Pivot3® Desktop Virtualization Appliances™

vSTAC™ VDI Technology Overview

February 2012

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Executive Summary

Virtual desktops have quickly become a top priority in IT organizations because of the tangible benefits associated with better security controls, reduced operational costs from centralized maintenance, and lower acquisition costs for endpoint desktops. More recently, end users themselves are pushing IT organizations to implement virtual desktop solutions so that secure corporate applications can be accessed from an ever-expanding set of devices such as tablets and smart phones.

But desktop virtualization (DV) adoption has been limited because of the management and cost challenges in using legacy products to solve the demanding need of DV infrastructure. Desktop virtualization, like server virtualization, demands shared storage that can be managed, protected and scaled independent of each desktop. Yet few customers have the expertise to configure DV infrastructure, much less implement the relocation of storage and compute for hundreds or thousands of physical single-point-of-failure desktops to a high-availability centralized model. IT management is being pressed to do more with less and the complexity and inflexibility of traditional storage and server products make DV projects simply too difficult to configure, manage and scale.

It's also not hard to see why the return on investment model is broken. On the storage front, replacing the $50 disk drive inside a physical desktop with $500 of high-availability SAN or NAS capacity quickly eats into promised cost savings. Similarly, replacing standalone desktop CPUs with failover-protected server CPUs introduces cost and management complexity.

Pivot3 has developed a totally new appliance approach to DV infrastructure that addresses each of these concerns. The Pivot3 vSTAC VDI appliance is simple to configure, seamless to scale and leverages server cost economics to meet the most demanding budget needs.

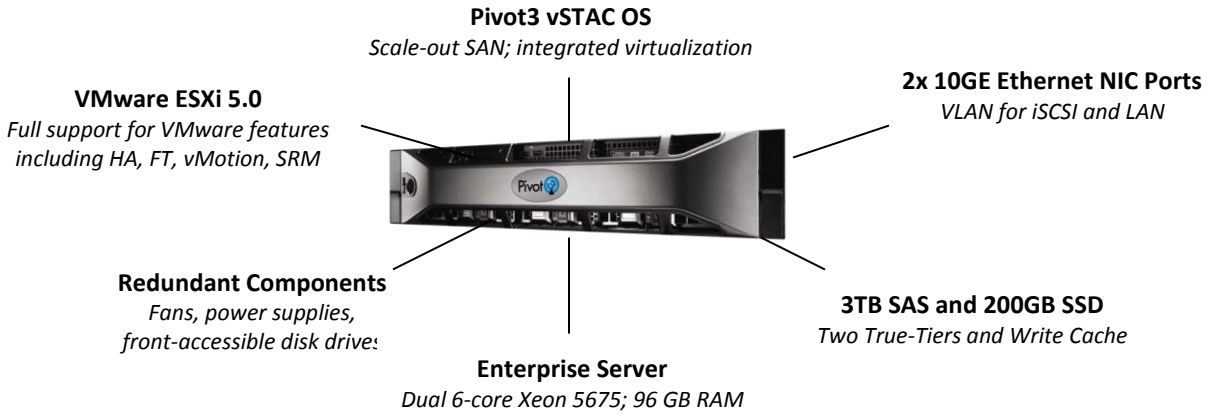
Our goal is to make DV accessible to a user who is not a storage expert and who does not have a storage budget. The purpose of this document is to provide a technical overview of the Pivot3 VDI approach for those users that want a more detailed view of the underlying technology that supports to solution set.

The Pivot3 VDI Appliance

Each Pivot3 VDI Appliance provides the compute, network and storage resources for over 100 virtual desktops. A VDI Appliance can be used standalone or can be stacked for high-availability as part of a scale-out cluster, which we call a vSTAC™ or virtual storage and compute stack.

VDI Appliance Resources

Each Pivot3 VDI appliance can support over 100 virtual desktops as a standalone appliance. The resources of each appliance are shown below:



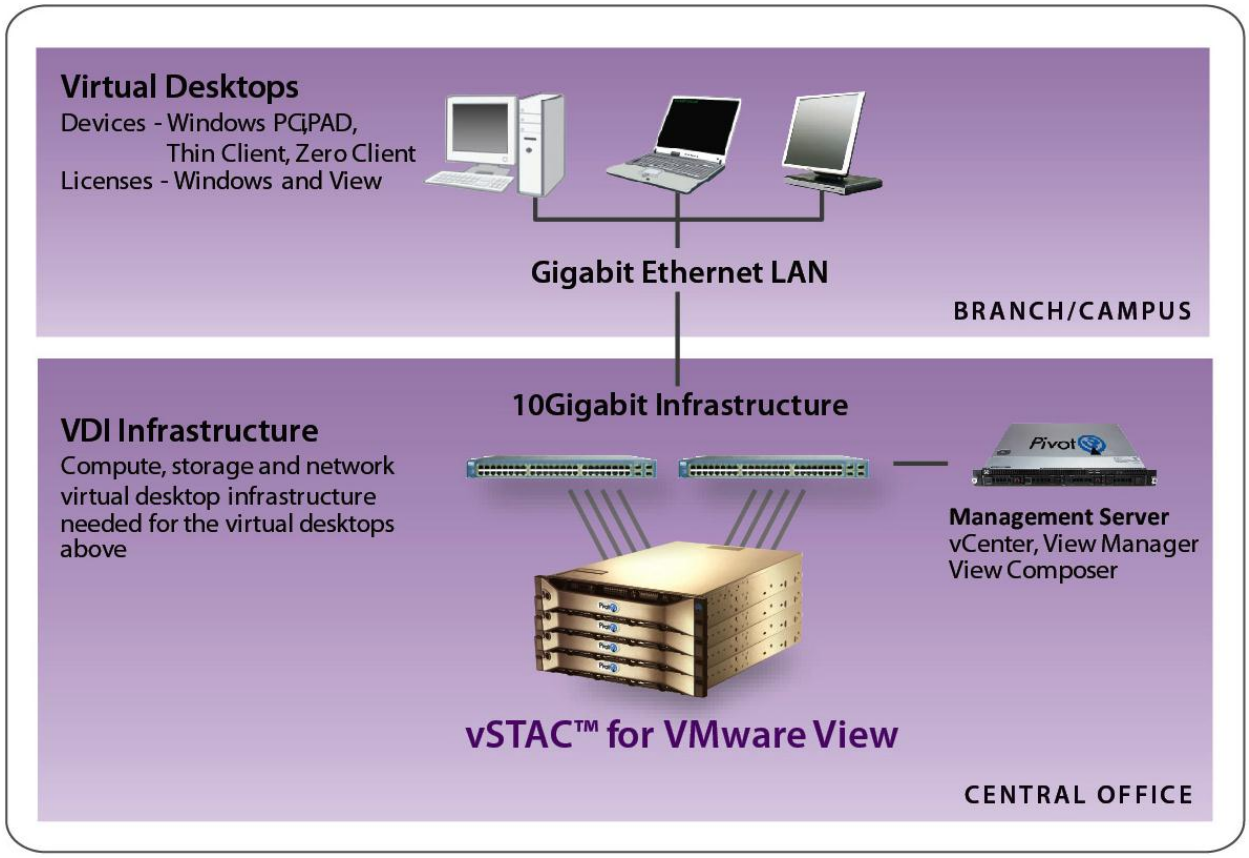
The complete Pivot3 VDI specification sheet is available at http://www.pivot3.com.

Each Pivot3 VDI appliance is high-volume off-the-shelf server hardware from several leading manufacturers.

Stacking Pivot3 VDI Appliances

Pivot3 VDI appliances can be configured together as an integrated "stack" to support more virtual desktops. As VDI appliances are stacked, the system gains high availability and automatically distributes resources optimally.

For a desktop administrator, this stack approach means that DV resources do not have to be configured at an appliance level and that the system can be self-healing in the case that one of the appliances fails. It also provides a simple appliance-level scaling model so that more resources of all kinds are added to the pool as more virtual desktops are supported.



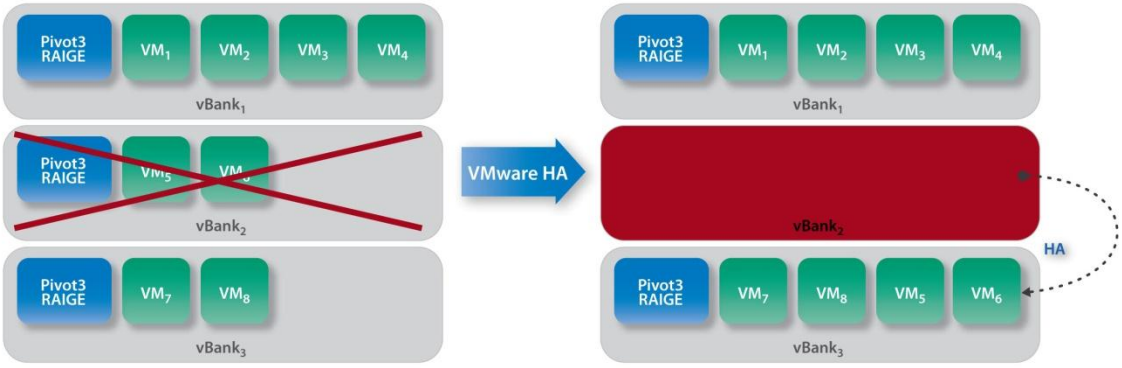
There are a number of unique benefits from this stackable approach, namely:

- Seamless scaling from proof-of-concept into production
- High-availability and high-performance of share storage without the cost or need for a SAN administrator
- No big initial investments so a budget-friendly pay as you grow model
- Easy deployment with all key software loaded
- 40% cost, power and cooling savings over systems requiring physical servers and physical SANs or NAS
- Hardware protection across appliances to eliminate any single point of failure and improve uptime
- Self-healing virtual desktops so that systems restart automatically in the case of appliance failures.

Specific features of the vSTAC approach are described in each subsection below.

Self-healing Virtual Desktops

Failover, migration and even disaster recovery of virtual desktops is managed through VMware vCenter using HA, FT, SRM and vMotion features as required for the application environment. For restart purposes, the HA utility can be configured so that virtual desktops running on a VDI appliance will automatically restart on another appliance in the vSTAC. For disaster recovery, the SRM or Site Recovery Manager utility can replicate virtual desktops to a secondary site for failover and failback.



Example: Appliance Failover within a vSTAC

High-availability Storage

Each of the VMware features listed above is made possible because of the shared storage pool created across the vSTAC. The Pivot3 vSTAC OS creates high-availability storage volumes that exist on all drives in the vSTAC. There is no single point of failure across controller, network or compute resources. Any NIC, switch or cable can fail; any VDI appliance can fail, individual components inside an appliance can fail; and up to 5 simultaneous disks can fail within the vSTAC without compromising existing data stores or volumes.

Automatic Performance Load-Balancing

The disk and solid-state storage resources of each vSTAC are automatically load-balanced across all of the Pivot3 VDI appliances so that performance is automatically delivered to the desktops that are exerting the highest demand. This is critical as desktop workloads will vary in real-time as users log-in or log-out and as different applications are run. Virtual desktops can be moved or added at will and there is no need to move the storage since data stores and volumes are always distributed across all of the available disks.

Storage Aggregation

Pivot3 simplifies management by aggregating the capacity of the underlying appliances. A desktop administrator can parcel out capacity as needed for each data store at a logical level without worrying about storage inside one appliance. Attributes for each logical volume, such as RAID protection, name, rebuild priority, and access control are set logically and the aggregate capacity of the appliances is presented as a multi-ported iSCSI target.

Dynamic Expansion to Add Virtual Desktops

VDI appliances can be dynamically added to an existing vSTAC and new storage, network and compute resources will be dynamically added to the pool. This is ideal for small DV environments that need to expand over time. The ability to physically and logically expand a vSTAC is ideally suited for administrators used to responding quickly to changing user requirements in the field. The appliance model is also familiar to admins who understand servers and Ethernet but who may not be trained storage experts.

Distributed Parity Versus Replication

Scale-out architectures have a need to protect against an appliance failure so that systems are highly available. The common approach to protect against node failures is to simply replicate data in each appliance to at least one other appliance in the system. This approach has some serious drawbacks in terms of scalability, performance and cost but is the easiest approach to implement. Market products using replication include HP's Lefthand Network PS4000, VMware Virtual Storage Appliance, Nutanix and Datacore.

Definition of Distributed Parity

Distributed parity is a patented approach developed by Pivot3 where parity is calculated internally to each appliance and then distributed across the vSTAC. The distributed parity approach limits the amount of data that has to be sent between appliances so that performance scales linearly and capacity efficiency improves as the appliance count in a vSTAC increases.

Improved Capacity Efficiency with Distributed Parity

Pivot3's innovative implementation of distributed parity delivers up to 90% usable capacity and protects against more drive failures than scale-out approaches that offer simple mirroring. Replication-based systems typically max out at 50% usable capacity and frequently deliver only 25% usable capacity. This low efficiency adds to system cost, power and cooling and reduces system reliability since many more disk drives are needed to reach a desired capacity threshold.

Improved Performance with Direct Disk Access™

Pivot3's patented Direct Disk Access™ pipelines disk reads and writes directly to the disk controller inside each Pivot3 VDI Appliance. The DDA approach leverages the Intel® VT extensions to bypass the slower emulated virtual disk services used by replication products. With Direct Disk Access technology, Pivot3 VDI appliances offer native disk performance, eliminate virtualization overhead and deliver improved storage performance up to 30% over legacy emulation.

Easier Management with a True Storage Pool

Distributed parity delivers a true storage pool where data stores and volumes are distributed across all of the spinning and solid-state resources in all of the appliances. This true pool approach means that desktop administrators and virtual desktops never have to worry about or track where a volume or data store physically resides.

Simplified Load Balancing with Distributed Parity

Desktop virtualization installations are characterized by frequently changing end-user performance needs. Some of the variables driving performance include changing concurrent use, boot storms, time-of-day usage models, application performance needs and unplanned outages. The underlying storage requirement can be quite complex affecting capacity needs, IOP delivery, and bandwidth. A distributed parity system distributes changing end user loads automatically and quickly across all of the available storage resources.

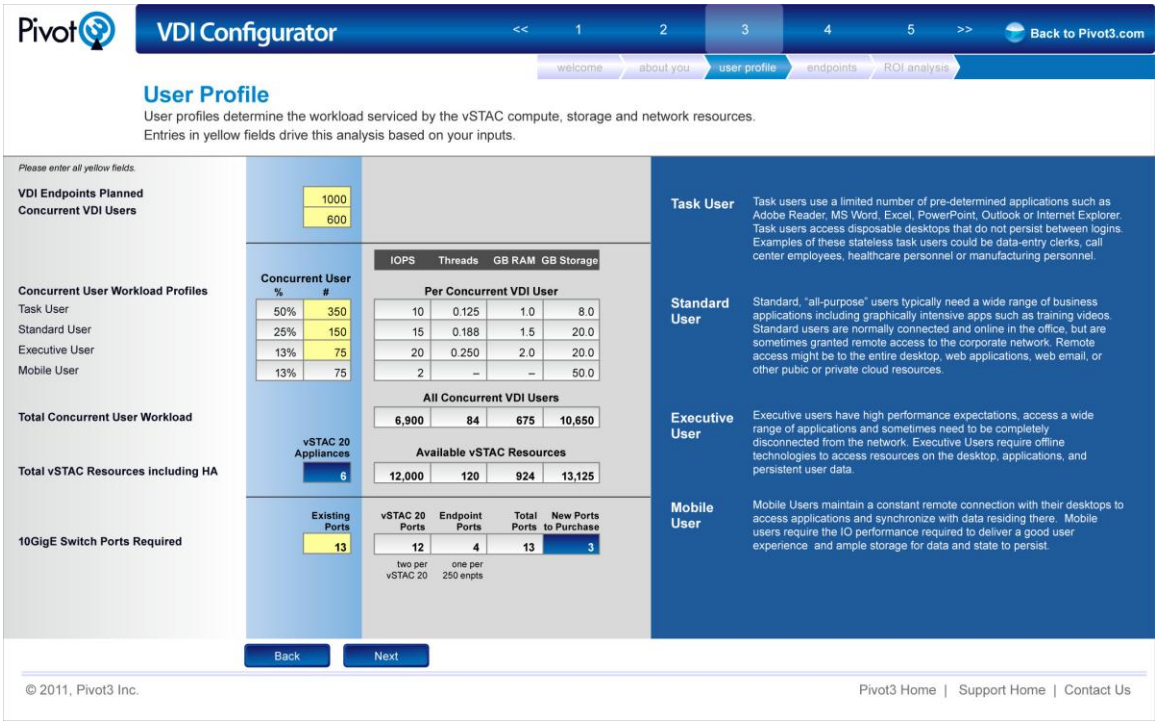
Pivot3 Configuration and Implementation Planning

The Pivot3 VDI Appliance model simplifies configuration planning and accelerates the transition from proof of concept installs to production. By eliminating the upfront lumpy investment required for traditional SAN/NAS systems, Pivot3 can reduce the risk of deployment and allow users and integrators to smart small and scale up as more virtual desktops are required.

The Pivot3 Configurator

Pivot3 offers a simple web-based tool for configuring virtual desktop infrastructure. This tool allows users and integrators to generate a system configuration and a financial ROI from the input of known information such as the number of concurrent desktops, the types of users, the endpoint devices that will be deployed and the existing switch infrastructure.

Since desktop requirements can vary in the field, the configurator offers a simple way to generate configurations for a variety of user profiles and for different configuration scales. It also demonstrates the simplicity introduced by the appliance model since the system can be scaled out in easy-to-manage appliances with a deterministic budget impact. It is the ideal solution for budget-conscious projects where value can be shown at small scale so that budgets can be justified and the installation can be incrementally scaled.



The Pivot3 Configuration tool is available at http://VDIconfigurator.pivot3.com/

Other Pivot3 Storage Features

There are a number of other storage features implemented in the Pivot3 system that contribute to performance and scalability.

Allocate-on-write

The vSTAC OS uses an allocate on write method so that a configured volume can be written to immediately and does not require disk formatting time, which for large conventional arrays may take over 24 hours.

Virtual Global Sparing

Virtual drive sparing is used to automate and speed drive rebuilding if a drive fails in a Pivot3 vSTAC. The capacity of one logical spare drive is reserved across all of the drives in the vSTAC and removed from usable capacity. In the event of a drive failure, the rebuild process begins immediately using the previously reserved capacity.

Fast Parallel Rebuilds

Pivot3 vSTACs provide extremely fast parallel rebuilds of failed drives because of the distributed nature of data allocation and sparing. Many drives contribute to the rebuild process and the recovered data is written to all drives resulting in a massively parallel activity. Only sectors of a failed disk that actually have data allocated and written need to be rebuilt which further speeds rebuild times in lesser utilized VDI appliances.

Disk Groups

The vSTAC OS maintains logical Disk Groups that further minimize the effect of drive failures on the overall vSTAC. Disk Groups consist of one drive per appliance and are automatically created and maintained by the vSTAC OS. Disk Groups effectively increase the number of simultaneous drive failures that each Pivot3 vSTAC can sustain without data loss since drive failures outside of a Disk Group do not affect other Disk Groups.

Continuous Background Verification

The Pivot3 vSTAC continuously performs background disk verification. Each disk is completely scanned to identify disks that are beginning to fail and to detect and repair bad blocks on the media. This is another process that benefits from the massive available bandwidth of the vSTAC and the processing power available in the Pivot3 appliances.

Predictive Sparing

Pivot3 Predictive Sparing is a background routine that continuously monitors disk drives to identify drives that could negatively impact overall system performance or that have a high likelihood of failure. Since drive deterioration is often characterized by gradual performance degradation, Predictive Sparing is an important method of gracefully removing suspect drives from the vSTAC, both to optimize performance and to keep the Pivot3 vSTAC in a fully protected state.

SNMP Support

Pivot3 appliances can be monitored using Simple Network Management Protocol (SNMP). Community strings for SNMP are configured through the vSTAC Director Software and the SNMP MIB (management information base) is provided with the Pivot3 software. Because appliances cooperate within a STAC, SNMP agents can be set once at a vSTAC level and do not need to be set for each appliance.

Summary

The Pivot3 vSTAC VDI solution introduces a simple appliance model for customers looking to reduce management complexity and cost. For the changing performance and scale needs characteristic with virtual desktop deployments, the Pivot3 VDI Appliances provide a new standard for simplicity, scalability and savings.

There are a number of unique benefits from this stackable approach, namely:

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The underlying vSTAC OS has been proven with over 500 customers in the field and the unique architecture is ideal for ROI-challenged environments. For more information, please visit www.pivot3.com.

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