VIRTUALIZATION USE CASES IN TESTING

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Abstract

In today’s context, main challenges for IT organizations and Enterprises with respect to Testing is to achieve agility while reducing costs or keeping costs under control and enabling more testing with the existing resources.

In order to support the above needs, in the recent times, various Dynamic systems technologies either have evolved or expanded in terms of capabilities. Some of the relevant/useful technologies in this context are Virtualization and Cloud Computing.

This paper offers a brief summary of Virtualization Technologies and Outlines how these can be utilized with respect to testing needs. Also included are implementation best practices, challenges and recent trends which would further enhance the deployment of these technologies in lieu of testing needs.

1. Introduction

Today’s enterprises are looking forward more actively towards agility, TCO optimization and improved customer satisfaction.

One of the important aspects from Testing that could help out the Enterprise’s IT organization in the above aspect is test environment/test infrastructure side improvement. It is estimated that high amount of capital is invested by IT Organizations worldwide in Test Infrastructure and Cost of Cycle time lost due to Test environment provisioning etc., is taking maximum part of the total capital investment. It is estimated that Test Infrastructure Provisioning, Issues would consume half of the amount of test life cycle cascading the impact to the test cycle time which interns gets translated to the overall product release cycle of the Enterprises.

As systems become more complex and interdependent, development and quality efforts are further complicated by constraints that limit developer and tester access to realistic test environments. These constraints may include:

- Missing/unstable components
- Evolving development environments
- Inaccessible third-party/partner systems and services
- Systems that are too complex for test labs (mainframes or large ERPs)
- Internal and external resources with multiple "owners"

With the above facts and requirements insight, test environment setup has become an important aspect. Below are the areas that would be benefitted by any improvements in this aspect:
• Faster environment provisioning, availability – Need to support frequent and shortened test cycles for completing testing effectively at a rate that supports business goals, new development models like Agile, TDD and parallel development requirements.

• Numerous/Multiple Environment Configurations – Need of multiple configurations due to different operating Systems, Software and browser versions bringing in compatibility testing as one of the important aspects for test environment setup to support business goals.

• Improved Production like Environment for increased Quality – Need of environment that mimics/emulates/simulates the in use/production environment for increased test effectiveness.

• Optimized Capital Expenditure and Operating Expenditure costs in the areas of test infrastructure

To overcome these challenges during Testing Phase organizations are adopting Virtualization.

2. Virtualization

2.1 What is Virtualization?

Virtualization allows multiple operating systems to run and share resources on a single piece of hardware which allows multiple programs to run on a single piece of hardware.

This is accomplished by placing an additional layer of software between the operating system and the hardware. This software is often called a “hypervisor” or “Virtual Machine Manager”.²

Before VM technology, we could run only one OS environment on a server at a time—the physical OS environment that runs directly on the server as shown in Figure–A.

Current technologies such as Microsoft Virtual Server 2005 R2 add a layer on top of the OS in the physical OS environment to enable you to run multiple OS environments on the same server Figure–B.

Virtual OS environments run on virtual machines. Upcoming technologies from Microsoft and other vendors provide virtualization services Figure-C

2.2 Virtualization Options

![Virtualization Options Table](image)

![Virtualization Diagram](image)
3. Use Cases for Virtualization in TESTING

3.1 Testing Multiple User Configurations

Testers, while working with virtual machines, can create the unlimited number of user configurations (in terms of operating system, browser, software set up, and hardware configurations) on their physical machines and choose the most suitable configuration at each stage. This will bring in the below possibilities:

- To perform testing with different user profiles.
- To experiment with potentially incompatible applications
- To perform testing on different environment configurations/back ward and forward compatibility testing

All the above can happen in parallel bringing in the reduced cycle time benefits as well.

3.2 Support to Defect Reproduction

Many a times, one of the major reasons for delay in defect resolution is inability to reproduce the defect in the developer environment. Defect writing guidelines etc might help to alleviate some extent, but cannot address the problem completely. In few cases, reproducing a defect might become almost impossible due to several environment state factors.

If test environment is created using virtualization technologies, it is possible for the tester, when finding a bug to simply save a system state and also attach snapshot of the environment as part of the defect information. This will help developer to easily reproduce. It also brings additional benefits like no impact to the tester’s environment and continued availability for further testing without waiting for the developer to fix the issue.

For Example VSTS 2010 Lab Management renders this kind of support using features like IntelliTrace and Environment snapshot availability as part of the defect information.

3.3 Simulate Multiple Hardware Conditions

Required conditions for testing can be quickly created due to flexible settings of virtual machine hardware (RAM memory space, number of virtual processors, limitation of resources). Often, great flexibility of hardware components configuration is required when testing a software product. For example, checking of software product work in extreme or limiting conditions is required while stress testing (low disk space, network connection break). In this case, we can add new virtual devices to a virtual machine or limit resources assigned to it with a help of a virtualization platform.

3.4 Disaster Recovery Testing

As virtualization technologies has the ability to take the snapshots of the environments and roll back to the required system state, these capabilities could be of value for Disaster Recovery Testing.

3.5 Testing Cloud Computing Platform based Applications

Latest software trends emphasize on enterprise modernization in serving more requests with optimized and smarter way of sharing and leveraging existing resources, both on-premise and remotely testing the applications. With users demanding for faster response with in lower budget, a better strategy is required to address the IT testing needs. Cloud computing evolved to address these challenges and cuts through IT complexity by leveraging the pool of on-demand shared services, built-in virtual infrastructure, and software as a service.

Testing in cloud environment leverages virtual resources to enable all aspects of testing in a highly cost-effective manner. With cloud testing you have unlimited resources to plug and use for the testing, and deployable based on consumption only.

While moving applications to cloud environments, there are few aspects that need to be aware while testing to ensure the smooth transition compare to on-premise environments. Below is the list of the focus areas which could be used for test considerations.

Integration and platform considerations:
Moving application to cloud might require changes within the application to fit into the cloud-based environments. For e.g., if application reside on Solaris and while moving to cloud if it moves to different operation system such as RedHat Linux, application requires additional areas with respect to platform compatibility. In the similar way if application has authentication functionality against active-directory and integration with external systems, lead to additional testing after the application moved to cloud environment.

Security requirements:
Companies may enforce application authentication against active-directory and integration with external systems and while migration to cloud environment data might need to move from fire-wall limit to public internet leading to introduction of SSL requirements. Cloud applications usually follow encryption and decryption strategy to comply with security requirements. These may lead to additional security testing

Performance aspects:
Application moves to cloud environment would definitely take an advantage of consolidating infrastructure across different regions for testing needs. This would lead to some latency in responses while comparing to the on-premise environment. This will require careful performance results analysis based on these facts to improve performance of the application.

3.6 Setting up Test Lab

The usage of Virtualization software such as VM ware has helped to enable service provided by many physical servers as one virtual server. Test environment creation and maintenance is one of the key tasks of the testing, which can be done using Virtual lab technology. Virtual labs help in building creating realistic test environment. Replacement of physical lab with a virtual lab would eventually results in significant cost savings depending upon their frequency of usage, complexity, no of servers. Virtual lab is always hosted for the user with ‘ready to execute’ setup. Following are some of key features of the virtual test lab:

Isolated network:
A virtual test lab has its own isolated networks to support the application’s network requirements. Virtual helps in connecting to internet, downloading the patches and registering the operating systems. Once the test lab setup is completed, isolated network lab environment can be established with multiple virtual machine instances. E.g.: VMware Bridged network

Multi-Tier applications:
Supports a wide range of software, starting from simple development tools to complex multi-tiered applications

Virtual lab is more efficient in supporting huge data, services, and processes on less number of servers. Simulation of multi-tier applications instantly for testing (using SOA Virtualization technology) and eliminate lead time for dependent applications to get deployed.

Consistent configurations:
Consistency in configuration of virtual lab environment helps testers in early reproducing the software defects and faster resolution. With the creation of catalog of virtual applications, they can be deployed demand to existing virtual infrastructure. These images of pre-configured multi-tier applications help in configuration consistency across application instances and reduce the overhead and risk associated with manual configurations. Eg: Virtual apps in VMware

Optimal use of hardware resources and Quick resource ram-up:
With Virtual lab technology, the resources can be optimally utilized which leads to efficient utilization of infrastructure resources which leads to significant cost benefits. Multiple Physical resources can be replaced with single VM server with multiple virtual machines created within it with the required configuration. Virtual lab is ideal for quickly ramping up resources for the testing needs. For eg., Testing an application on multiple operating systems, multiple browser types and multiple software versions (JVM, App Server etc.) required large infrastructure setup. By using virtual lab technology these configurations quickly created and made as ‘ready to execute’ for testing.

Virtual Lab Automation:
Automation of Virtual Lab can help in below aspects
Considerable effort reduction (up to 75%) for testers to manage in creation and managing the test environment. Instantly deploy the production live configurations to the best available resources in a pool of shared servers
Microsoft VSTF 2010 has lab management module which helps in instant creation and setup of the virtual lab with the required configuration.

4. Limitations of Virtualization Usage for Testing

Virtualization is Not Recommended for the below cases

- It is not recommended to apply virtual systems while testing the performance and also while testing applications with high requirements to the physical resources of the computer.
- The final testing of the developed software must be performed on real machines.
- While using Virtualization Technology for Testing all main devices and hardware are supported by Vendors of the Virtualization systems. Incase if some of the devices which are not supported by vendors are used it is impossible to maintain such unsupported devices.
- Virtualization requires additional hardware resources. Existing virtualization technologies make it possible to bring performance of virtual machines to real. But to start some definite configuration with a number of machines, need a physical host to allow this.
- In case of low disk space on the hard disk of the virtual machine, we cannot increase it if the virtual machine contains snapshots.

When a virus is detected on one of snapshots, it is hard to define on which stage it appeared. We have to check all snapshots because the antivirus that can detect and delete viruses on all snapshots of the virtual machine isn’t developed yet.

5. Best Practices of Virtualization Usage for Testing

- Using virtualization, IT can quickly build development, unit test, QA, and pre-
production environments which saves time, effort and cost.

- Test all changes in the virtual staging and testing sandbox that are to be deployed to production
- Test the change across as much of the end-to-end infrastructure as can be established within the virtual sandbox and connected to across the physical test lab
- Schedule changes on a regular basis rather than making changes on an ad-hoc basis

Thorough Testing is needed before implementing virtualization in any project to make sure that new virtualization infrastructure will boast all of the functionality that is needed.

6. Conclusions

From everything mentioned above, we can conclude that using virtualization in testing helps in the following aspects:

- It considerably reduces the time costs on preparing test user environments and configuration of test environments.
- Bug detection and bug fix become more effective when development team members and product users have general access to found bugs.
- Testers can experiment with potentially incompatible applications.
- Easy portability to other hardware without the necessity to reset and the independence from the hardware platform. If there is a serious failure on the virtual machine, this will not affect the real tester’s machine in any way.
- A backup of the virtual machine can be created by copying a folder or creating a snapshot. If testers use virtual machines on their work stations, they can create their backups by copying a folder with files of a virtual machine. If the system fails, there is no need to recover the saved copy as it is quite ready for work. Besides, many virtualization platforms make it possible to create several snapshots of the virtual machine state. The rollback to each of these snapshots can be performed in a few minutes.
- Required conditions for testing can be quickly created due to flexible settings of virtual machine hardware.

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