WHITEPAPER

Virtualisation – the Smarter and Faster Way to Perform Testing

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Management summary

Today, cost-effective utilisation of IT infrastructures, responsiveness in supporting new business initiatives, and agility and flexibility in adapting to organisational changes are key business challenges which are faced by most companies. As a consequence, these companies often face difficulties maintaining consistent growth in their sector. However, using virtualisation and cloud initiatives could help them improve the way their business delivers IT. Virtualisation is a technological solution that allows skilled IT managers to manage test environment provision and operations. The technologies that are used for servers, clients, storage and networks are being virtualised to create flexible and cost effective IT solutions. Virtualisation provides many benefits, which affect many aspects of information technology operations. For example, reductions in power consumption lead to cost reductions, increase in CPU utilisation, agility in allocation of storage, faster and easier disaster recovery, a template approach for faster lab creation, and many more.

The focus of this paper is to demonstrate how virtualisation can be beneficial in use and overcome the challenges faced in different testing phases. Case studies showing the benefits of using virtualisation will be referenced.

Introduction

For every organisation, quality assurance and testing are two of the most critical components to maintaining a competitive edge. Testing not only reduces the risk of business losses, but also improves the quality of the product significantly. In today's multiple technology platform scenarios, testing is more critical than ever.

In fact, the average software project expends considerable time and budget on unproductive tasks versus relevant tasks. It's very important to minimise the time required for provisioning test environments and test data, to give sufficient time to testers for conducting more focused testing.

Virtualisation is currently transforming nearly every aspect of how technology is architected, developed, implemented, deployed and managed, and has massively improved the way we test. A virtualised development and test environment will boost collaboration between developers and testers, improving the overall quality of the product.

Market – current status and outlook [1, 2]

Virtualisation is already making a huge impact on IT, with 2014 seeing dramatically increased use, particularly in data centre networks where it brings several benefits in power consumption, server utilisation and application performance. And while virtualisation may have its share of issues, such as extra network loads that can impact performance and response times, the technology is poised to grow even more in 2015.

Research states that 75% of surveyed companies are now in the process of virtualising in the interests of improved application performance. The report predicts that by 2015:

- More than half of data centre servers will be virtualised
- The number of virtual machines (VM) per server will reach 30

Server virtualisation penetration has reached 54% (unweighted), up from 41% two years ago. Within midmarket businesses, penetration levels have reached 88% and another 7% are planning to follow this route within the next year.

Figure 1 uses data from multiple surveys to illustrate trends in virtualisation penetration within SMB accounts that have adopted server virtualisation. In 2013 the proportions of servers virtualised was very similar across all employee-size categories, ranging from 61% – 62% in microbusinesses (which sometimes only have one server, making virtualisation an all-or-nothing proposition) to just over 50% in midmarket enterprises with 500-999 employees, which can be expected to have many servers. The statistics for 2014 show virtualisation penetration rising in all employee-size segments: rapidly in microbusinesses and the 500-999 midmarket enterprises, and gradually in other SMB segments. The perspective on future intentions, drawn from the Techaisle SMB 2015 survey, indicates that these trends will continue and accelerate. Microbusinesses and larger SMBs (including both the 250 – 499 and the 500 – 999 segments) are expecting rapid further penetration of virtualised servers, and the other midmarket segments are expecting a further 6% – 10% of servers to be virtualised.

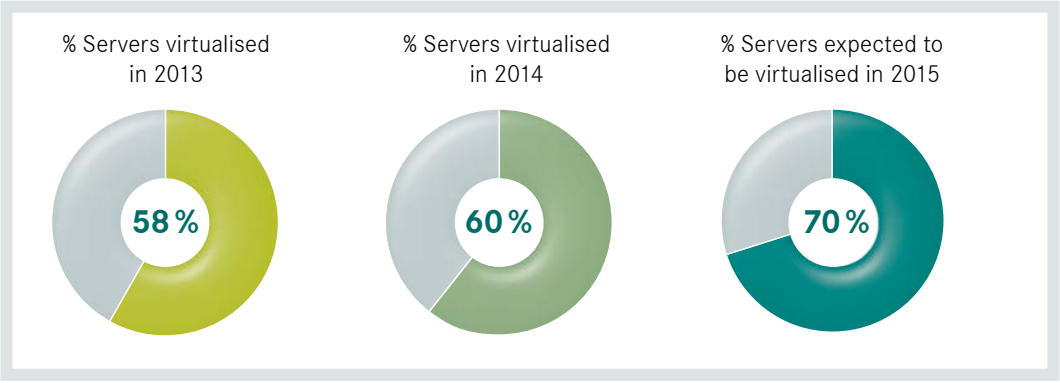

Figure 1: Per cent servers virtualised within SMBs [2]

Virtualisation

Virtualisation: a faster and smarter way of performing testing

In this whitepaper we explain how virtualisation can help to perform testing in a faster and smarter way in the various testing phases, i.e. in overall test organisation.

We have listed typical challenges which are faced during the different testing phases and looked at how virtualisation can be used to overcome these challenges. At the end of this white paper, we have added a virtualisation case study which may help readers to understand the overall benefits of virtualisation in detail.

Test stages in test organisation

- **Component testing:** Modules are seen as applications analogous to company internal software development, having applications and application owners
- **System testing:** All internal business processes consisting of interacting modules. This is the highest integration depth in SQS product testing
- **System end-to-end testing:** Full end-to-end business processes of an application integrated into a customer environment.

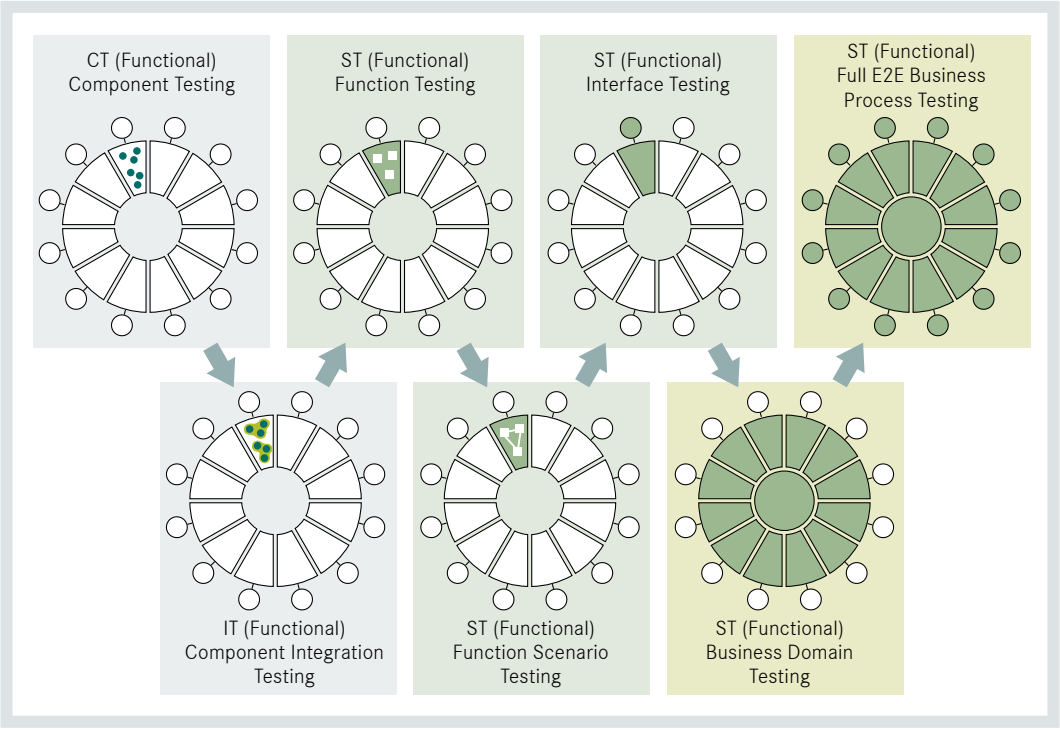

Figure 2: SQS Test Organisation

1. Component testing phase

In Figure 2, component and component integration testing are shown in the upper and lower left corners.

1.1 Challenges faced with the traditional way of managing test labs for component testing

The biggest challenge faced in component functional and integration testing is unavailability of the required component or application. Unavailability of components is due to having less control over these components. This is because components may be not yet developed or are controlled by third parties. Some components are pay-per-use, which is very costly and means they cannot be used in a test environment for load and performance testing. Applications which are integrated with the components have restricted access and it is difficult for most organisations to configure any instance of the application specifically for development and testing.

1.2 Solutions using service virtualisation

Service virtualisation emulates the behaviour of software components to remove dependency constraints on development and testing teams. Rather than virtualising entire systems, it virtualises only specific slices of dependent behaviour critical to the execution of development and testing tasks.

Using a service virtualisation tool, we create and deploy a "virtual asset" that simulates the behaviour of a real component required to exercise the application under test, but which is difficult or pay-per-transaction or third-party controlled or available only in limited capacity to access for development and testing purposes. A virtual asset stands in for a dependent component by listening for requests and returning an appropriate response – with the appropriate performance. For a database, this might involve listening for an SQL statement, then returning data source rows. For a web service, this might involve listening for an XML message over HTTP, JMS or MQ, then returning another XML message.

We can create virtual assets by recording live communication among components as the system is exercised from the application under test (AUT); we can provide logs representing historical communication among components, analysing service interface specifications (such as a WSDL) and defining the behaviour manually with various interface controls and data source values. These are then further configured to represent specific data, functionality, and response times.

Service virtualisation enables user to develop and test the software in parallel. Service virtualisation testing can be started at an earlier phase of SDLC where it is less expensive and disruptive to solve application defects.

Using service virtualisation, the overall development and testing cost can be reduced by eliminating much of the concurrent demand for development environments and pay-per-use service charges. It also reduces the costs and complexities of test data and scenario management by virtualising the system behaviour to account for edge conditions, negative test scenarios and error conditions.

2. System testing phase

The middle portion of Figure 2 shows the system and system integration testing.

2.1 Challenges faced with the traditional way of managing test labs for system testing

In the software industry, one application or system is integrated with many other applications to form a complete product. The biggest challenge in testing the whole system or the complete product is unavailability of these integrated applications due to any number of reasons, for example, the third party applications have restricted access in testing environments or they are very costly to use for testing.

As setting up test environments with different configurations is very complex, the traditional way of managing test labs was not very flexible and environment downtime was very high. To provision and maintain test labs requires highly trained and skilled resources for effective management.

2.2 Solution using service virtualisation

In today's service-oriented architectures in the software industry, third-party software components are extensively used. These third-party software components save time that can be used to develop and build the application. But increasing dependency on these third-party components has its own problems, for example, third-party components may not yet be integrated with your code or easily available for testing purposes.

Using a service virtualisation application means integration testing can take place in the early stages of the development lifecycle, removing bottlenecks which delay production release timelines. Service virtualisation removes the dependency on components or third-party applications by simulating their responses as virtual assets, thus showing how the integration components interact. When developing complex software services, virtualisation is very useful where hardware and software third-party applications or components are not readily available for testing.

2.3 Solution using server virtualisation testing

Server virtualisation is a technology for partitioning one physical server into multiple virtual servers. Each of these virtual servers can run its own operating system and applications, and perform as if it were an individual server.

The process is carried out by virtualisation software in an intelligent way, where the masking of server resources is kept isolated from the server users. This masking will include physical servers, processors and operating systems.

Types of server virtualisation:

1. Full virtualisation: Almost complete simulation of the actual hardware to allow software, which typically consists of a guest operating system, to run unmodified.
2. Partial virtualisation: Some but not all of the target environment is simulated. Some guest programs, therefore, may need modifications to run in this virtual environment.
3. Para-virtualisation: A hardware environment is not simulated; however, the guest programs are executed in their own isolated domains, as if they are running on a separate system. Guest programs need to be specifically modified to run in this environment.

Server virtualisation is robust and affordable. Virtualisation software partitions a server into multiple virtual systems, and using the hardware of the host system makes server virtualisation very cost effective and reduces server footprints. Virtualised servers work isolated from each other and, as they are highly secure, are used as sandboxes. Virtualisation technology reduces server downtime and ensures high availability of the application. Virtualisation software also offers prompt disaster recovery options for data continuity, such as creating whole server images, use of template architecture for provisioning, etc. However, integrated software products add and enhance almost all disaster recovery in a server virtualisation environment. This reduces cost and facilitates the implementation of disaster recovery within the company.

3. System end-to-end testing phase

The upper and lower right hand corners of Figure 2 show the system end-to-end testing.

3.1 Challenges faced with the traditional way of system end-to-end testing

Nowadays, most organisations have onsite and offshore working models. These work models force organisations to constantly enhance the organisational infrastructure to ensure the security and availability of the environment. This requires highly trained technical administrators for server provisioning, asset management and implementing disaster recovery processes within the organisation.

Another challenge within companies is to store and retain data for longer in order to comply with legal and regulatory pressure. These challenges create huge dependency on IT admin departments.

3.2 Solution using network virtualisation

When applied to a network, virtualisation creates a logical software-based view of the hardware and software networking resources (switches, routers, etc.). The physical networking devices are simply responsible for the forwarding of packets, while the virtual network (software) provides an intelligent abstraction that makes it easy to deploy and manage network services and underlying network resources. As a result, NV can align the network to better support virtualised environments.

With network virtualisation, the goal is to take all of the network services, features and configurations necessary to provision the application's virtual network (VLANs, VRFs, firewall rules, load balancer pools & VIPs, IPAM, routing, isolation, multi-tenancy, etc.), decouple them from the physical network and move them into a virtualisation software layer.

With network virtualisation it is easier and cheaper to provision, manage networks and troubleshoot network issues. It also avoids limitations in current network topologies and allows policy-based access, granular security and easier compliance. Network virtualisation is a stepping stone for building a fully automated cloud environment.

3.3 Solution using storage virtualisation

In the current climate, nearly all organisations are moving to digitise business processes and expand their web presence. This creates legal and regulatory pressure to store and retain data for longer periods of time, which eventually becomes the biggest problem for an organisation. Most data emanating from an organisation grows exponentially to almost double or even sometimes triple every year.

Storage virtualisation abstracts the logical aspect of storage from the physical, allowing you to pool and share large quantities of storage among several applications and servers, regardless of the physical hardware that lies underneath. It masks the underlying complexities of individual storage device configuration and management, and puts all provisioning, management and allocation under a single storage virtualisation management interface. The result is a single logical storage pool that you can slice, dice and allocate to applications at will.

Using storage virtualisation, storage become more agile, mobile and easier to manage. Storage virtualisation also uses existing storage much more efficiently. Backup and replication become much easier with a single, highly mobile storage pool. Many storage virtualisation solutions come with advanced software solutions for migrating and protecting the virtual storage pool. As a result, the task of disaster recovery becomes much more efficient and reliable. By itself, storage virtualisation is a very effective way to cut costs and make the provisioning of resources for new and existing business purposes quick and easy.

3.4 Solution using server virtualisation

Many IT companies face problems in terms of addressing asset management and the time consumed in provisioning a physical server. Using virtualisation software we can build templates with development / testing / production server configurations and data. An administrator can copy these VM templates to build a new server. This new virtual server can be invoked on any host machine which has visualisation software (VM Player). In a virtualised environment, the procurement, physical racking and networking steps all take place via software and can be completed in a matter of minutes.

Also, because of their portability, VMs can be easily copied to another location for disaster recovery purposes. Unlike backups of ghost images that won't reliably run on dissimilar systems, VMs can be started on any server that has your virtualisation server software running on it. Not only that, VM software has the facility to create snapshots of the VM. A snapshot is a complete replica of the current running state of the machine with all configuration and data. This ensures that, if the VM crashed or failed to start for any reason, we can revert to the last snapshot or we can choose from the list of snapshots taken in order to revert and recover the data. This recovery process is much faster, easier, more convenient and cost effective than any other backup solution.

Live Example

Customer requirement

1. Test lab creation for frequently released patches on different modules (total of 8 modules) and software configurations (including different OS versions (Win Xp-SP3, Win 7, Win 8) and SQL (SQL 2012 Express), Oracle 11i)
2. Customer has developed the software as they have a development lab but they don't have a testing environment to test the software and don't want to use their development lab for testing.
3. Customer was not willing to create a test lab at their location.
4. Customer did not agree to invest in software licences to create a test lab at SQS location.
5. Customer does not have the infrastructure to support remote connections.

Solution

The SQS team suggested that this valued client take up the facility provided by cloud virtualisation. As SQS is a Microsoft Gold Partner, we suggested Microsoft Windows Azure as the best solution to fulfil our customer's requirements. The cost to the customer has been drastically reduced with the use of the cloud platform (cf. Table 1).

Result

S. No.	Particulars	Traditional Method	Virtualisation (Cloud)
1.	**Combinations**	59	59
2.	**Machines**	150+	31
3.	**Resources**	Due to the complex configuration of the test environment, the traditional method needs highly specialised resources who have good networking and application domain knowledge	No resources required to create and maintain test lab
4.	**Time for setup**	Performing complete setup and configuration of test environment consisting of 150+ machines will be time consuming due to complex configuration and network topology	The only time needed is that taken by Microsoft to provide our machines on the cloud

S. No.	Particulars	Traditional Method	Virtualisation (Cloud)
5.	**Electricity**	Electricity consumed by 150+ physical machines is much higher. Electricity will not only be consumed by physical machines but also by supporting hardware including switches, power boards, etc. Also, AC in the server room requires more power as more heat is generated by 63 physical machines.	Electricity required for host machines used to connect to the cloud. No electricity required for test lab as test lab is on the cloud.
6.	**Idle time cost**	At any stage if the project is on hold, all 150+ machines would be isolated and idle, which may result in high idle time costs and maintenance. As the machines are configured according to customer requirements, this may lead to reconfiguration of the machines from scratch.	No idle time cost as we can release the machines which we don't require for our testing.
7.	**Disaster recovery / Failsafe**	If any of the servers or machines crash for any reason, this may lead to severe loss of data, time and effort. With the traditional method there is no easy, straightforward way to restore the machine to the desired state or recover the lost data.	Using the snapshot facility provided by the virtual machine server, users are easily able to revert to either the last running state or a desired running state of the virtual machine.
8.	**Lab space**	A test lab comprising 150+ machines needs a fully equipped room with racks so that physical machines can be adjusted.	No lab space required.
9.	**Network and cable management**	A test lab comprising 150+ machines needs a fully equipped room with a preconfigured network and cables. This is very complex and needs highly skilled resources to create and maintain.	No network or cable management is required as machines are already configured and on the cloud.
10.	**Maintenance**	Maintenance of 150+ machines in a traditional environment is very cumbersome and complex, so we need to deploy third-party software such as Norton Partition Magic, Norton Ghost Image, etc. to maintain the lab, which ultimately increases the cost of maintenance.	No maintenance required.

Table 1: Comparison of traditional method and cloud virtualisation

Conclusion & outlook

Virtualisation is an effective way to cut down IT costs without increasing complexity, and achieve significant gains in agility, efficiency and scalability. Virtualisation is already having a huge impact on IT, with dramatically increased use, particularly in data centre networks, where it brings a number of benefits in terms of power consumption, server utilisation and application performance. These benefits are critical for growth and progress, and by leveraging server virtualisation, as well as the next generation of virtualisation efforts in networking, storage and applications, firms will be able to realise these goals with ease.

References

[1] http://www.techopedia.com/2/30893/trends/the-future-of-virtualization-whats-new-for-2015

[2] Techaisle (2015). US SMB Virtualisation Study. http://techaisle.com/blog/197-smb-server-virtualization-penetration-is-increasing-but-challenges-remain

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