSRS"=dword:0001E666
"First-Run"=hex(3):8B,5A,2D,66,55,45,87,4A,A4,72,F0,39,F0,25,46,48
"CreateWelcome"=dword:0001c398

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Common]
"UserData"=dword:00000001

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Common\General]
"FirstRun"=dword:00000000
"Authorized"=dword:7FFFFFFF
"ShownOptIn"=dword:00000001

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Common\UserInfo]
"UserName"--
"UserInitials"--
"Company"--
"UserName"="logbench"
"UserInitials"="user"
"Company"=""

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook]
"FirstRunDialog"="False"

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Addins]
"SearchToolbarsDisabled"=dword:00000001

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Options\General]
"PONT_STRING"="60,"
"AutoSyncDisable"=dword:00000001

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Options\RSS]
"SyncToSysCFL"=dword:00000000

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Preferences]
"SyncDlgPos"=hex(3):2C,00,00,00,00,00,00,00,01,00,00,00,FF,FF,FF,FF,FF,FF,FF,FF,\
FF,FF,FF,FF,FF,FF,FF,FF,00,00,00,00,00,00,00,00,81,02,00,00,44,01,00,00

;Set default save format to .xls

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Excel\Options]
"DefaultFormat"=dword:00000038

;Set default save format to .doc
[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Word\Options]
"DefaultFormat"=".doc"

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Setup]

[HKEY_CURRENT_USER\Software\Microsoft\Exchange\Forms Registry]
"CacheSyncCount"=dword:0000008E

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook]
"MTTF"=dword:0000003A
"MTTA"=dword:0000003A
"MTT"=-

[HKEY_CURRENT_USER\Software\Microsoft\Office\12.0\Outlook\Options\Mail]
"Send Mail Immediately"=dword:00000000

[HKEY_CURRENT_USER\SOFTWARE\Microsoft\Office\12.0\Common\General]
"OfficeMenuDiscovered"=dword:00000001
```

8.5

VSI INSTALLATION SCRIPT

```

set installroot=%~dp0
set CentralLogServer=%1
set CentralLogShare=%2

::mkdir "%programfiles%\Login_Consultants\Login_VSI\GroupHome"
XCOPY "%installroot%GroupHome" "%programfiles%\Login_Consultants\Login_VSI\GroupHome" \
/Y /E /Q
XCOPY "%installroot%UserHome" "%programfiles%\Login_Consultants\Login_VSI\UserHome" \
/E /Q
XCOPY "%installroot%Files" "%programfiles%\Login_Consultants\Login_VSI\Files" \ /Y /E /Q
COPY "%installroot%locallogon.cmd" "%programfiles%\Login_Consultants\Login_VSI" /Y
COPY "%installroot%logon.cmd" "%programfiles%\Login_Consultants\Login_VSI" /Y

ECHO [Global]> "%programfiles%\Login_Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO CentralLogServer = %centrallogserver%>> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO CentralLogShare = %centrallogshare%>> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO LogLevel = 1 >> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO AutoLogoff = 1 >> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO RunsPerUser = 999>> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO RequireBaseline = 0>> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO. >> "%programfiles%\Login_Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO [User]>> "%programfiles%\Login_Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO SendKeyDelay = 150>> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"
ECHO BlockInput = 0 >> "%programfiles%\Login
Consultants\Login_VSI\Files\UserSettings\VSI.ini"

IF EXIST "%SYSTEMROOT%\SYSTEM32\CHANGE.EXE" CHANGE USER /INSTALL
START /WAIT MSIEXEC /I "%installroot%\Acrobat\AcroRead.msi" ALLUSERS=TRUE
EULA_ACCEPT=YES SUPPRESS_APP_LAUNCH=YES TRANSFORMS="%installroot%\Acrobat\AcroRead.mst"
/QB-
IF EXIST %SYSTEMROOT%\SYSTEM32\CHANGE.EXE CHANGE USER /EXECUTE

REG ADD "HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\FileSystem" /v
NtfsDisableLastAccessUpdate /t REG_DWORD /d 0x00000001 /f

REG ADD "HKLM\Software\Adobe\Acrobat Reader\8.0\Adobeviewer" /v EULA /d 0x00000001 /t
REG_DWORD /f
REG ADD "HKLM\Software\Adobe\Acrobat Reader\8.0\Adobeviewer" /v Launched /d 0x00000001
/t REG_DWORD /f
REG ADD "HKLM\Software\Adobe\Acrobat Reader\8.0\Downtown" /v bDontShowAtLaunch /d
0x00000001 /t REG_DWORD /f
REG ADD "HKLM\Software\Adobe\Acrobat Reader\8.0\Downtown" /v bGoOnline /d 0x00000000 /t
REG_DWORD /f
REG ADD "HKLM\SOFTWARE\Policies\Adobe\Acrobat Reader\8.0\FeatureLockdown" /v
bPurchaseAcro /d 0x00000000 /t REG_DWORD /f
REG ADD "HKLM\SOFTWARE\Policies\Adobe\Acrobat Reader\8.0\FeatureLockdown" /v
bShowEbookMenu /d 0x00000000 /t REG_DWORD /f
REG ADD "HKLM\SOFTWARE\Policies\Adobe\Acrobat Reader\8.0\FeatureLockdown" /v bUpdater
/d 0x00000000 /t REG_DWORD /f
REG ADD "HKLM\SOFTWARE\Policies\Adobe\Acrobat
Reader\8.0\FeatureLockdown\HostedServices\cMeeting" /v bShowMeets /d 0x00000000 /t
REG_DWORD /f
REG ADD "HKLM\SOFTWARE\Policies\Adobe\Acrobat
Reader\8.0\FeatureLockdown\HostedServices\cProtectPDF" /v bShowMeets /d 0x00000000 /t
REG_DWORD /f

IF EXIST "%ALLUSERSPROFILE%\Desktop\Adobe Reader 8.LNK" DEL
"%ALLUSERSPROFILE%\Desktop\Adobe Reader 8.LNK"
IF EXIST "%ALLUSERSPROFILE%\Start Menu\Programs\Startup\Adobe Reader Speed Launch.LNK"
DEL "%ALLUSERSPROFILE%\Start Menu\Programs\Startup\Adobe Reader Speed Launch.LNK"
IF EXIST "%ALLUSERSPROFILE%\Start Menu\Programs\Startup\Adobe Reader Synchronizer.LNK"
DEL "%ALLUSERSPROFILE%\Start Menu\Programs\Startup\Adobe Reader Synchronizer.LNK"

START /WAIT msixec /i "%installroot%\Flash\install_flash_player_active_x.msi" /qn

START /WAIT msixec /i "%installroot%\Flash\sw_lic_full_installer.msi" /qn
call "%installroot%\FreePDF\Setup.exe" /SILENT
call "%installroot%\Kl\KlSetup.exe" /VERYSILENT /NOREBOOT

```

```
net localgroup "Remote Desktop Users" "Login_VSI_TS" /add

:: Page File Configuration
SET DRIVELETTER=%systemdrive%
SET INTERNALMEMORY=

FOR /F %%I IN ('CSCRIPT /NOLOGO Lib\Lib\MEMORY.VBS') DO SET INTERNALMEMORY=%%I

IF %INTERNALMEMORY% LSS 512 SET INTERNALMEMORY=512
MD %driveletter%\Page1
MD %driveletter%\Page2
REG ADD "HKLM\SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management" /v
PagingFiles /t REG_MULTI_SZ /d "%systemdrive%\pagefile.sys %INTERNALMEMORY%
%INTERNALMEMORY%\0%driveletter%\page1\pagefile.sys %INTERNALMEMORY%
%INTERNALMEMORY%\0%driveletter%\page2\pagefile.sys %INTERNALMEMORY% %INTERNALMEMORY%"
/F

CALL "%installroot%\Lib\AD_GETDN.cmd" Login_VSI

FOR /F "tokens=*" %%i in ('"%installroot%\lib\dsquery.exe" computer -name
%computername%') DO SET COMPDN=%%i

CALL "%installroot%\Lib\dsmove.exe" %COMPDN% -newparent %FULL_OUPATH%

REG DELETE "HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Internet Explorer\Toolbar" /v
{31CF9EBE-5755-4A1D-AC25-2834D952D9B4} /f
REG DELETE "HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run" /v
GrooveMonitor /f
REG DELETE "HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run" /v "Adobe
Reader Speed Launcher" /f
REG ADD "HKEY_USERS\DEFAULT\Control Panel\Desktop" /v ScreenSaveActive /t REG_SZ /d 0
/f

SET WINAUDITSRC=\\%CentralLogServer%\%CentralLogShare%\Reports
IF NOT EXIST "%WINAUDITSRC%" MD "%WINAUDITSRC%"

IF NOT EXIST "%WINAUDITSRC%\winAudit.exe" COPY "%installroot%\winAudit\winaudit.exe"
"%WINAUDITSRC%" /y
IF NOT EXIST "%WINAUDITSRC%\winAudit.cmd" COPY "%installroot%\winAudit\winaudit.cmd"
"%WINAUDITSRC%" /y

CALL "%WINAUDITSRC%\winAudit.cmd"
```



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