Streamlining Software Testing with the IBM Rational® and VMware™ Test Lab Automation Solution

Executive Summary
Software test teams that have deployed Rational TestManager to improve productivity are still challenged by the difficulty and expense of testing in multiple system configurations. Testing on all necessary combinations of hardware, operating systems and installed software normally requires labor-intensive setups on many dedicated test machines. The only alternative has been a large investment in banks of test machines. VMware virtual machines vastly simplify configuration management and eliminate the need for a physical machine for each configuration to be tested. VMware virtual machines contain a complete test configuration – hardware platform, operating system and installed software – in a file that can run on any Intel-based computer with VMware software installed.

IBM Rational and VMware have jointly developed the IBM Rational and VMware Test Lab Automation Solution to address the challenges of configuration testing. The solution combines the testing productivity benefits of Rational TestManager with the configuration management efficiencies of VMware GSX Server to multiply the capacity of software test teams. The solution tightly links the two products, letting Rational TestManager call GSX Server to automatically start a virtual machine in which a test is executed and report the results of the test back to Rational TestManager.

Why configuration testing is so important
Releasing a software product without testing on all the configurations customers are likely to use is a risk that software development and testing teams expose themselves to because of the difficulties and expenses of configuration testing. Yet, proper configuration testing will uncover the bugs that are the most costly to fix.

Thorough configuration testing will find the bugs that might otherwise only be encountered on the wide variety of hardware and software that exists in the field. Those are the bugs – triggered by certain combinations of software, hardware and networking configurations – that are toughest for a test team working with a limited set of machine environments to replicate. Also, once those configuration-dependent bugs are tracked down, it’s hard for the development and test team to get hold of a matching machine for debugging and testing.

Challenges facing software test teams
Configuration testing is a difficult problem, due to the combinatorial complexity of setting up many computers with different production-realistic installations. It takes lots of hardware. It takes lots of time. The space of interesting configurations in which the tested application runs includes hardware differences (e.g., amount of memory, network speed, graphics display resolution) as well as software differences (e.g., OS version, service packs, and shared libraries.) Setting up images of operating systems and dependent software requires dedicated lab staff and tools. The build process is time consuming and difficult to manage.

In particular, configuring distributed systems for testing amplifies the problem. The number of variables for clients, servers and network configurations make the job of reliably maintaining an inventory of test configurations for the lab a huge management and technical task.

Test automation is only part of the solution
The productivity benefits provided by Rational TestManager begin when test clients are configured and ready for testing. TestManager handles the tasks of test planning, management, automated execution, evaluation and reporting. However, as long as manual methods or slow machine imaging tools are used to prepare multiple test client configurations, a test team will spend most of its time setting up for tests or else a major investment in banks of test hardware must be made.

For true effectiveness and efficiency, a software test team needs to pair the test automation features of TestManager with a method for handling multiple test configurations.

Virtual machines are ideal for managing multiple configurations
VMware virtual machine software completes the solution for software test teams, letting them use virtualized test environments. With VMware software, multiple operating systems and software applications can run concurrently in virtual machines on a single Intel-based computer. Since VMware software allows multiple hardware configurations and operating systems to co-exist and be easily updated, test teams can work effectively in multiple machine environments.
Using VMware software, test teams can:

- Run multiple operating systems concurrently on the same computer, including multiple versions of Microsoft® Windows®, Linux, and DOS.
- Maintain a library of test configurations stored in virtual disk container files on a server or storage network.
- Create suspended virtual machine instances that can be restarted from a checkpointed state at any time.
- Use the virtual machine networking features to build complex test networks on a single box.

**Create Virtual Test Banks to Reduce Hardware and Environmental Costs**

VMware software ends the drudgery of searching for the right tool and installing-uninstalling-reinstalling new environments. With VMware software, test teams can create virtual test banks without needing to buy, install, or configure additional hardware. As shown in Figure 2, test teams can create an easily accessible library of test clients with pre-installed operating systems, applications and Test Agents from the Rational Suite family. Since operating systems and associated applications can be stored as a file, all development and testing configurations can be stored as virtual machines on a centralized server. Entire rooms full of test computers are no longer necessary. Resources required to maintain, configure, and manage those computers can be redeployed to testing tasks rather than system administration.

VMware customers who have built centralized virtual test banks report:

- An immediate reduction of 40 to 80 percent in testing hardware.
- A 50 percent reduction in the amount of space, power, and IT support required to maintain test labs.
- An increase – often upwards of 80 percent – in testing productivity.

VMware customers cite improvements in the quality and efficiency of their application deployment processes. Test teams, in particular, attest that VMware software streamlines processes by allowing them to:

- Share a reusable library of hundreds of test environments that can be accessed and run on any computer.
- Always have the required test environment available in a clean state.
- Restart tests with a clean state instantly.
- No longer be constrained by hardware.
- Create multi-machine environments for testing complex applications on a virtual network, such as clustering, VPN and firewalls, and domain servers.
- Create more realistic tests to improve testing quality.
- Spend less time configuring test environments and more time testing.

With VMware software, creating a new virtual machine for additional configurations is quick, easy, and inexpensive. Additional hardware is no longer required to test a new OS environment, which allows test teams to spend time testing rather than procuring and setting up hardware.
Create Virtual Test Environments to Increase Productivity

Because the complete configuration of a virtual machine – its operating system and applications included – is encapsulated and contained in a single file, these disk files can be copied and moved around. With VMware software, test teams no longer need to create a whole new system for a new series of tests. Instead, they can just pull up the virtual machine that matches their test needs and run it again and again with no additional hardware. Test configurations can be stored centrally and used by testers around the globe.

Running test configurations in virtual machines reduces test cycle time and eliminates delays caused by software failures or corruption in test systems. With VMware server software, each virtual machine is completely isolated and can be quickly restarted if the software under test fails. The VMware undoable disk and repeatable resume features let any changes from a test run be discarded and the test client can immediately be returned to a known good state without the need for a reboot or software reinstallations.

Virtual test environments are flexible, enabling test teams to simulate complex environments with less hardware and less setup time. This flexibility leads to better testing, ensuring smooth and timely rollouts of new applications, with fewer bugs and fewer maintenance issues.

The IBM Rational and VMware Test Lab Automation Solution – the solution test teams have been looking for

Rational and VMware have jointly developed a complete test automation solution that brings together the software testing management benefits of the Rational Test Suite family and the virtualization technology of VMware GSX Server. The IBM Rational and VMware Test Lab Automation Solution provides Rational TestManager with the ability to automatically select from an array of test configurations with installed Rational Test Agents contained in VMware GSX Server virtual machines and control their execution state. Now, for the first time, test teams can automate software testing across a large number of configurations with the test clients running in VMware virtual machines and TestManager V2003 supervising the entire process.

VMware GSX Server – virtualization technology designed for software test operations

VMware GSX Server is enterprise-class virtual machine software for business-critical environments. In its third generation, VMware GSX Server is the most flexible and easily deployed server virtualization product on the market. VMware GSX Server simplifies computing infrastructure by partitioning and isolating servers in secure and transportable virtual machines. VMware GSX Server allows these virtual machine servers to be remotely managed, automatically provisioned, and standardized on a secure, uniform platform. VMware GSX Server has these features critical for hosting test clients:

- GSX Server installs on Windows or Linux hosts for maximum flexibility.
- The Windows or Linux host operating system provides GSX Server and its virtual machines with support for any connected devices – disk storage, networks, SCSI, USB, serial, parallel, etc.
- GSX Server supports the broadest array of Microsoft, Linux and Novell operating systems in its virtual machines.
- GSX Server virtual machines are hardware-independent so they can run without changes on different host servers.
- GSX Server virtual machines can run headless with no need for a connected console that requires resources and can reduce reliability.
- Multiple virtual machines can be powered on and executing tests concurrently.
- Testers can manage and monitor GSX Server virtual machines remotely over any network connection using its web-based management interface and remote console tool.
- The GSX Server Scripting API supports remote programmatic control of virtual machines.
Key Features of the IBM Rational and VMware Test Lab Automation Solution

IBM Rational and VMware have worked together to merge the most powerful features of TestManager and GSX Server into a truly integrated solution.

- TestManager can execute test plans spanning multiple GSX Servers. Virtual machines hosted on any GSX Server with network connectivity to TestManager can be controlled for test execution. TestManager can address any number of virtual machine configurations.
- TestManager will automatically power on or resume a stopped or suspended virtual machine at the start of test execution. This means that idle test configurations consume no system resources.

- At the conclusion of a test in a virtual machine, TestManager can be configured to return the virtual machine to its initial state from before the test run or to preserve any changes made.
- TestManager is aware of resource constraints on a GSX Server host. If the active virtual machines on a GSX Server host consume available memory, TestManager will wait until it can deactivate a virtual machine after a test run completes before it activates a new virtual machine for the next test run.

Figure 3: The IBM Rational and VMware Test Lab Automation Solution lets common test environments be configured and stored in virtual machines so that Rational TestManager can access those virtual machine configurations as if they were real physical machines, automatically starting, shutting down, suspending and resuming virtual machines when needed.
**Solving the business problems of software test teams**
IBM Rational and VMware have applied their extensive experience with software testing to address the toughest issues facing software testing operations.

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<th>Answers provided by the IBM Rational and VMware Test Automation Solution</th>
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<td>Test teams can't cover all the configurations they should – software quality goes down, support and maintenance costs go up.</td>
<td>Cutting corners on configuration testing just defers encountering the tough bugs until the software is in real-world use and fixing is most expensive.</td>
<td>Any needed test configuration can be built in a virtual machine – no hardware is needed. Libraries of test configurations in virtual machines can be saved on a file server. Now it’s easy to test across all necessary configurations.</td>
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<td>New test configurations require additional equipment – spend more on hardware or lengthen testing time to compensate.</td>
<td>Test teams face an expensive choice: purchase dedicated hardware for each configuration to be tested, or share hardware and spend time reconfiguring before each test run.</td>
<td>Saved test configurations in virtual machines can be invoked at any time with no setup required. Undoable disk and repeatable resume features let changes caused by test runs be discarded so each test can begin with a known good configuration.</td>
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<td>Test teams are spending more time setting up machines and less time testing – testers should be testing, not administering systems.</td>
<td>Covering all the combinations of installed hardware, operating systems, service packs, and application versions is overwhelming. Test teams end up spending too much time configuring machines for each test case.</td>
<td>Building a library of virtual machine test configurations is easy. A “gold master” virtual machine can be cloned by simply copying the virtual disk container file. Just clone and add new service packs or software versions when variations on the configuration are needed.</td>
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<td>Lack of archived configurations means work wasted on replicating setups and difficulties maintaining old releases.</td>
<td>With physical machines, a previously tested configuration takes just as long to setup as a new configuration. Replicating bugs on older configurations becomes nearly impossible.</td>
<td>An archived virtual machine test configuration uses no resources other than disk space and will run on any machine with VMware software installed. Now every test configuration can be saved and kept ready for immediate reuse.</td>
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<td>Virtual machines by themselves are an incomplete testing solution.</td>
<td>While they make management of multiple test configurations easy, virtual machines lack test automation and management features, so testers end up running tests manually.</td>
<td>TestManager can control the starting and stopping of GSX Server virtual machines to automate the most complex test plans. No manual intervention is needed.</td>
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<td>Unregulated execution of tests on virtual machines results in resource shortages – tests get stalled and automation breaks down.</td>
<td>Simplistic approaches to running automated tests in virtual machines can overload the virtual machine server. Manual test management becomes necessary.</td>
<td>When GSX Server host resources are constrained, TestManager is smart enough to wait until a test completes in one virtual machine before starting another.</td>
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Considerations when testing software in virtual machines

VMware virtual machines provide a high level of compatibility with software written for the Intel x86 architecture. VMware virtual machines provide a faithful representation of an x86 platform that be configured with a broad set of virtual devices (IDE, SCSI, USB, serial, parallel, etc.) That property makes virtual machines highly suited for functional software testing because it is assured that x86 operating systems and applications will run normally in a virtual machine.

The VMware virtualization technology does not rely on software emulation of the x86 instruction set. Instead, virtual machines share access to the host processors so that CPU-intensive tasks run very close to native speeds in virtual machines. Disk and network I/O activity in a virtual machine is handled by virtual network and disk adapters that map to the physical devices on the host system. This mapping introduces a virtualization performance overhead that causes I/O activity to be processed somewhat slower than in a native machine. For that reason, virtual machines are sometimes not suitable platforms for load testing. Another factor that can reduce the performance of a virtual machine and make load testing results unreliable is loads imposed on the GSX Server host by other concurrently running virtual machines and processes running on the host.

Setting up the IBM Rational and VMware Lab Automation Solution is easy

Rational and VMware have made it easy to get TestManager and GSX Server working together. Rational TestManager V2003 is now “virtual machine aware” and includes the integration component that allows it to communicate with a GSX Server host to start/stop/resume/suspend any test client virtual machines. Setup of the IBM Rational and VMware Test Lab Automation Solution is simple:

**Step 1** – Install Rational TestManager in the normal fashion.
**Step 2** – Install VMware GSX Server on any server that has network connectivity to the TestManager host.
**Step 3** – Create test configurations in GSX Server virtual machines and install the Rational Test Agent in each virtual machine. Building a library of test configurations in virtual machines is much faster and easier than with real machines or with disk imaging tools. Virtual machines can be cloned and copied by simply copying the virtual disk files that contain them.
**Step 4** – Create test plans using TestManager. The only difference is now the computer properties defined for test execution can specify a virtual machine as well as a physical one.
**Step 5** – Execute your test plan using Rational TestManager.

The IBM Rational and VMware Test Lab Automation Solution will automatically invoke the startup of any virtual machines needed by a test plan on the designated GSX Server host. As tests are completed, TestManager will stop or suspend the virtual machines.

All that is needed to execute a test in a GSX Server virtual machine is to tell TestManager the name of the GSX Server host and the name of the virtual machine to be used.
How to get started
The IBM Rational and VMware Test Lab Automation Solution is marketed jointly by Rational and VMware. Contact your Rational Sales Team or your VMware Sales Team for more information or to get started with an evaluation of the solution.

Contact Rational

Contact VMware
Visit VMware on the Web at www.vmware.com, send email to sales@vmware.com, or call 877-4VMWARE to get started. For further information on the integration, contact alliances@vmware.com.

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