

WHITE PAPER

Accelerate Software Development, Testing and Deployment with the VMware Virtualization Platform



Contents

Executive Summary..... 3

Challenges in Developing, Testing and Deploying Applications..... 3

The Solution: The VMware Virtualization Platform
for Software Development and Testing 4

Increase Productivity to Accelerate the Software Lifecycle 6

Reduce Overall Development Costs..... 7

Improve Software Quality..... 7

Using the VMware Virtualization Platform Throughout the Software Lifecycle..... 8

Summary..... 10

Customer Case Studies 11

Accelerate Software Development, Testing and Deployment with the VMware Virtualization Platform

Executive Summary

The popular VMware virtualization platform has transformed IT operations in enterprise data centers worldwide, by allowing common computing workloads to be freed from the underlying hardware, thereby enabling more efficient and dynamic resource reallocation. One aspect of IT operations where virtualization has driven significant process improvements is in application development and testing. By deploying the VMware virtualization platform throughout their development lab, IT managers can accelerate software project completion by increasing the individual and team productivity of their developers and testers, reduce hardware and administrative costs, and improve the quality and robustness of applications that are deployed in production.

These benefits are enabled by key capabilities of VMware's industry-leading virtualization technology. VMware virtualization software lets technical professionals quickly and easily package a complete hardware configuration, firmware and operating system with its applications and settings into a portable virtual machine package. This virtual machine can then operate on any x86 (Intel or AMD processor) system. Virtual machines make it possible to manage the hardware configuration, operating system and applications as a single unit encapsulated in a simple set of files so that it is possible to provision, clone, share and migrate entire virtual machines quickly and easily. Virtual machines can also run simultaneously and independently on the same physical hardware, enabling the consolidation of physical systems.

This use of VMware virtualization technology in the development lab is a key facet of the broader virtual infrastructure vision, which can be deployed throughout an enterprise's entire computing infrastructure. Replacing physical systems with virtual equivalents simplifies administration, increases flexibility and responsiveness, and decreases IT hardware costs. From developers to QA testers, UI designers, localization engineers and integration partners, everyone involved in the application development lifecycle can benefit from VMware virtualization technology.

For many years, VMware® Workstation has remained the preferred desktop virtualization solution for software developers and testers worldwide, since it offers the immediate benefits of desktop consolidation along with functionality designed specifically to optimize the development process (such as multiple snapshots and virtual machine Teams). In conjunction with VMware's popular desktop product, many software development teams also deploy VMware Server and ESX Server in their labs to optimize server-based resources and boost team productivity. Gaining the best of both worlds, and increasing number of development teams within enterprises and ISVs (independent software vendors) are taking advantage of the VMware Technology Network (VMTN) Subscription to standardize virtualization across all elements of the development process very easily and inexpensively. From desktop PC to server, the VMware virtualization platform transforms and optimizes the software development process, while fitting seamlessly into existing environments and providing a non-disruptive means of boosting productivity and performance.

This white paper explains how VMware software helps software development, test and IT professionals to accelerate projects by increasing productivity; reduces operational, environmental, hardware and support costs; and improves software quality.

Challenges in Developing, Testing and Deploying Applications

Enterprise application development and testing has evolved to become a complex undertaking that requires support for a diverse set of computer and network environments, typically involving collaboration between geographically distributed teams and a multitude of development tools and components. IT managers are challenged to focus on controlling hardware, facilities and administrative costs while trying to deliver projects on time and consistently maintain and improve software quality.

Developers, QA and IT teams have key requirements that must be addressed to enable effective creation, testing and deployment of applications. These requirements include the following:

- Isolated "sand box" environments for application development and pre-deployment testing.
- Support for creating realistic test environments in order to verify compatibility of applications with other elements of the deployment infrastructure. For example, compatibility with clients running on different operating systems and connecting to applications via different technologies.

- Collaboration within and between geographically distributed teams including passing complete information about configurations between development teams, QA and support to reproduce problems.
- Automated regression tests, including some that may require shutdown and/or reboot cycles
- The ability to introduce simulated failure conditions into the QA cycle for stress testing.

One of the most significant challenges facing enterprise development teams is the loss of productivity resulting from team members contending for limited hardware resources. Because the number of systems is often limited by capital budgets and by facilities constraints (such as rack space, network ports, HVAC and power), access to hardware becomes a significant bottleneck that may slow down or stall projects. Even when hardware does become available, testing is often stalled for days or even weeks waiting for servers to be configured from scratch or for a specific application to be configured. For these reasons, test managers must often dedicate servers to testing specific applications to the exclusion of all other workloads. These factors lead to obvious problems: longer testing cycles, contention for hardware resources between different projects, poor utilization of servers during set-up time and inflexibility that makes it difficult to find appropriate hardware for debugging high-priority defects as they are detected.

Another significant challenge is the substantial hardware requirements for development and testing and the resulting high costs. Many developers working on multi-tiered projects require two to four physical systems for basic application development and functional testing. The most common scenario is a developer who has to validate applications on multiple versions and service packs of the Windows® operating system, requiring a separate physical machine for each operating system version. Similarly, developing the more sophisticated multi-tier applications requires multiple physical machines, each hosting an application tier that is appropriately networked to the other systems. Developers may also require an additional system for tools such as kernel-level debuggers or network analyzers. Linux developers who can complete their coding on a single development system may still need an additional system to access standard Windows applications and productivity tools. Finally, developers usually prefer to dedicate one or more systems for working on code that may crash or cause corruption, use another for lengthy compilation and build processes, and keep yet another system separate for day-to-day tasks such as e-mail and office applications.

QA testing groups are confronted with similarly costly hardware requirements. However, maintaining a large server farm drives up costs for power, cooling, rack space and network and storage infrastructure. Administrative costs also climb, due to the high rates of reconfiguration of testing servers, the need to duplicate environments for distributed teams and the complexity of the required testing configurations. For multi-tiered applications, such resource constraints limit the number of permutations that can be tested, reducing the breadth of test coverage and compromising the robustness of completed applications.

A related challenge is the difficulty of maintaining and increasing overall software quality. The time available for testing is reduced by the time required to set up and tear down complex configurations of hardware, operating system, patches, and application versions. The time and effort required to precisely reproduce configurations to debug problems further delays and complicates problem resolution. Finally, inadvertent differences between testing/staging environments and the target production environments can result in unforeseen problems during application rollout.

The Solution: The VMware Virtualization Platform for Software Development and Testing

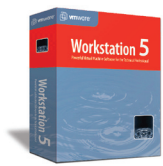
VMware has a lengthy and respected heritage of providing virtualization solutions for software developers and testers, dating back to the origins of the company. As a result, the VMware product line has many features specifically designed for optimizing development and test environments. By using this virtualization platform for software development and testing, project teams are able to accelerate project completion, improve productivity, remove hardware constraints, reduce hardware costs and improve the quality of deployed applications.

VMware virtualization technology allows multiple operating systems and software applications to run concurrently on a single x86 (Intel or AMD processor) computer as individual virtual machines. Those virtual machines encapsulate entire physical systems — hardware configuration, operating system and applications — into a self-contained package that can be run on any x86 system. Benefits enabled by VMware virtualization include the following:

- Run multiple operating systems and versions of Microsoft® Windows®, DOS, Linux, Solaris x86 and NetWare simultaneously on a single machine
- Consolidate multiple virtual test machines onto a single physical system
- Build complex multi-tier environments on a single computer

- Move between operating system environments without repartitioning or rebooting
- Create libraries of virtual machines for each operating system and network configuration with preconfigured test environments and tools
- Suspend and restoring virtual machine instances on demand to maximize hardware utilization
- Allow several developers simultaneous access to a virtual machine
- Automate entire test sequences, including ones that require system reboots

The VMware virtualization platform for development and testing includes the following suite of products:



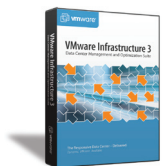
VMware Workstation

Powerful virtual machine software for the desktop, designed for software professionals to run multiple operating system environments on a single PC



VMware Server

Virtual machine software for departmental server environments, designed to provide a secure, uniform platform for consolidating servers and streamlining software development and testing



VMware Infrastructure

The most widely deployed software suite for optimizing and managing industry standard IT environments through virtualization. Includes ESX Server, VMware VMFS, Virtual SMP™, Virtual Center, VMware VMotion, VMware DRS, VMware HA and VMware Consolidated Backup.



VMware Technology Network (VMTN) Subscription

A service for developers and testers that provides a powerful suite of VMware products, support and upgrades in a convenient, low-cost annual subscription. VMTN Subscription includes access to VMware Workstation, VMware Server, VMware Infrastructure Standard Edition, and P2V Assistant for development and testing teams.

Most importantly, the VMware virtualization platform fits seamlessly into existing environments, without disruption to IT infrastructure or processes. It provides these benefits by improving the efficiency of the tools and processes that are already in use. Because VMware virtual machines are exactly like physical hardware, the same operating system and applications - as well as the same development and testing tools - can be used in a virtualized environment.

The VMware virtualization platform for development and testing includes the following suite of products:

VMware's virtualization platform can support many development and testing scenarios such as using VMware Workstation for running multiple applications on a developer's desktop, VMware Server for consolidating test servers and developing multi-tier departmental applications, or ESX Server for testing and for pre-deployment staging of data center applications. VMware technology helps enterprise IT and application development teams in three significant ways: it shortens development and deployment schedules by increasing developer productivity; reduces costs by cutting the amount of hardware needed for application testing, development, and deployment; and improves software quality by increasing the efficiency and extensiveness of testing.

Increase Productivity to Accelerate the Software Lifecycle

Using the VMware virtualization platform dramatically improves the productivity of enterprise application development and testing. Teams using VMware software are able to spend less time on repetitive, lower-value tasks (such as physical server setup and teardown) and more time on the core tasks of developing, testing and debugging. This in turn enables organizations to accelerate the delivery of software applications.

Software development and test teams can significantly reduce system provisioning and configuration time with VMware software, whereby IT managers create and manage a versioned library of virtual machines and virtual machine templates to use to provision new servers. It is also possible to create new templates from running systems. Virtual machines are completely encapsulated in as few as two files, making them easy to capture and restore, without any Windows Registry entries or other artifacts connecting them to physical systems. As a result, the virtual machines can be stored as files in a centrally-accessible location and then they can be easily restored to any physical system with sufficient CPU and memory capacity.

In this way, traditionally labor-intensive tasks such as installing the operating system, applying necessary patches and deploying development tools are eliminated from all but the original setup. As a result, provisioning a new system can be done in a little time as it takes to boot a server rather than the hours or

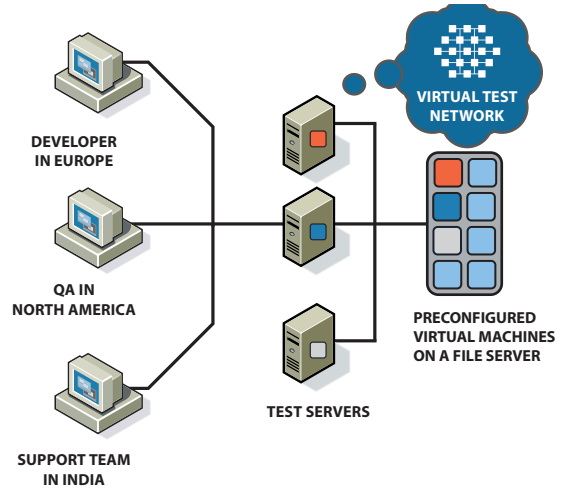


Figure 1. Standardized development and testing environments can be quickly deployed from a centrally accessible library to any test server with available CPU and memory capacity.

days typically required. Rather than wasting time waiting for a new physical system to arrive, developers and testers receive the servers they need almost instantly. Teams can also create virtual test banks for each application under development. For example, a test configuration containing multiple virtual machines and applications that took a long time to build can instantly be turned into a test bank image for use in regression testing.

The ability to archive and share standardized virtual machines can be used to improve productivity and collaboration across distributed teams. As shown in Figure 1, IT teams can create an easily accessible library of standard test environments complete with operating systems, standard patches and development tools. These standardized environments can then be accessed and shared by distributed teams throughout an organization, eliminating the need for each local team to recreate the setup and configuration work for their own development and testing. Developers and testers can access the same virtual machine by connecting to it via remote console, enabling them to work together seamlessly. Archived virtual machine environments also eliminate time wasted on problems caused by inadvertent differences between environments rather than by actual problems with the software being developed and tested.

Configuration management can also be simplified and streamlined with VMware software. The virtualized disk architecture makes it possible to discard disk changes and quickly roll back to a clean state after testing, eliminating time previously spent cleaning up and reconfiguring systems between tests. The snapshot capability captures the complete state of a virtual

machine (including disk, memory and processor state) and in effect freezes a running system in time. In addition to enabling easy rollback to a known clean state, snapshots can be used to archive an environment before and after the installation of a service pack, for example, so that both scenarios are readily available for testing. Standard version control systems can be used to manage virtual machine libraries by tracking changes and protecting critical virtual machines from undocumented alterations.

VMware software further improves productivity by allowing IT teams to manage all of the enterprise's virtualized resources, including development and test virtual machines, from a central location. IT managers can use VirtualCenter to provision new Windows, Linux or NetWare servers to the pool of hardware resources. VirtualCenter also enables centralized monitoring and management of performance and availability of virtual machines and physical systems throughout a large testing environment.

Reduce Overall Development Costs

VMware software has enabled customers to realize dramatic and immediate reductions in the cost of development and test infrastructure. The VMware virtualization platform reduces costs by decreasing hardware requirements, improving hardware utilization and reducing IT administrative costs.

Hardware costs are significantly reduced by the ability to consolidate multiple physical servers and desktops onto fewer machines. Multiple complete systems (including BIOS, operating system, security patches and applications) can run simultaneously in complete isolation from each other on the same physical hardware. Each hardware system—server or desktop—can be dynamically partitioned into multiple independent virtual systems that can be used for different applications and different environments. For example, a developer can run multiple independent development environments or even multi-tier testing configurations on their desktop system. Testing environments used by developers and by QA can also be consolidated onto fewer physical servers. VMware customers have demonstrated average test server consolidation ratios of 8-10 test servers to one and in some cases up to 30:1.

VMware virtualization software also simplifies the consolidation of complex multi-tier testing environments through the use of its virtual networking capabilities. Virtual machines on the same physical hardware can be connected to virtual switches to create complex "network in a box" networks matching real physical network configurations. In addition, because virtual machines run completely independently of each other, testing for different applications can occur on the same physical hardware at the same time. The resource controls available in ESX Server control performance isolation, ensuring that activity

in one virtual machine does not change resources available to other virtual machines on the same physical hardware.

The flexibility of VMware virtualization also enables greatly improved hardware utilization. The ability to run multiple virtual machines simultaneously on a single physical machine has enabled VMware customers to take underutilized physical servers and increase CPU utilization from 5% to 50% or more. Application environments that are not currently being tested can be powered off, freeing computing resources for other active testing. The end result is that organizations can get more useful computing cycles from their existing hardware, reducing hardware requirements and eliminating the need to allocate a new server for each new request for a test system.

Reducing physical hardware requirements for development and testing reduces the following:

- Capital expenditures for hardware, which typically decrease by 40 to 80%
- Power, cooling and network cabling costs
- Space in computing centers and on desktop systems

Adding to these savings, administrative costs are reduced by implementing the VMware virtualization platform. The reduction in the number of physical systems means less IT effort is needed to support the hardware required for development and test, which reduces the labor costs associated with development and test environments. The ability to use VirtualCenter to centrally manage the provisioning, configuration and migration of virtual machines as well as to monitor their performance and availability further reduces the administrative costs for development and test infrastructure.

Improve Software Quality

IT managers are measured on software quality and are focused on constantly maintaining and improving the success of new application rollouts, upgrades and patches. The VMware virtualization platform allows IT managers to increase testing coverage, more easily test real configurations, debug failures more reliably and efficiently and streamline deployment.

VMware software enables development and testing groups to increase testing coverage by allowing them to do more testing of more cases more efficiently. For one, they spend less time configuring and reconfiguring systems and more time testing and fixing problems as a result of using virtual machine libraries and the ability to rapidly provision new servers. The VMware virtualization platform makes it easy to configure and maintain larger test banks and enables implementation of more extensive test plans including of more operating system, patch and application variations. Using advanced virtualization features such as snapshots or undoable disks, developers can discard any changes from a test run and return the test client

to a known good state instantly without a daunting system reconfiguration. All tests can be conducted from a clean state, eliminating time wasted isolating possible ambiguities in fault locations and improving QA productivity.

Automated testing has provided QA groups great improvements in testing efficiency and testing coverage and VMware virtualization products combined with test automation tools enables significantly more powerful automated testing. Automated testing has thus far been limited to using a fixed set of static configurations. VMware software adds to that the ability to automate system configuration and more complex test cases that include system reboots or system failures. These capabilities are enabled by VMware's virtualization software development kit (SDK). The VMware SDK allows test managers to integrate virtualization with other parts of their automated testing environment to automate routine events or trigger them through external systems. For example, the IBM Rational and VMware Test Lab Automation Solution is a complete test automation solution jointly developed by IBM Rational and VMware that brings together the software testing management benefits of the Rational Test Suite family and the virtualization technology of VMware 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 stored in VMware Server virtual machines and control their execution state. This allows test teams to automate software testing across a large number of configurations, increasing testing productivity. [Please note that while VMware Server and ESX Server scripting APIs are available for basic virtual machine management, VirtualCenter is needed in order to use the VMware SDK.]

Ideally, testing environments should exactly match the target environments. VMware virtualization makes that possibility a reality. VMware virtual machines offer configuration options that allow them to replicate real hardware. To test against target environments that run on virtualized hardware, a copy of the exact production environment can be used throughout development, testing and staging. Multi-tier environments can be debugged without the need to replicate the entire production hardware environment. For target environments running on physical hardware, the VMware P2V Assistant tool can be used to create a virtual machine matching the physical hardware to ensure that development and testing use the most realistic environment possible. Doing so maximizes the ability to find problems before release and deployment. P2V Assistant is also useful for rapidly converting banks of physical test machines into virtual machines or converting archived physical machine disk images into virtual machines.

When problems are found in development, QA, staging, or production, debugging them is much more efficient with VMware software. For example, snapshots provide a QA team the ability

to give a developer the exact virtual machine that encountered the problem at exactly the point where the problem occurs. Rather than painstakingly trying to reproduce the application fault on a dissimilar physical system, developers can immediately begin debugging from the point where the failure occurs. By archiving the virtual machines used for testing prior releases, organizations can also ensure that they have the tools immediately available to recreate and debug high priority support calls for older software releases.

VMware software also provides significant benefits that streamline the migration from pre-deployment testing and staging into deployment. By maintaining staging environments in virtual machines, IT departments can easily provide environments for pre-deployment testing and/or conduct limited controlled deployments to ensure compatibility of new applications with the current enterprise IT environment. Once the testing and staging is completed, the complete virtual machine can be seamlessly moved into virtualized production environments. Because virtual machines are hardware independent, problems due to differences between staging and production hardware are eliminated. Because the entire virtual machine is moved from staging to production, problems due to differences between operating system and software configuration are also eliminated. The overall result is faster deployment of software with significantly fewer problems.

In summary, VMware customers realize the following quality benefits:

- Increased testing consistency results in improved software quality
- Automating hardware configuration for new or complex tests improves project quality by allowing more rigorous testing
- Consistently testing from a known 'clean' state reduces bug rates and delivers applications with fewer performance problems.

Using the VMware Virtualization Platform Throughout the Software Lifecycle

Enterprises can achieve these benefits of using the VMware virtualization platform for projects throughout the software lifecycle including development, testing, documentation, localization, training, staging, production and support.

As discussed, enterprises can benefit from using VMware software throughout development and testing, as well as in staging and production environments. Enterprises with stringent quality requirements and teams that are geographically distributed can use VMware virtualization solutions to easily standardize their development and testing environments, copy and share environments and centrally manage large and flexible test environments.

Documentation projects are often burdened with high costs because writers need significant hardware to duplicate production deployments to display appropriate screen shots and accurately document applications. Localization projects have similar hardware needs to develop localized versions. Enterprises can significantly reduce these hardware costs by deploying low-cost hardware with virtualization software to provide realistic environments for use in writing documentation and developing localized software.

Once new applications are rolled out, end users and administrators need to be trained to use them effectively. Training departments can benefit from virtualization software by reducing their costs for hardware and system administration for training environments. By packaging and deploying classroom software inside virtual machines, students can experiment with multiple operating systems, applications and tools in secure, isolated environments. IT administrators can configure the virtual machines to discard changes when the machine is shutdown to revert the system to a clean state. These features decrease the time required to prepare for a new class and ensure that students have a consistent hands-on learning environment.

Because IT departments are under increasing pressure to ensure reliable software infrastructure, IT managers are searching for ways to improve staging and deployment of new enterprise applications. By using the VMware virtualization platform for staging and deployment, IT managers can streamline and simplify staging and deployment. By using virtual machines in both staging and production environments, they can reduce or eliminate the risk of problems due to mismatched development and production environments. VMware software also enables IT managers to test patches in virtual machines that exactly match target environments before deploying them. If problems are discovered, the virtual machines and the faulty patch can be easily rolled back.

Finally, support organizations benefit from the VMware virtualization platform for many of the same reasons. They can use virtual machines to more easily recreate customer configurations with less hardware and less time spent installing and configuring applications. Once they have reproduced problems, they can share those exact virtual machines with developers in order to more quickly resolve and fix application issues.

Summary

VMware software, adopted by top organizations worldwide, helps application development teams to rapidly streamline software development, testing and deployment, while reducing hardware and maintenance costs. By standardizing on the VMware virtualization platform throughout a development organization, many thousands of enterprise development managers have successfully accelerated project completion, reduced costs and improved software quality, with results that include:

- Reduction of capital costs by 48% to 80%.
- Immediate cash savings from reduced operational, space, power and support needs.
- Increased team efficiency and effectiveness by more than 50%.
- Deployed applications on or ahead of schedule, accelerating time-to-market.
- Synchronized global development teams to produce more in less time.
- Reduced the amount of hardware required for development and testing by 40% to 80%.
- Increased test consistency, thereby improving the quality of deployed software.
- Eliminated the need to configure new hardware for new or complex tests.
- Reduced bug rates for new projects and deliver applications with fewer performance problems.

Customer Case Studies

Over 90 of the world's top 100 software companies and all of the Fortune 100 companies have adopted VMware software to streamline their development and test processes. The following table lists some examples of how leading organizations have deployed VMware software to revolutionize the application development life cycle to boost productivity and gain competitive advantage

Customer	Symantec	Bharat Petroleum	7-Eleven Inc.
Scenario	Set up test machines with a variety of operating systems and software configurations to ensure product quality.	Consolidate applications onto fewer servers to reduce server sprawl in testing, development and production.	Improve server resource allocation to development and testing to meet new business demands.
Benefits	Provided quick setup for a large number of machines.	Increased server and CPU utilization dramatically.	Reduced server deployment time from 6-8 weeks to one day.
	Reduced hardware, space and power costs by consolidating physical machines.	Reduced server set-up time from many hours to a few minutes	Increased CPU utilization averages from 6-8% to 50-70%
	Saved time by archiving virtual machines with standard test environment configurations.	Accelerated deployment of new applications.	Optimized server management allowing reallocation of virtual machines to different physical servers, without downtime.
	Improved efficiency of hardware investment.	Optimized server resources by reusing virtual machines.	Accelerated migration to new operating system platforms.
	Significantly reduced hardware, space and power costs.	Reduced recurring server costs such as annual maintenance, power consumption, administration and manpower.	Saved thousands of dollars on hosting development and test servers.
	Increased productivity and efficiency.	Reduced response time and lowered labor costs.	Reduced hardware, power and cooling costs for servers.
In Their Own Words	<p>"We save on space, power, air-conditioning and maintenance. We were purchasing computers—300 at a time. That hardware gets to be obsolete; VMware doesn't. With VMware, I can get 300 test machines in a space the size of a Volkswagen."</p> <p>—Mike Linsenmayer QA Director, Symantec</p>	<p>"VMware software is definitely the solution of choice for maximum cost savings from server consolidation and for greater flexibility and scalability in rapid application testing and development."</p> <p>—Anil Kumar Kaushik Deputy General Manager, IIS Infrastructure, Bharat Petroleum</p>	<p>"VMware enables us to allocate more server resources to developers. It has been a pleasant change now that getting a server up and running for a new project is not the delay it once was."</p> <p>—Matt Ramseyer Senior Business Analyst, 7-Eleven</p>

Notes



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