SAP LANDSCAPES DEPLOYED ON A SECURE MULTI-TENANCY INFRASTRUCTURE
The combination of application, server, network, and storage virtualization provides many advantages in managing existing SAP® environments or provisioning new ones. Secure multi-tenancy offers separation of environments on all layers of the solution stack. It also makes it possible to simplify and fully automate SAP application lifecycle management tasks, such as backup and the creation of SAP system copies. The system uses NetApp® SnapManager® products and efficient storage-based technologies integrated with SAP to automate backup and recovery tasks as well as the cloning of SAP systems and landscapes.
# TABLE OF CONTENTS

1  **INTRODUCTION** .................................................................................................................. 3

2  **SECURE SERVER AND NETWORK VIRTUALIZATION** ......................................................... 4
    CISCO ........................................................................................................................................ 4
    VMWARE .................................................................................................................................... 5

3  **SECURE STORAGE VIRTUALIZATION** .................................................................................. 5
    NETAPP MULTISTORE .............................................................................................................. 5
    NETAPP DATA MOTION .......................................................................................................... 6

4  **APPLICATION VIRTUALIZATION** ....................................................................................... 6

5  **SAP SOLUTIONS** .................................................................................................................. 6
    BACKUP AND RECOVERY IN MINUTES .................................................................................. 6
    FAST, SPACE-EFFICIENT SAP SYSTEM COPIES ..................................................................... 7
    ON-DEMAND SAP REPAIR SYSTEMS ...................................................................................... 8
    ACCELERATING TEST AND TRAINING CYCLES ..................................................................... 9
    RESOURCE PROVISIONING AND REALLOCATION .............................................................. 10
    OPERATING SYSTEM PROVISIONING AND MANAGEMENT ............................................... 10

6  **CONCLUSION** .................................................................................................................... 10
1 INTRODUCTION

THE CHALLENGE: COMPLEX, COSTLY SAP LANDSCAPE MANAGEMENT

As SAP landscapes grow to support more and more business-critical applications, the job of maintaining those landscapes becomes increasingly complex. The process of keeping SAP software, related databases, and operating system software up to date; managing data migrations and business process changes; and backing up and protecting data along the way has become a business process unto itself. In addition, today’s server and storage resources exist in silos, which can lead to low utilization, inefficiency, and the inability to respond quickly to changing business needs. The arrival of cloud computing—and the adoption of cloud infrastructure to deliver IT as a service in data centers of all types—promises to overcome these limitations and reduce future IT spending. However, lack of confidence that data and applications in the cloud are secure has been a major impediment to the adoption of cloud-based services.

THE SOLUTION: SECURE MULTI-TENANCY FOR SAP

Virtualization at all layers—servers, storage, and network—is at the heart of addressing these challenges. It provides new and much more efficient ways of operating and growing your SAP landscapes, while at the same time offering an evolutionary path to take advantage of cloud computing. NetApp, Cisco, and VMware have partnered to create an innovative service-oriented infrastructure that includes all server, storage, networking hardware, and software components to support secure multi-tenancy (SMT) in the cloud. With Cisco Unified Computing System, the joint solution opens up the combined potential of server, network, and storage I/O virtualization through a top-down approach that fuses traditionally separate infrastructure silos into a single holistic computing platform with high virtualization performance. The joint solution also supports sharing, reuse, and dynamic resource allocation for extending these capabilities to SAP landscapes, including SAP Adaptive Computing application virtualization.

Key features of the SMT model include an efficient, high-availability infrastructure with elastic scalability across all layers; integrated SAP application data protection; advanced automation of tasks such as SAP system copy creation; integration of SAP Adaptive Computing; and the ability to migrate both SAP applications and data transparently across the infrastructure.

SECURE SAP LANDSCAPES OPTIMIZED FOR VIRTUAL ENVIRONMENTS

A shared virtual infrastructure requires securely isolating the resources of different tenants, clients, business units, or departments while still delivering on promised service levels. The secure multi-tenancy solution from Cisco, NetApp, and VMware offers the industry’s first end-to-end, secure multi-tenancy solution for virtual SAP environments. The SMT solution keeps different SAP landscapes separated at the storage system level using NetApp MultiStore® software. MultiStore offers multiple isolated logical partitions on a single cost-effective Ethernet-based storage system so that tenants can share storage without compromising privacy.
The result is a secure, virtualized storage system with optimal storage utilization. This paper describes the enhancement and advantages of using secure multi-tenancy for SAP. Detailed information of the general SMT solution can be obtained here: www.imagievirtuallyanything.com.

2 SECURE SERVER AND NETWORK VIRTUALIZATION

CISCO

CISCO UNIFIED COMPUTING SYSTEM
The Cisco Unified Computing System physical servers are completely stateless and interchangeable. All server, network, and storage configuration information is contained in predefined XML service profiles, stored in the central Cisco Unified Computing System Manager, which dynamically maps these service profiles to physical compute blades based on predefined resource pools and policies. SAP administrators can bring new computing resources online and replicate or repurpose them in a matter of minutes rather than the weeks or months it traditionally takes to procure and deploy new resources.

Cisco Unified Computing System includes a series of improvements for better management, security, and performance of VMs. For example, each virtual interface card (VIC) provides up to 128 logical Ethernet or Fibre Channel interfaces to the VMs. This enables each VM to have its own dedicated interfaces for application, kernel, and control traffic, and these interfaces then move with the VM wherever it goes. Companies can also apply standard isolation best practices with individual/isolated network interface cards provisioned to the host OS, while still converging all traffic on a single 10GE unified fabric. With dedicated
interfaces, the Cisco Unified Computing System can consistently and centrally apply network policies whether the network port is on a physical host or a virtual machine.

The Cisco Unified Computing System provides dramatic improvements in simplicity, scalability, and cost reductions for customers. It minimizes the required number of systems, cables, switch ports, adapters, and associated power consumption. It consolidates and streamlines the management of systems required for development, testing, and production. The Cisco Unified Computing System also meets the requirements for customers running both physical and virtual systems and is particularly well suited for customers whose strategic direction is virtualization.

CISCO NEXUS SWITCHES
The innovative architecture of the Cisco Nexus Series Switches simplifies data center transformation with a standards-based, high-performance unified Gigabit Ethernet and 10 Gigabit Ethernet fabric that connects servers, storage, and users, greatly simplifying network management while delivering advanced capabilities with end-to-end security for all network traffic. Cisco TrustSec provides role-based security for all network traffic. TrustSec makes your network fabric role aware through secure access control, a converged policy framework, and pervasive integrity and confidentiality.

VMWARE

VMWARE VSHEILD ZONES
VMware vShield Zones is a centrally managed stateful, distributed virtual firewall bundled with vSphere 4.0 that takes advantage of ESX host proximity and virtual network visibility to create security zones. VMware vShield Zones integrates into VMware vCenter and leverages virtual inventory information such as vNICs, port groups, clusters, and zones to simplify firewall rule management and trust zone provisioning.

3 SECURE STORAGE VIRTUALIZATION

NETAPP MULTISTORE
NetApp MultiStore software lets you quickly and easily create separate and private logical partitions on a single storage system. Each virtual storage partition (vFiler™ unit) maintains separation from every other storage partition, so you can enable multiple tenants to share the same storage resource without compromise to privacy and security. You can be confident that no information on a secured virtual partition can be viewed, used, or downloaded by unauthorized users.

Since MultiStore enables the creation of multiple administrative domains, it is the ideal multi-tenant foundation for a shared storage services model.

With MultiStore, your users and clients have the confidence that each virtual data partition is private and that the storage network can easily be designated as either separate or shared. You can delegate administration of individual storage partitions to the clients and departments with access privileges while sharing physical storage infrastructure across a diverse set of SAP applications, without impact on data security.

MultiStore can help you achieve a truly dynamic data center environment, since data can be provisioned, moved, and protected based on user and application boundaries.
Since your critical information is kept in virtual storage containers, you can establish operational and business continuity policies that are data and application centric and not tied to specific hardware configurations.

Your ability to easily migrate data sets from one physical storage system to another is particularly important for nondisruptive system upgrades and system load balancing. MultiStore virtual partitions allow you to achieve this type of flexibility within the framework of a unified, multiprotocol architecture. MultiStore also simplifies data movement for disaster recovery since no client configuration changes are required on the destination storage system. The result is that you can create a shared storage infrastructure that is more responsive, easier to manage, and significantly less expensive to deploy.

**NETAPP DATA MOTION**

NetApp Data Motion™ lets you easily and quickly migrate data across multiple storage systems while maintaining continuous access to your applications. The result is that you can keep your shared storage infrastructure running as you add capacity, update infrastructure technology, and balance performance.

NetApp Data Motion integrates three proven NetApp software technologies—MultiStore, SnapMirror®, and Provisioning Manager—to provide live data migration for physical and virtual environments. You are now able to keep your clients and applications connected to their data regardless of where that data physically resides.

NetApp Data Motion lets you move data for either physical or virtual storage infrastructure without the need for planned downtime normally associated with storage capacity growth, lifecycle management, technology refresh, and system balancing. All data migration operations are performed while your applications continue to run, and since this is done at the storage array level, there is no performance impact on host systems. For ease of operation and control, all data migration is initiated and monitored from an intuitive management interface where source and destination storage systems are selected. Once data migration operations are complete, all applications and clients are transitioned seamlessly to the destination system. NetApp Data Motion is optimized for both physical and virtual server environments. All major virtual server environments are supported.

**4 APPLICATION VIRTUALIZATION**

**SAP ADAPTIVE COMPUTING**

The ability to combine server and storage virtualization with application virtualization offers additional advantages. With the SAP Adaptive Computing concept and the Adaptive Computing Controller, you can easily move SAP systems from one virtual machine to another or even to a physical server. The Adaptive Computing Controller system supports starting, stopping, and relocating of SAP systems as manual, scheduled, or mass operations.

With Adaptive Computing, it is now possible to relocate an instance from one host to another in a few minutes. The aim of Adaptive Computing is to replace the previously inflexible link between operating system and SAP system with the concept of a central storage system and resource sharing. Resource sharing is enabled by organizing the system landscape into building blocks, which allows the system landscape to react extremely flexibly to current demands. All servers, whether physical or virtual, are designated as resources, which in turn can be logically grouped and separated into pools. All resources within a pool are linked with each other by their own network.

**5 SAP SOLUTIONS**

**BACKUP AND RECOVERY IN MINUTES**

In virtualized, shared environments, as secure multi-tenancy, traditional backup approaches driven by the server layer are not practical. In order to optimize server utilization for application loads, it is important to remove the backup tasks from the server layer down to the storage layer with efficient storage-based backup automation.

With NetApp SnapManager® products integrated with SAP, you can create SAP database backups in minutes using NetApp Snapshot™ technology. NetApp SnapManager products also control the restore process, which takes just a few minutes.
NetApp SnapManager products also integrate with NetApp Protection Manager to extend backups based on Snapshot to an end-to-end disk-to-disk backup solution without the need for tape backups. NetApp Protection Manager and NetApp SnapVault® transfer the Snapshot backups from the primary to a secondary storage system by moving only changes at the block level. In this way, SnapVault minimizes the load on primary and secondary storage as well as on the backup network. This also reduces the amount of disk space required for each backup to typically less than 5% of the database size for each daily full backup. Protection Manager further simplifies the backup process by using protection policies to automate SnapVault transfers between storage systems.

![Snapshot backups transfer](image)

**Figure 2) SAP backup and recovery**

**FAST, SPACE-EFFICIENT SAP SYSTEM COPIES**

A typical SAP customer environment today consists of different SAP Business Suite and SAP NetWeaver® components. Processes such as testing application patches, running performance and data integrity tests, and providing user training environments all require several copies of SAP components. During these processes, the copies must be refreshed, often on a weekly or monthly basis. The creation of an SAP system copy normally takes several days, and many of the steps involved in creating the copy are manual, so they consume valuable IT staff time.

NetApp SnapManager products make it easy to create SAP system copies on demand, in a few minutes, and with minimal impact on the source system. Because the data is not copied but is referenced in place, the amount of storage required is limited to only data that is changed at the source and the target system. This significantly reduces the disk space required for SAP system copies.

Secure multi-tenancy for SAP makes it possible to clone individual SAP systems or complete SAP landscapes and to separate each clone securely from its source. In addition to standard SAP system copies including postprocessing specific to SAP, this makes it possible to run the cloned systems with the same system identifiers (SIDs) as the source and to eliminate any postprocessing specific to SAP. The isolation of the clones is assured by NetApp MultiStore at the storage level and by the Cisco Unified Computing System and TrustSec and VMware vShield on the server/network level.
On the source system a database-consistent Snapshot copy of the data files is created. This is done during online operation and has minimal performance effect on the source system. Therefore this step can be carried out at any time.

The FlexClone® copy can be created at the same storage system or at a secondary storage system. The secondary storage system could be already in place and used as a disk-to-disk backup device or a disaster recovery solution. The backup or disaster recovery replication images can be accessed for reading and writing using FlexClone technology. Existing backup or disaster recovery images will be utilized for test environments, turning expenses into assets. As a side effect the backup and recovery or disaster recovery solution is tested without any additional effort and without any interruption. As the original system, also the copied system can be truly separated from other systems using NetApp MultiStore, the Cisco Unified Computing System and TrustSec, and VMware vShield technology.

**ON-DEMAND SAP REPAIR SYSTEMS**

A specific use case in SAP environments is to use an SAP system copy as a repair system to recover from logical errors without having to restore and recover the entire SAP production system. NetApp SnapManager products enable you to clone a backup of the production system and attach it to another host to analyze the error, then test corrective procedures or export the required data out of the repair system and into the production system. This makes it possible to resolve the logical error with little or no impact on the production system, no data loss, and no inconsistencies within the SAP landscape. Because the creation of the repair system takes very little time and storage resources, it’s possible to test corrections multiple times before performing them on the live production system.

Secure multi-tenancy for SAP provides secure separation of SAP systems so that you can start the repair system immediately without having to do any postprocessing specific to SAP. This is assured by the usage of NetApp MultiStore, the Cisco Unified Computing System and TrustSec, and VMware vShield technology.
Figure 4) SAP repair system.

Figure 4 shows the general process of creating and using the repair system.

1. A logical error is discovered on the production system. Dependent on the kind of logical error, the decision can be made to shut down the production system or to keep it online, and only parts of the business processes are affected.

2. Several Snapshot backups of the production system are available, and any of these backups in the past can be chosen to create a SAP system copy of the production. The SAP system copy is created using a FlexClone copy of the Snapshot copy.

3. The clone is assigned to a new vFiler unit and provisioned to a new server or VM securely separated by Cisco Unified Computing System and TrustSec and VMware vShield from the original system.

4. The repair system is used to analyze the problem.

5. The appropriate data is exported from the repair system.

6. The data is imported to the production system.

In the described example there is less or no effect on the production system, no data loss, and no inconsistency within the SAP landscape.

The described scenario is quite simple, and it is obvious that not all logical errors can be solved in such an easy way. However, the repair system approach will also help in more complex scenarios, because there is more flexibility, and there are more options to analyze and to recover from the logical errors.

ACCELERATING TEST AND TRAINING CYCLES

Backups and SAP system copies based on Snapshot copies and FlexClone offer the possibility to create several consistent images/golden images of an SAP system, which can be used for test runs or user trainings.

If a test run has to be repeated, SnapRestore® reverts the system back to a consistent image within minutes to repeat the test or to rerun the test with other settings.

This also applies for user training systems. After the training session has been finished, the system will be reverted back to a golden image within minutes using SnapRestore, and the next session can be started immediately. Secure multi-tenancy for SAP provides secure separation of SAP systems so that you can start additional training or test systems immediately without having to do any postprocessing specific to SAP using the SAP system copy solution and the separation of these systems provided by secure multi-tenancy.
RESOURCE PROVISIONING AND REALLOCATION

SMT for SAP simplifies the provisioning of new resources and reallocation of existing resources.

At the storage level new space can be provisioned using MultiStore and FlexVol® technology, and new SAP systems can be provisioned with FlexClone technology. In addition, NetApp MultiStore, together with NetApp Data Motion, provides data mobility at the storage level. This makes it easy to move SAP systems, for example, to higher performance storage and servers when operations require greater throughput. For example, you can migrate an SAP HR system to a higher performance environment to run payroll twice a month.

At the server level the Cisco Unified Computing System and VMware vSphere provide the possibility to exchange the physical hardware without reinstalling the operating system. VMware VMotion is able to move a virtual machine from one physical ESX server to another without interrupting the application. Therefore SAP administrators can bring new computing resources online or repurpose them in a matter of minutes, rather than the weeks or months it traditionally takes to procure and deploy new resources.

SAP Adaptive Computing extends the virtualization to the application layer. This means the SAP solution will be installed using virtual hostnames and IP addresses. This offers the ability to move any SAP application or service from one physical or virtual server to another physical or virtual server at any time. Besides load balancing of applications, for example, move of an HR system to a bigger server during payroll run, this allows the nearly seamless refresh of physical server hardware and simplified operating system management.

OPERATING SYSTEM PROVISIONING AND MANAGEMENT

The combination of NetApp cloning technology, “golden images” of operating systems, and virtualized applications with SAP Adaptive Computing allows fast provisioning of operating systems (OSs) for new servers or virtual machines and simplified patching of operating systems.

New patches will be applied and tested at a new golden image and afterward, cloned and in combination with VMware vSphere and the Cisco Unified Computing System, provisioned to new servers (physical or virtual), and the SAP application will be moved to the new hosts.

This reduces the amount of time and resources required to apply patches to operating systems as only one operating system must be patched and tested and not the operating systems of all involved hosts.

6 CONCLUSION

The combination of application, server, network, and storage virtualization provides many advantages in managing existing SAP environments or provisioning new ones. Secure multi-tenancy offers separation of environments on all layers of the solution stack. It also makes it possible to simplify and fully automate SAP application lifecycle management tasks, such as backup and the creation of SAP system copies. The system uses NetApp SnapManager products and efficient storage-based technologies integrated with SAP to automate backup and recovery tasks as well as the cloning of SAP systems and landscapes.

The secure multi-tenancy for SAP solution enables SAP customers to reduce costs by running a shared, virtualized infrastructure while maintaining secure separation of their different environments when required. They can also create fast, space-efficient, fully isolated repair systems that can help them address logical errors in a very flexible way that can help save time and money.

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