

# DATA CENTER VIRTUALIZATION

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compellent

## EXECUTIVE SUMMARY

Many enterprise IT departments have attempted to respond to growth by adding servers and storage systems dedicated to specific applications, business functions, customers, and geographic locations. In many cases, the result has been a complex, inflexible infrastructure that is difficult and costly to manage. Today, virtualization technologies are the generally accepted way to solve these issues.

Server virtualization, which enables several applications to run independently on a single physical server, is an important first step toward achieving a virtualized environment. But it is only by combining server virtualization with storage virtualization that enterprises can realize the full benefits of virtualization. Consolidating resources through data center virtualization techniques can improve the return on IT investments, boost IT productivity, increase system reliability and availability, and ultimately enhance the ability of IT to meet the needs of the business.

Today there are several field-proven virtualization software and hardware products available, including Compellent Storage Center™ virtualized storage products and VMware® server virtualization software. This white paper will discuss how using Storage Center and VMware together allows both large and small enterprises to realize immediate benefits from data center virtualization.

## Virtualization Improves Utilization and Reduces Costs

The fundamental technique for consolidating resources is virtualization. Virtualization creates a pool of servers, storage, and other infrastructure resources that applications can share. Because applications in a virtualized environment draw from the resource pool without specifying the type of processor, memory, or storage required, the IT department gains the flexibility to choose the best underlying components. Meanwhile, the availability of new tools to manage virtualized infrastructures can enhance the reliability and availability of IT services while boosting IT staff productivity.

## Server Virtualization Increases IT Flexibility

Server virtualization can help increase IT flexibility and reduce equipment and labor costs by consolidating applications and workloads onto fewer physical servers. Rather than using five separate physical servers for five distinct applications, enterprises can employ VMware ESX Server™ virtualization software to run all five applications on the same physical server. Figure 1 illustrates five virtual servers running on a single server.

On that physical server, administrators create distinct virtual machines that host operating systems and applications. Each virtual machine is completely isolated from the others and operates as if it has a dedicated set of resources. But in fact, the virtual machines share the same physical resources. Virtualization management tools such as VMware VirtualCenter™ enable IT administrators to dynamically adjust the size and number of virtual machines, as computing needs change.

Having fewer physical servers reduces not only complexity but also software licensing and operating costs (for space, power, and cooling). In addition, server virtualization offers important advantages for testing and development. By creating virtual machines, administrators can establish full-fledged test and development environments by simply

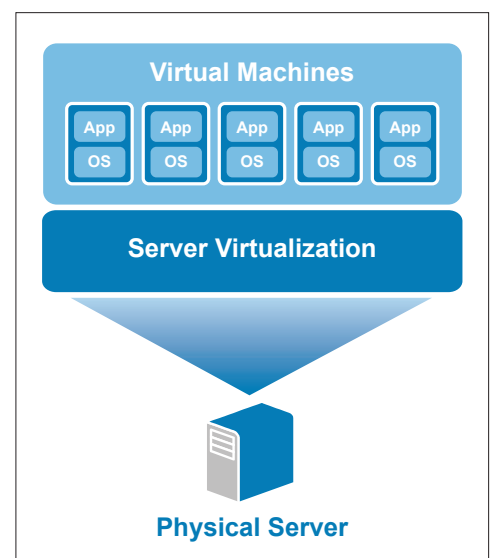


Figure 1: Server virtualization software allows multiple server instances to run on a single physical server.

copying the production environment onto virtual machines. Using server virtualization in this way, enterprise IT departments can reduce the need for dedicated test systems.

## Storage Virtualization Extends the Benefits of Server Virtualization

Server virtualization offers several important advantages, but to realize the full benefits of server virtualization, enterprises must overcome significant storage challenges. In many IT infrastructures, those challenges arise because storage is directly attached to servers and cannot be shared beyond the physical server. Storage area networks (SANs) enable servers to share centralized resources but virtualizing storage on a SAN is only the first step.

Traditional SAN offerings can experience some of the same stumbling blocks as direct attached storage in a virtualized environment. In fact, some of the shortcomings of direct attach storage and traditional SANs are actually exacerbated by server virtualization. When virtualized server environments are coupled with traditional storage, it is more difficult for administrators to tailor storage requirements for each application. An application might benefit from a particular server interface, drive technology or speed, RAID configuration, or snapshot schedule. But in a virtualized server environment with direct attach storage, all of the applications running on the physical server are forced to use the same storage, with the same storage characteristics. Traditional SANs do not provide a solution. They offer only a limited number of volumes which are not enough to accommodate each of the large number of applications that can run on a virtualized server.

To take full advantage of server virtualization, IT departments need a storage solution that allows fully shared resources, easy and automated storage classification and migration and complete data protection.

## Powerful Data Center Virtualization Using Compellent and VMware

It is only through data center virtualization—virtualizing both storage and servers—as illustrated in Figure 2—that enterprises can realize the full benefits of virtualization. Compellent Storage Center is a leading storage system with advanced storage virtualization capabilities that integrates with server virtualization software, such as VMware ESX Server, to form the foundation for data center virtualization.

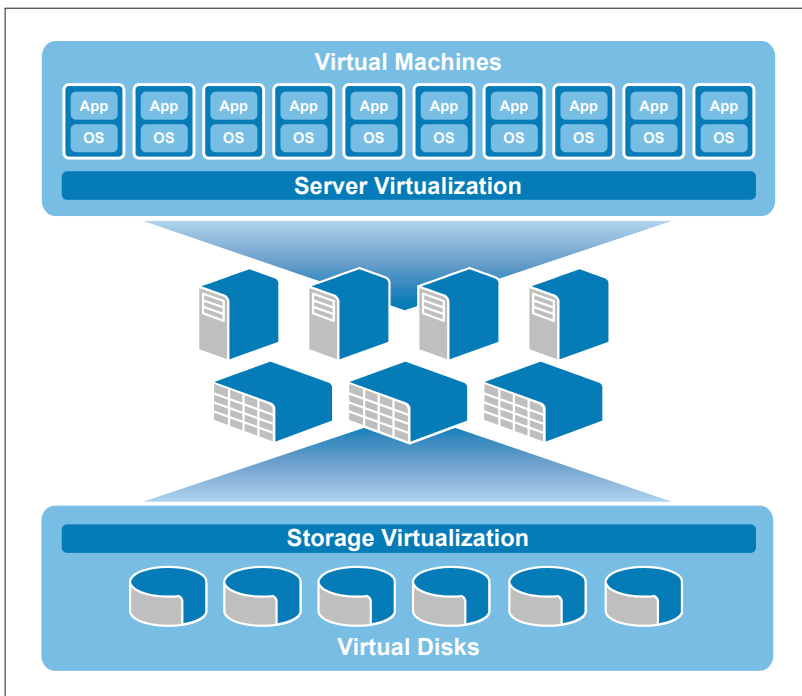


Figure 2: Server virtualization and storage virtualization software combine to create a powerful data center virtualization solution.

Storage Center includes a full range of storage virtualization capabilities along side other features that complement server virtualization initiatives and enable a complete data center virtualization solution:

### Thin Provisioning

By pre-allocating disk space, as required in traditional SAN implementations, storage is underutilized. For example, an administrator might pre-allocate 2 TB of disk space for an application in anticipation of growth over the next two years. But if only 500 GB of that storage is used over the course of the first year, the other 75 percent of that allocated space remains unused. Administrators are often reluctant to purchase and allocate storage in smaller increments, however, since allocating storage can be a complex and time-consuming process that interrupts availability for users.

With Storage Center, there is no need to pre-allocate drive capacity to volumes before that capacity is used. Storage Center Dynamic Capacity™ dynamically allocates storage only when data is written to disk. This approach, also called thin provisioning, can dramatically increase storage utilization while reducing the need to over-provision capacity in anticipation of future growth. As a result, enterprises can purchase significantly less storage than they would need in a non-virtualized storage environment.

For example, an enterprise might use VMware ESX Server to create ten virtual machines on a single physical server. Each of those virtual machines might require 1 TB of storage. Without virtualizing storage, the enterprise would need to purchase 10 TB of storage to satisfy the applications' requirements. Figure 3 shows how enterprises can create a virtual storage volume for each server based on a single terabyte of storage with Compellent Storage Center.

Each application has access to the full amount of storage it needs. If and when the enterprise actually requires more storage capacity, it can simply add storage capacity while applications remain online.

Storage Center enables administrators to create an unlimited number of virtual storage volumes across a SAN and then match those volumes with individual applications running on virtual machines. As a result, administrators can fine-tune storage characteristics for the individual applications. Each application can use the optimal server interface, drive technology and speed, RAID configuration, and snapshot schedule. Because Storage Center lets administrators create an unlimited number of volumes, administrators can support the large numbers of applications running in virtual server environments.

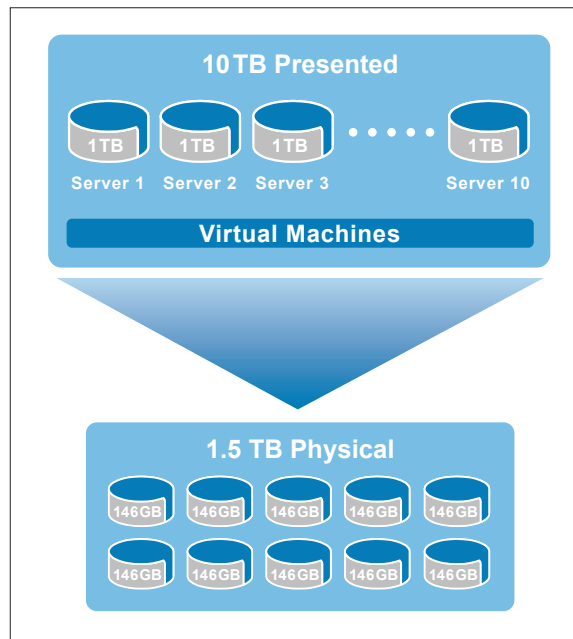


Figure 3: Storage Center's Dynamic Capacity can present 10 virtual storage volumes, 1 TB each, for use by 10 unique VMware servers based on only 1.5 TB of physical capacity.

**BUILDING THE ULTIMATE TEST ENVIRONMENT WITH COMPELLENT AND VMWARE**

A major application developer uses Compellent Storage Center and VMware ESX Server to rapidly test software in a wide range of operating environments. With Storage Center, each operating environment, with its operating system and any associated data, can be kept on a separate storage volume. When the developer is ready to test a new version of the software, they can use Storage Center Data Instant Replay to map a space-efficient Replay of each volume to a VMware virtual machine—saving the time and storage capacity required for copying the full volume. Within minutes, the developer can run the test infrastructure. When the test is done, the developer removes the Replay but has the original volume readily available to test the next application.

## Automated Tiered Storage

The complexity of managing SANs is amplified by the use of multiple storage classes. Most enterprise SANs have a combination of faster (expensive) and slower (economical) storage to provide several price/performance options for data in an effort to optimize costs. But managing a multi-class SAN can be labor intensive. Administrators need to effectively analyze data usage and manually migrate data to the most cost-effective storage or risk leaving unused data on fast, expensive storage.

Storage Center Data Progression™ optimizes the use of multiple storage classes by tracking usage and automatically moving data between storage classes based on predefined rules. Frequently used data can remain on faster storage, while less-frequently used data can be pushed to slower, more economical storage. By automating this process, IT staff can address more strategic tasks. Moving inactive data off high-performance drives can also help improve performance for all VMware instances by freeing up spindles to be used for performance-intensive applications.

## Continuous Snapshots

Data protection can present challenges for typical SANs. For enterprises that employ RAID storage, the cost of adding storage capacity is significantly increased by RAID overhead. When storage is pre-allocated to specific applications, much of that expenditure will be for allocated but unused space. Mirrored SANs increase these costs even further. Using Storage Center's Data Instant Replay™, enterprises can purchase less storage.

Data Instant Replay can automatically create space-efficient snapshots, called Replays, which protect data against loss or corruption. These Replays do not require full volume clones during the creation or recovery process. Storage Center simply maps the Replay as a logical unit number (LUN) to be used by the server. Negligible storage is consumed for mapping, and Replays can be mapped any number of times as read/write volumes. In fact, the size of the Replay grows only to accommodate changes as blocks are modified. This efficient use of storage, compared to other SANs, means many more Replays can reside in a given amount of physical storage.

Data Instant Replay also provides an extremely rapid way to restore data. In the event that a file must be rolled back to a previous point in time, Data Instant Replay does not need to restore the entire volume; it simply restores the blocks that contain changed data. Replays can also help administrators test new applications and service packs, efficiently support server Boot from SAN operations, and virtually eliminate backup windows on production systems.

When combined with VMware, Data Instant Replay enables IT departments the ability to recover any virtual machine within ten seconds. All of this leads to a highly available and completely protected data center.

## Remote Replication

For even greater data protection, Storage Center Remote Instant Replay™ can replicate multiple volumes at multiple locations. Administrators can create any combination of Replays at local and remote locations, or establish frequent local Replays with periodic replication to a remote location. Using Data Instant Replay and Remote Instant Replay together, administrators can also replicate multiple volumes to multiple sites. Remote Instant Replay can provide a high level of protection with a minimum investment in storage capacity.

Using Remote Instant Replay in combination with VMware allows businesses the flexibility to easily replicate entire server instances off site.

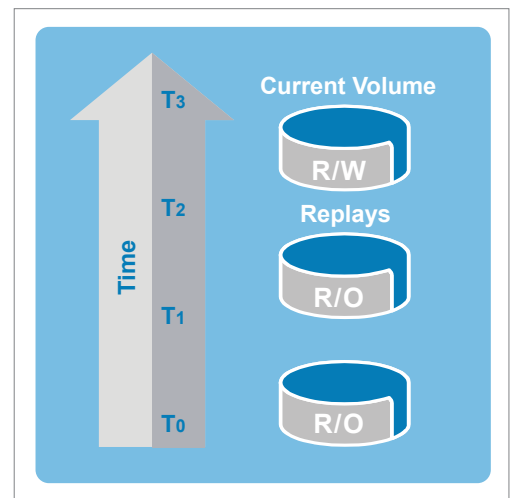


Figure 4: Example of multiple Replays taken at successive points in time. These Replays can be used to provide granular data protection for VMware server instances.

## Compellent and VMware Provide Data Center Virtualization

With Compellent and VMware, data center virtualization can be deployed today, allowing enterprises to realize several immediate and tangible benefits:

### Reduced Costs

Using server and storage virtualization, enterprises can consolidate their infrastructure into resource pools that have fewer servers, disk drives, and enclosures. By consolidating resources, organizations can lower equipment and administration costs. Infrastructure consolidation also reduces power, heat, and cooling expenses while decreasing the physical space needed for equipment.

### Enhanced IT Productivity

Consolidated infrastructures are simpler to manage, often times requiring lower IT skill levels than complex, widely distributed infrastructures. In many cases, consolidated infrastructures require lower IT skill levels than complex, widely distributed infrastructures. Compellent and VMware also provide powerful tools to deploy new servers and allocate storage for new applications, changing workloads, and maintenance needs. VMware VMotion™ enables administrators to move functions from one virtual machine to another, or one physical box to another, with straight forward workload management tools. Moving volumes from one class of storage, or one set of disks to another, is accomplished with equal ease in Storage Center's virtualized environment using an intuitive point and click interface.

### Greater System Availability

In the event that service is required for a storage system or server, administrators can use system management tools to deliver high levels of availability. Storage Center's intuitive interface helps administrators preserve application availability by quickly moving storage volumes. Administrators no longer have to wait for narrow change windows to make modifications or to service components.

Other tools help minimize interruptions due to failures. Data Instant Replay, for example, enables administrators to quickly move a volume to another drive and roll back to a state prior to the failure. As a result, a failure can be overcome very rapidly, affecting very few infrastructure elements.

### Greater IT Flexibility

Virtualization gives an IT department greater flexibility to choose the best mix of resources for its needs—without having to make changes to applications. This flexibility enables IT to be more responsive to changing user demands and the associated service-level agreements (SLAs).

For example, using Storage Center, administrators can quickly add or remove volume capacity without interrupting ongoing operations. By using Storage Center in combination with VMware ESX Server, administrators can also change the type of server-to-storage connectivity to quickly move an application from test to production, or to increase the bandwidth to meet rising demand. Since Storage Center supports both iSCSI and Fibre Channel interfaces, administrators can use VMware software to move an application from one physical server, which uses an iSCSI connection, to another physical server, which uses a Fibre Channel connection—all without any downtime.

### Enhanced Business Agility

Ultimately, virtualization delivers benefits to the enterprise. As enterprises increasingly rely on IT to achieve their goals, IT flexibility translates into business agility.

Masonic Care Community, an upscale retirement village, estimates it will save at least six IT headcounts by implementing a data center virtualization solution using Compellent and VMware.

Scott County, the fastest growing county in Minnesota, uses a combination of Storage Center and VMware ESXRanger to ensure continuous availability.

During the day Data Instant Replay takes several snapshots of Scott County's VMware Exchange instances. If they get a virus, they can simply revert back to a clean Replay and email will be back up and running in minutes. At night, ESX Ranger copies instances of VMware servers to direct attached storage, for double data protection.

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