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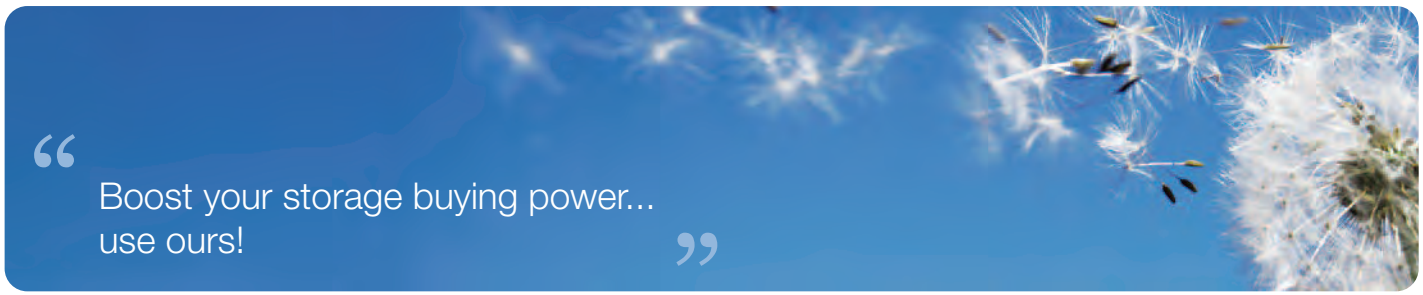

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TINTRI

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Tintri For VDI Deployments

TECHNICAL WHITE PAPER

by
Saradhi Sreegiriraju
Director, Product Management

Executive Summary

As users increasingly become mobile and require access to desktops and applications from remote locations, IT organizations are struggling to deliver cheap, secure and accessible environments.

Companies have reduced both the capital and operating costs of data centers by virtualizing enterprise applications like Exchange and SQL Server. At the same time, they're able to provide higher levels of service to end users. Desktop virtualization or virtual desktop infrastructure (VDI) is meant to deliver similar benefits to the desktop.

However, virtualizing desktops poses very different challenges. Shared storage infrastructure cost, performance and per-VM manageability of the storage layer are the most commonly cited obstacles to successful VDI implementations.

A new VM-aware storage system that uses VMs and virtual disks as management entities can overcome manageability issues. Combined with a Flash/SATA hybrid system, it is possible to achieve an effective cost per VM for VDI. This white paper looks the various components of VDI solution, the storage challenges of deploying VDI, and explores why the unique features and functionality of Tintri™ VM-aware storage (VMstore™) are perfect fit for VDI deployments.

Introduction to VDI

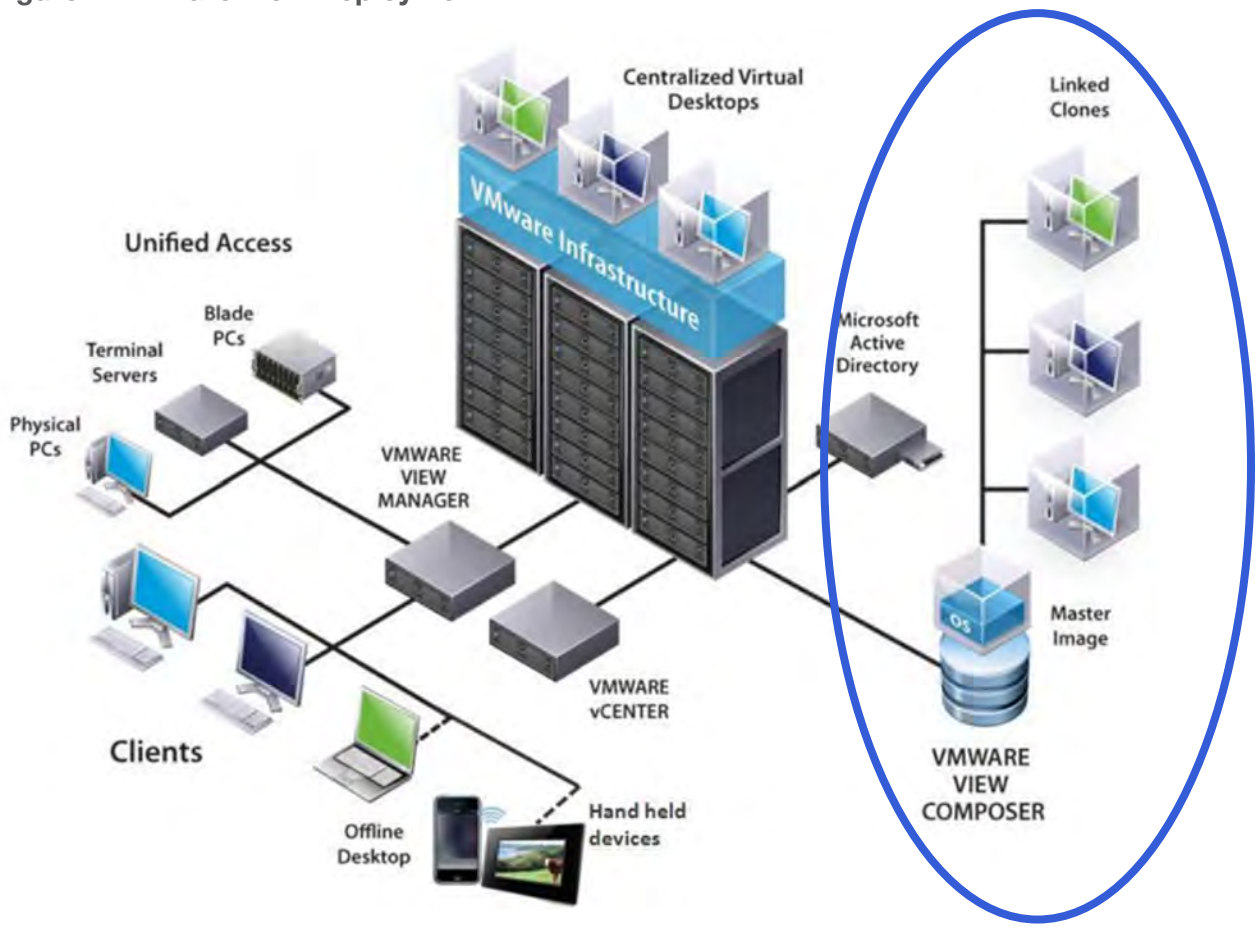
At a high level, VDI deployments include several distinct components:

1) Hypervisor: For example, VMware vSphere and Citrix XenServer
2) Centralized desktop management tools: For example, VMware View Composer and Citrix Machine Creation Services
3) Connection broker and desktop assignment/management: For example, VMware View and Citrix Desktop Delivery Controller
4) Thin client/PC: For example, Wyse and Cisco
5) Virtual desktop images: For example, Windows XP, Windows 7 and SUSE Linux

Virtual desktop images are hosted on a storage system which also provides storage for data generated by users of the virtual desktops. Figure 1, below, shows an example of a VMware View deployment with the storage component circled. Storage is at the center of VDI deployments and is often the performance bottleneck in large-scale deployments with traditional storage systems.

Although this white paper uses VMware View terminology and assumes the underlying hypervisor is VMware vSphere, Tintri VMstore can be used just as easily with XenDesktop using vSphere as the underlying hypervisor.

Figure 1: VMware View Deployment



Source: Courtesy of VMware, Inc.

Storage challenges in VDI environments

Virtualization poses serious challenges to legacy shared storage systems. Traditional storage systems were designed before the advent of virtualization and fall short in VDI environments at many different levels. Traditional storage systems:

1) Require overprovisioning of storage leading to unnecessary capacity and a large footprint that increases both CAPEX and OPEX.

2) Require complex management of RAID groups, LUNs, and volumes that make troubleshooting and performance management almost impossible (see Figure 2, below, for an illustration).

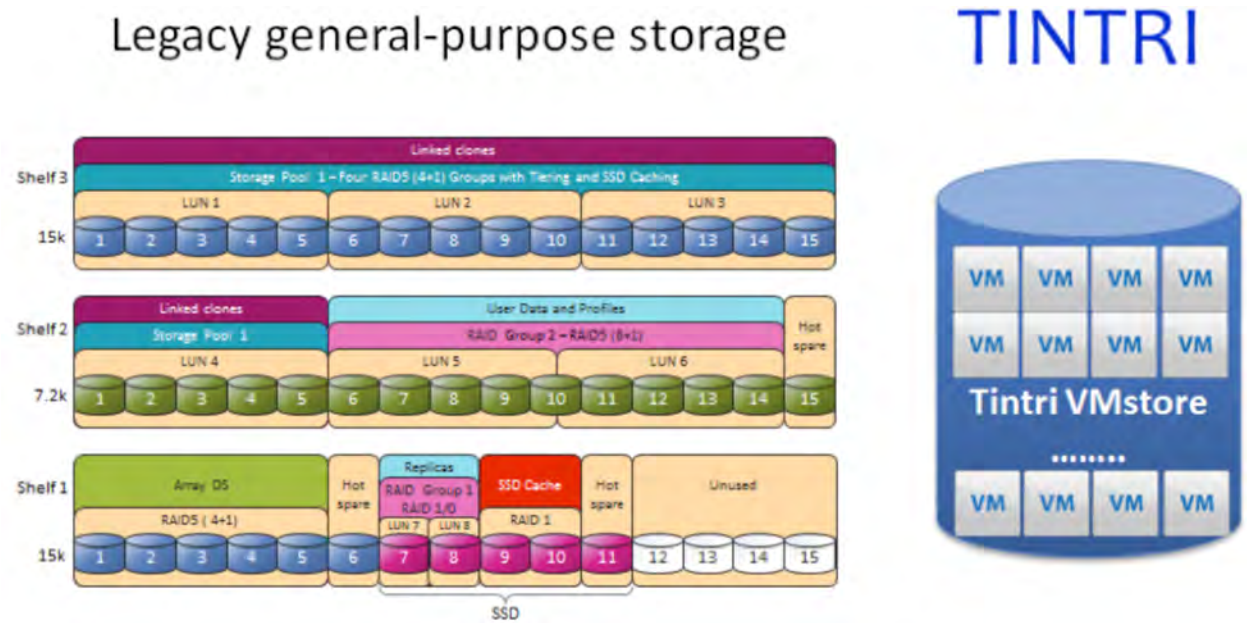
3) Lack simplified performance and storage monitoring tools for installing and scaling VDI deployments.

4) Lack VM-level statistics to identify issues with individual desktops.

5) Are not designed to work with VDI: VDI deployments generally produce small random write workloads. When hundreds of VMs are deployed, the impact is quickly amplified and poses a serious challenge for legacy storage systems, which are optimized for large coalesced IOs.

Figure 2 shows the complexity of a typical VDI deployment using legacy storage system architectures, contrasted with the simplicity of Tintri's VM-aware storage.

Figure 2: Legacy Storage Architectures vs. Tintri



VM-Aware Storage for VDI

Virtualization owes its success in transforming data centers to the power of VM abstraction. A VM may be run on a generic pool of shared hardware resources, and its CPU and memory usage are easily monitored and modified. Unfortunately, storage for VMs has increasingly become a bottleneck in server virtualization environments. It poses even greater challenges for VDI environments with hundreds of virtual desktops provisioned on a single storage system.

Tintri VMstore overcomes these limits. The Tintri VMstore file system is designed from the ground up for VMs. It uses VM abstractions — VMs and virtual disks — in place of conventional storage abstractions such as volumes, LUNs or files. Purpose-built for VMs and focused specifically on the problems of VM storage, Tintri VMstore provides management at the same level of abstraction as the rest of the virtual infrastructure.

Tintri VMstore has a number of capabilities that make it highly suitable for large-scale VDI deployments. The next sections explore each of those features and functionality in the context of VDI deployments.

Easy to setup and administer

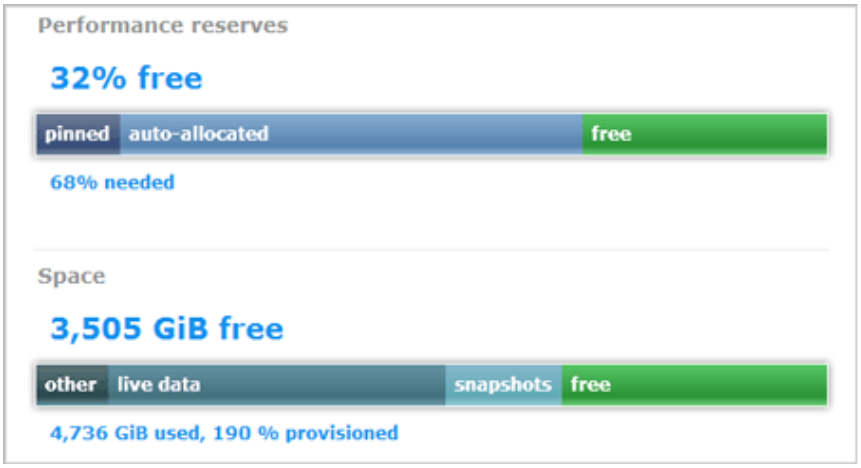
Tintri VMstore can be set up and configured in minutes. No complex storage configuration is required. Once the appliance is powered on, it's as simple as connecting it to your VMware vCenter Server™ and provisioning VMs on the VMstore. Each node is a single datastore, making it easy to map to your VMware vSphere™ hosts. What's more, when you add new VMs, you won't need to worry about configuring new LUNs, volumes, RAID groups or any other complex storage objects — since there are none.

Benefit: Simplified installation reduces installation, support, and maintenance costs substantially.

Performance and capacity fuel gauge

A unique "fuel gauge" gives you immediate visibility into both the available storage capacity and performance headroom on any Tintri VMstore appliance (see Figure 3, below). For the first time, this gives you predictable storage performance with a single, easy-to-use metric. Two aggregate indicators with drill-down capability let you keep tabs on your VMs. The unique performance gauge allows users to quickly identify how many more virtual desktops can be deployed on a given VMstore based on the resources available.

Figure 3: Tintri VMstore Fuel Gauge

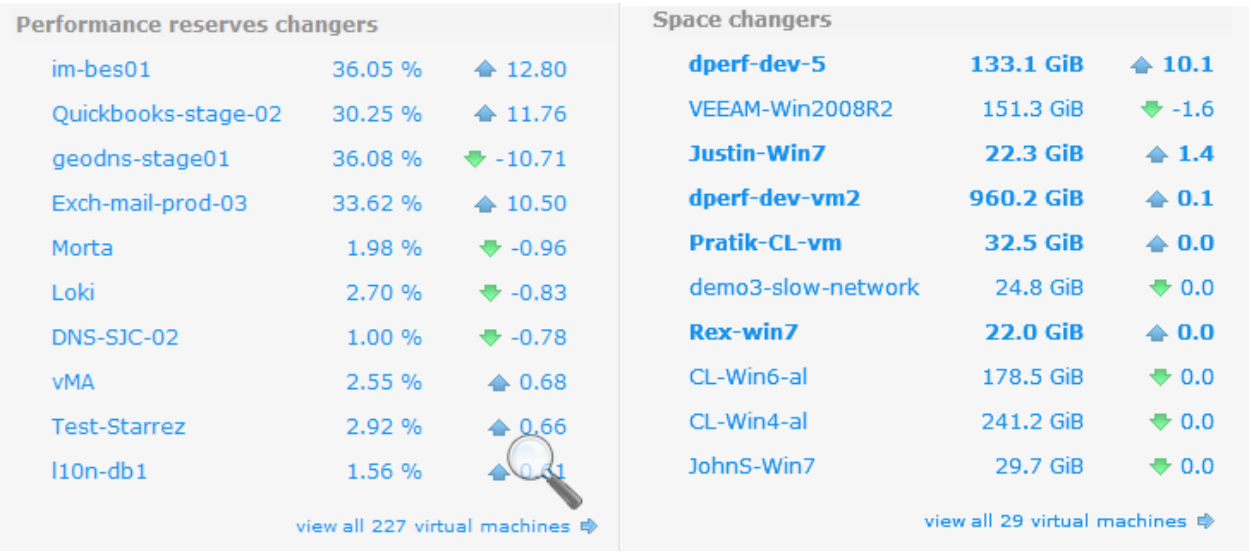


Benefit: Managing performance is as easy as managing capacity. Administrators can quickly estimate how many more virtual desktops can be provisioned on a given Tintri VMstore, taking the guesswork and complexity out of provisioning storage for VDI.

Performance Dashboard

Tintri VMstore's dashboard view quickly identifies VMs with the most changes in performance or capacity requirements in the past seven days (see Figure 4, below). Administrators need not understand how VMs map to the storage components; all they need to know is the name of the VM. Tintri VMstore manages the details behind the scenes by integrating with vCenter.

Figure 4: Tintri's Performance Dashboard



The per-VM granularity for tracking performance and space changes in use by individual virtual desktops allows administrators to keep tabs on desktops that may be using undue storage resources. The dashboard is arranged to provide a summary view to show the top VMs, making the information much more readily actionable.

The per-VM performance and space change information also helps administrators in environments that share the Tintri VMstore for hosting both server and virtual desktop workloads. Administrators can immediately see the changes in storage resource needs of the different categories of VMs running on a VMstore and ensure that different workloads do not affect each other.

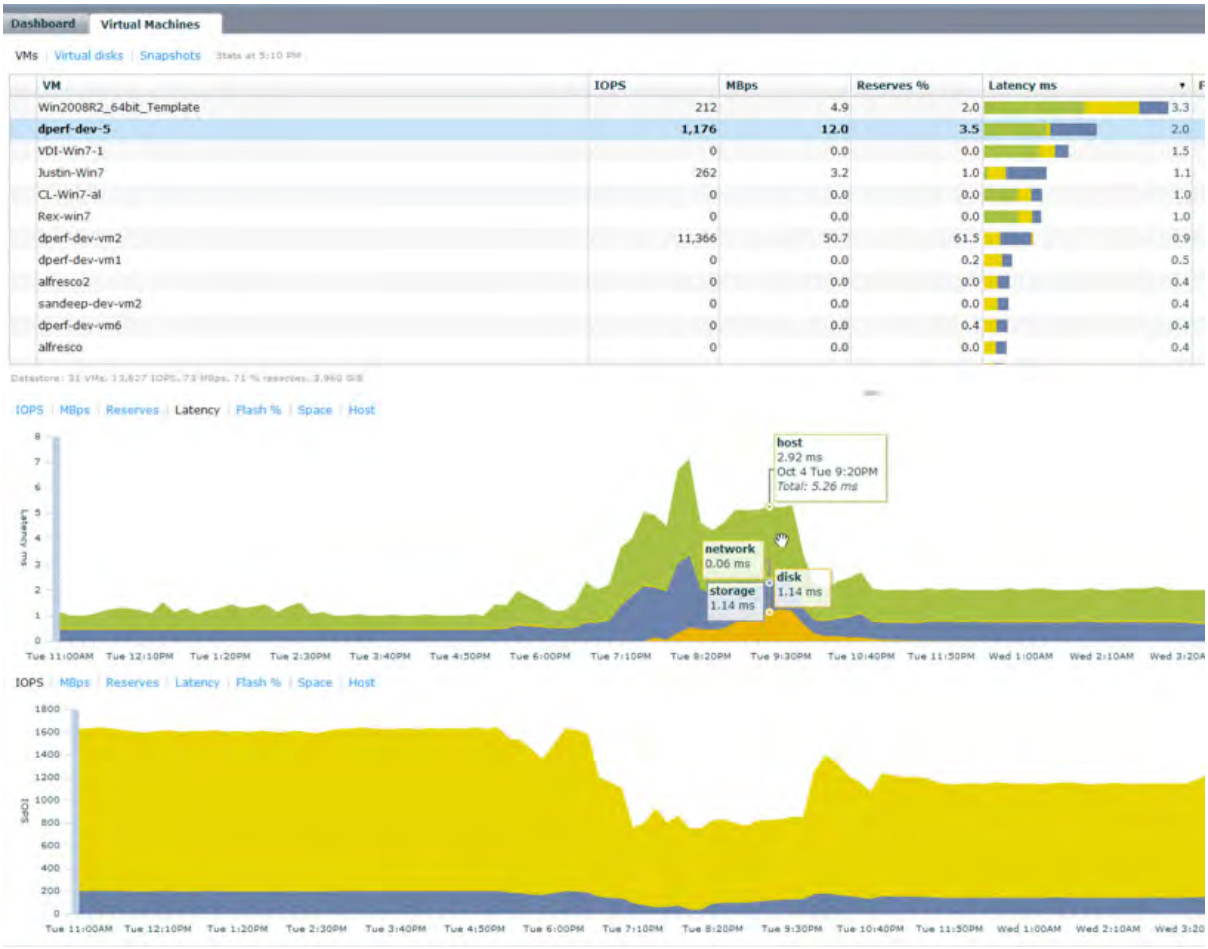
Benefit: Provides administrators with a quick way to monitor end user experience on a per-VM basis.

Instant Bottleneck Visualization

Tintri VMstore visualizes per-VM performance bottlenecks for instant diagnosis. Performance troubleshooting is one of the most tedious VM management tasks. With Tintri VMstore, administrators can quickly see a performance and storage utilization profile on a per-VM and virtual disk basis and have instant visibility into the latency, from the guest OS layer to the storage layer (see Figure 5, below). They can see per-VM or per-vDisk latency at any infrastructure layer, identify the source of performance issues, and take immediate action. VMstore also maintains historical latency data automatically, giving administrators a graphical seven-day view of performance.

Per-VM and virtual disk performance visualization allows VDI administrators to quickly troubleshoot on a per-desktop basis to provide end users with unparalleled service.

Figure 5: Instant Bottleneck Visualization



Benefit: Visualizing per-VM performance and latency allows administrators to quickly troubleshoot issues and provide a consistent service levels.

Predictable Performance

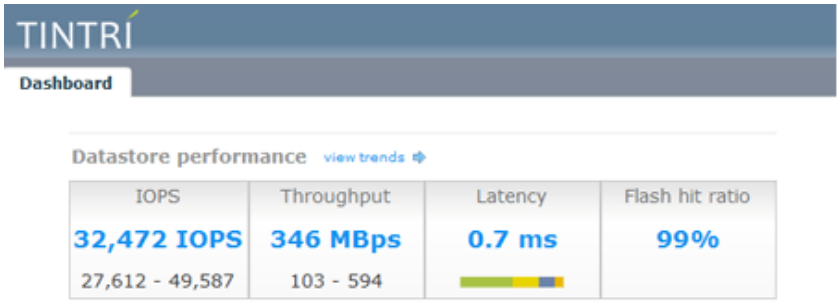
Disk access latency and IOPS performance requirements are magnified in large virtual desktop deployments because of the number of VMs. These can become highly unpredictable in a legacy disk-based storage system. Flash performance, in contrast, is much easier to characterize, is location-independent, and is much more uniform. Legacy storage systems must employ complex caching and tiering technologies to take advantage of Flash, creating ongoing administrative headaches for the storage and virtualization teams.

Tintri eliminates traditional tiering by automating placement and writing directly to Flash when appropriate. The Tintri file system is designed specifically to deliver Flash performance without requiring manual configuration or VM placement. It deduplicates and compresses data in Flash using a very small block size to provide much larger effective capacity. For example, the base image for a VMware-linked clone

can be entirely cached and or pinned in Flash to service all read IOs from Flash directly, thereby providing low and uniform latency even during boot, log-on and application launch storm-type workloads, even with hundreds of virtual desktops.

VDI deployments also produce small random-write IOs that are not suitable for legacy disk-based storage systems. Tintri VMstore services the write IOs directly from cost-effective multilevel cell (MLC) Flash with its innovative file system that solves random-write IO amplification issues with MLC that previously made it unsuitable for enterprise environments. Figure 6 shows the consistent sub-millisecond latency achieved by a Tintri VMstore at high IOPS and throughput.

Figure 6: Datastore Performance



The Tintri file system minimizes swaps to disk with automated placement to ensure only active data is kept in Flash. The typical mixture of hot and cold data in virtualized environments often include minimally-active or periodically busy virtual desktops. The Tintri file system adapts to periodic workloads to ensure they are not evicted from Flash during idle periods, and provides good read/write performance even for VMs that reside mainly on disk.

The VM-aware nature of the file system allows Tintri to provide performance isolation for each VM. By automating data placement and keeping the most active data sets in Flash, VMstore provides QoS on a per-virtual disk and per-VM basis. The Tintri file system automatically uses the combination of Flash and disk that best suits the activity of the VM, adjusting it over time to prevent variations in a few desktop VM I/O patterns from causing disruptions for other VMs. This can appreciably help VDI installations to prevent runaway desktops from using up system performance, and provide acceptable performance to all desktops hosted on the system.

Benefits:

1) Much larger effective Flash capacity accommodates higher VM density and provides a fast response time and end-user desktop experience.

2) Write-intensive VDI workloads are serviced from Flash, ensuring consistent end-user desktop experience.

3) Minimally active desktops are not evicted from Flash, providing a consistent desktop experience.

4) Provides consistent performance to end-users to meet service level agreements, without the need to overprovision storage to meet peak and unanticipated IO workloads.

Incremental Scalability

Hypervisor administrators have perfected deploying incremental hosts for increasing CPU, network and memory resources to scale compute resources. The hosts can be managed from vCenter as a cluster. Tintri VMstore integrates software and hardware capability in to a field-serviceable storage appliance, built from the ground up to run VMs. The Tintri file system is designed to take full advantage of Flash, multicore CPUs and 10GbE to deliver the performance needed for hundreds of virtualized desktop environments.

Traditional SAN-based storage architectures typically map 500GB LUNs as datastores, creating a large number of storage objects. Each Tintri VMstore appears as a single 13.5 TB NFS datastore per appliance. Tintri reduces the number of storage objects to manage by a substantial factor. With Tintri, even fairly substantial VDI deployments can start out using a single datastore. As the environment grows, the storage can scale incrementally simply by adding additional Tintri VMstore appliances. Because each appliance appears as a datastore, it's easy to manage them seamlessly from vCenter.

Benefit: The cost of the solution can be scaled by scaling capacity and performance together on a demand basis, to reduce both CAPEX and OPEX.

Data Center Footprint

Tintri VMstore is designed to fully capitalize on the most cost-effective Flash technology available. The Tintri file system integrates Flash as a first-class storage medium rather than as a bolt-on cache to fully leverage continued improvements in Flash price and performance. MLC Flash — combined with inline deduplication, compression, and a unique Flash/disk file system — enables Tintri to provide 13.5 TB of Flash performance in a small 3U footprint, keeping the total per-VM acquisition cost (CAPEX) very affordable.

The small footprint of the appliances saves substantially in operating expenses for power, cooling and floor space.

Benefit: The small footprint of Tintri systems provides substantial savings from reduced rack space, power and cooling, thereby reducing the cost of storage per virtual desktop.

Conclusion

Desktop virtualization can provide huge benefits in streamlining the IT infrastructure, reducing costs, and increasing security and compliance, while making desktops and applications more accessible. However, storage remains the primary obstacle to deploying and maintaining virtual desktop infrastructures. Tintri VMstore, with its innovative VM-aware file system, leverages cost-effective MLC Flash to deliver high performance in a very small footprint that can scale incrementally to meet growing needs. Tintri's file system uses deduplication, compression and thin provisioning to provide unparalleled VM density required for deploying virtual desktops. Tintri VMstore allows administrators to overcome the complexity, performance and cost obstacles preventing organizations from deploying VDI.