

Accelerate VDI Performance With NetApp All-Flash Storage



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This article is the second in a series that examines how to deploy all-flash storage for common use cases, including database, server virtualization, and VDI

There are many reasons to love virtual desktop infrastructure (VDI). From an IT standpoint, who wouldn't want to replace the hundreds, even thousands, of physical desktops scattered across an organization with centralized infrastructure that's more secure, easier to support, and more efficient?

From an end-user's perspective, who wouldn't want a desktop environment that you can access from wherever you happen to be—and, from almost any device—so you can pick up right where you left off? Or check an important file? Or review a presentation from last month?

With the end-of-support of Windows XP in 2014, there's probably never been a better time to make the move to VDI, but there are two main hurdles relative to existing physical desktops:

- VDI has to deliver equivalent performance
- VDI has to offer the same or lower cost

Surmounting these two obstacles is tied directly to storage performance. In this article, I look at how all-flash storage can address the performance and cost issues that may be keeping you from adopting VDI in your organization.

Delivering Maximum Virtual Desktop Performance

March 2015

Explore

Full Graphics Acceleration for VDI

To replace the physical workstations required for graphics-intensive applications used in technical and creative fields, FlexPod Datacenter with Citrix XenDesktop and NVIDIA GRID combines the advanced capabilities of Citrix XenDesktop HDX 3D Pro with NVIDIA GRID GPU technology to deliver full graphics acceleration for [oil and gas](#), manufacturing and design, media and entertainment, healthcare, and other industries.

Podcast: VMware vSphere 6 Launch with Duncan Epping

Duncan Epping joins hosts Nick Howell, Glenn Sizemore, and Pete Flecha to discuss everything you need to know about vSphere 6, including how it interacts with NetApp.

[More >](#)

NetApp All-Flash FAS and VMware Horizon View 6 with VVOLS

[VMware Horizon View 6 is here](#) and NetApp is ready with full support for VVOLS. The team at

Unique Aspects of VDI Workloads

datacenterdude.com has been blogging regularly on NetApp-related topics, so be sure to check out this news and [other recent blogs](#).

To understand how storage affects both virtual desktop performance and cost, you first have to understand the unique I/O demands of virtual desktop infrastructure. When operating at a steady state—with a large number of users accessing and using their desktops normally—the virtual desktop workload can be up to 80% writes—a higher percentage of writes than almost any other storage workload.

Now think about what happens with VDI when hundreds of virtual machines (VMs) have to be booted. The simultaneous booting of all those desktop VMs creates an intense “boot storm,” as each guest operating system is read from storage and loaded into a VM. A similar phenomenon occurs with “login storms,” when many users login at the same time to begin work. Because of the multiplier effect created by large numbers of virtual desktops, regular activities such as virus scanning and patch application have a similar impact. Your storage needs to accommodate these bursts of activity without increasing latency to an unacceptable level—which to the end-user is seen as desktop- and application-sluggishness.

Satisfying VDI Workloads with All-Flash

The ideal storage environment for VDI must have the ability to accommodate high write workloads and bursts of both read and write activity without performance slipping to a level where users notice and complain.

If you try to support VDI with disk or hybrid storage, you’re likely to start running into problems when you move beyond a few hundred users. The “standard” solution of adding storage systems and over-provisioning increases the cost of VDI solutions, especially for large deployments. That’s why disk-based storage solutions for VDI can end up costing hundreds of dollars per user.

This is where all-flash storage comes in. The right all-flash array can accommodate VDI I/O patterns and still deliver extremely low latency to satisfy end users.

Additional Storage Factors

Naturally, there are factors besides raw performance to consider when choosing an all-flash array. These factors also affect the overall cost of a VDI solution and your organization’s overall satisfaction with VDI.

- **Data reduction.** Data reduction technologies such as inline compression, deduplication, and cloning can significantly

decrease the total amount of storage you need for a given set of virtual desktops, and thus the cost. Because of the high amount of duplication that results from having hundreds or thousands of copies of the same guest OS, there's a huge opportunity for savings here.

- **High availability, nondisruptive operations, and DR.** With hundreds or thousands of virtual desktops sharing the same storage, you must think carefully about storage reliability and availability. How often will it need to be taken down for maintenance or upgrades? What are the options for disaster recovery (DR)?
- **Data management.** VDI environments can benefit significantly from storage data management features such as snapshots, cloning, and replication. Close integration with management tools such as VMware® vCenter have become essential.
- **Scaling.** Can the storage solution scale or will you need to add more storage systems as your infrastructure needs grow?

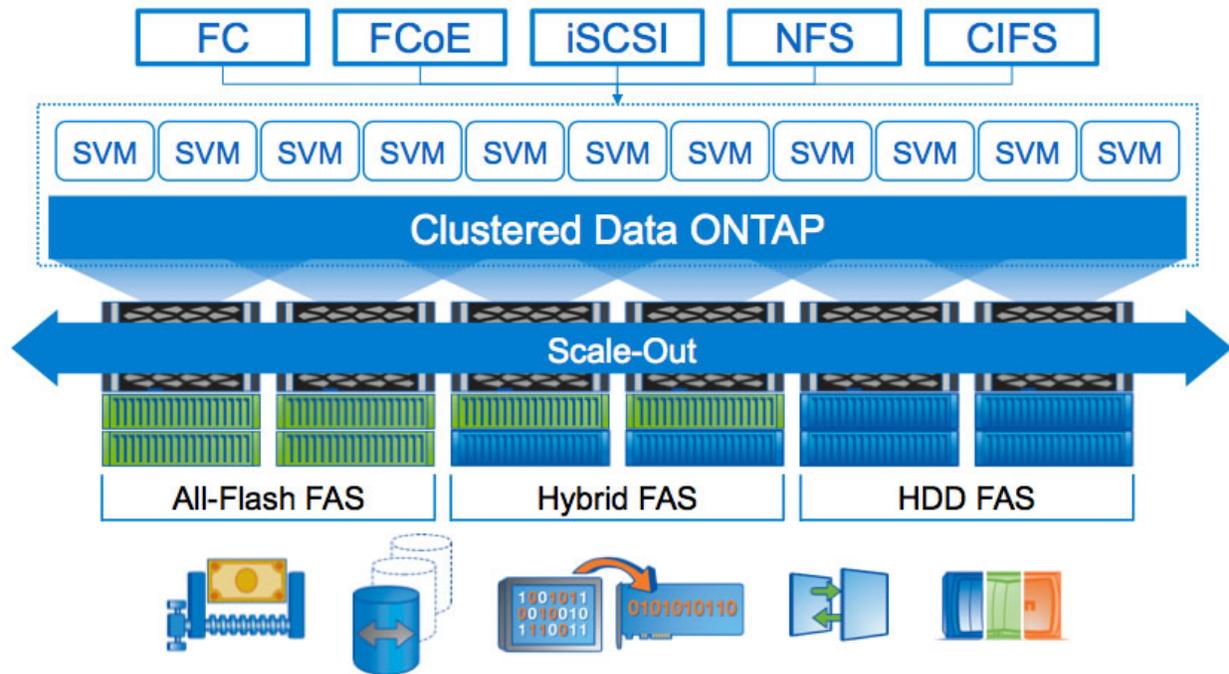
NetApp All-Flash FAS for VDI Workloads

When it comes to all-flash storage, NetApp® has found that it's faster to add performance features to our existing enterprise architecture than to add enterprise storage features to a new all-flash architecture. Other all-flash vendors talk about the need to build an all-flash architecture from the ground up, but none of them has a feature set or a partner and application ecosystem that compares to clustered Data ONTAP® and All-Flash FAS. We believe that in the real world you'll be better served by storage that solves your business problems versus marketing hype.

NetApp has spent two decades building out the feature set of Data ONTAP, including data management, data protection, data reduction, and broad application and partner support. We believe All-Flash FAS running clustered Data ONTAP is the best choice for VDI environments that take full advantage of these capabilities.

As illustrated in Figure 1, All-Flash FAS delivers multiprotocol support, multitenancy, scale-out with homogeneous or heterogeneous storage, and data reduction and data management features—including compression, deduplication, cloning, and replication.

Figure 1) All-Flash FAS supports VDI in a full-featured and flexible enterprise platform.



Source: NetApp, 2015

Clustered Data ONTAP and Flash: A Perfect Match

NetApp clustered Data ONTAP with its Write Anywhere File Layout (WAFL) is inherently flash-friendly, with an optimized write architecture that benefits VDI.

- Incoming writes are processed in memory, protected in NVRAM, and acknowledged immediately. This results in extremely fast write response times, and takes SSDs out of the critical write latency path.
- Writes are coalesced in memory and de-staged in large stripes to SSDs, thus maximizing performance, minimizing RAID overhead, and preventing uneven SSD wear.
- Block overwrites are automatically written to a new location; WAFL never overwrites an existing block, avoiding wear issues that might otherwise result.

In Data ONTAP 8.3, NetApp re-architected the read path to optimize flash performance. These changes resulted in [up to a nearly 70% improvement in read performance](#) for existing systems.

In addition to the native capabilities of Data ONTAP, we've also incorporated innovations from our next-generation FlashRay platform, providing incremental efficiency, performance, and ease-of-use benefits.

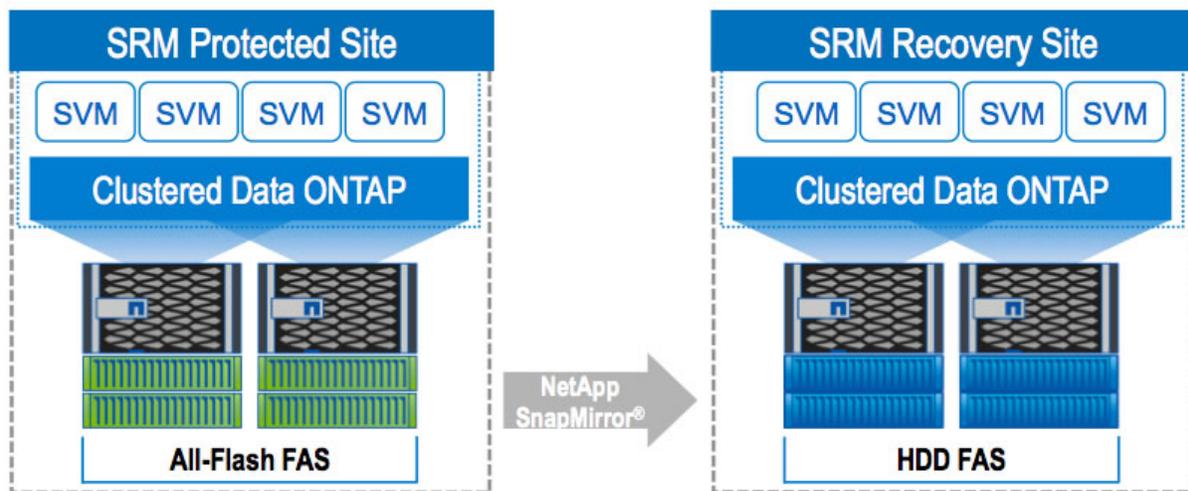
- **Effective inline compression.** Our compression protocol outperforms compression algorithms—such as the widely used LZ4—reducing the processing cost of decompression by more than 40% and accelerating the read pathway. Incompressible data detection (IDD) saves further CPU cycles by quickly identifying data that doesn't benefit from compression.

- **Inline zero-block deduplication.** Deduplicating zero blocks speeds up virtual machine provisioning by 20% to 30%. All data entering the system is hashed and compared. Zero blocks are immediately eliminated. Data that is similar is marked for deeper bit-by-bit inspection, with deduplication scheduled every minute. Because client work takes precedence, this approach delivers consistent, low latency.

Data ONTAP delivers deployment advantages and software-defined control that other all-flash solutions can't match.

- **Store secondary copies on HDD or in the cloud.** You need a second copy of your VDI data for disaster recovery. With Data ONTAP, secondary copies of data can be kept on disk storage or in the cloud, optimizing cost. (see Figure 2.)
- **Save capacity with space-efficient clones.** NetApp's cloning technology lets you create writeable "copies" of VDI virtual machines. Clones only consume additional storage as changes are made, delivering up to 584:1 space reduction. This provides substantial advantages versus other all-flash arrays. For instance, a hypervisor snapshot results in a 20% increase in storage consumed for metadata. NetApp can avoid this penalty and achieve better density using its native cloning capability. (For VMware View we recommend using VAAI clones for persistent desktops and VCAI and NFS for non-persistent desktops.)
- **Put your data where you want it.** Clustered Data ONTAP makes it possible to move data to all-flash storage when it's needed—with no disruption to running applications. You can start your VDI environment on hybrid storage today, and migrate to all-flash in the future as your needs grow.

Figure 2) All-Flash FAS lets you replicate your VDI environment to a hybrid or disk-only environment to optimize cost.

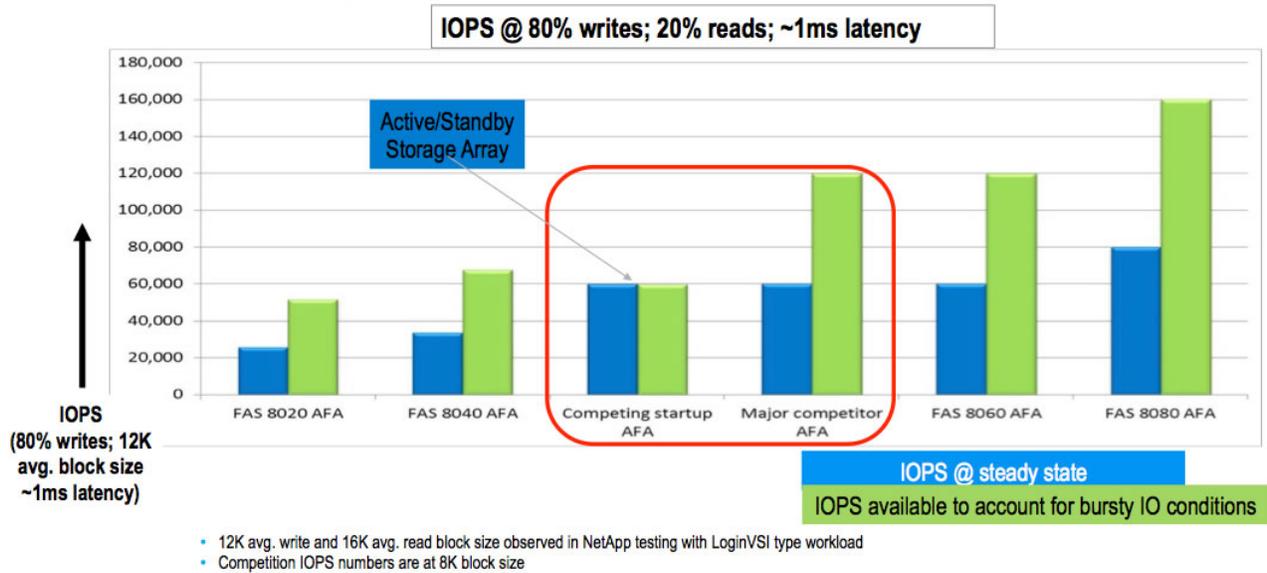


Source: NetApp, 2015

All-Flash FAS VDI Performance

NetApp has conducted extensive VDI testing of the entire All-Flash FAS8000 product line, measuring both steady-state and burst performance based on a workload that's 80% writes and 20% reads. Figure 3 illustrates a nice distribution between the four models. The graph also shows several competitors. As you can see, FAS8060 performance matches that of XtremIO, and the FAS8080 EX exceeds it by a 30% margin. The ability to outperform the competition on this write-intensive workload is a testament to the optimized write architecture of All-Flash

Figure 3) All-flash FAS VDI performance versus a competitor.



Source: NetApp, 2015

Our testing used an average write size of 12KB and an average read size of 16KB (versus 8KB block sizes used by competitors). The different block size is a result of our testing methodology. We used Login Virtual Session Indexer (Login VSI), the industry-standard load-testing tool for testing the performance and scalability of virtual desktop infrastructure. You can read complete details of our VDI testing for the FAS8060 in [TR-4307: NetApp All-Flash FAS Solution for VMware Horizon View](#).

Based on that testing, the FAS8060 has enough performance headroom to support 4,000 desktops (with HA failover) and [comes in at \\$55/desktop for storage](#). That’s an extremely competitive storage cost for VDI. It’s also important to note that the NetApp VDI performance data shown in Figure 3 is for 2-node configurations. Expanding your cluster to 4 nodes doubles the performance and the number of desktops you can support. For VDI we recommend a building-block approach using a pod-based architecture. This allows you to deploy VDI in discrete units: for instance, 4K VMs at a time. All-Flash FAS scales out linearly as nodes are added to a cluster.

Financial Services Firm Deploys All-Flash FAS for VDI

A large insurance and investment firm picked all-flash FAS for its Citrix VDI environment after an evaluation of major all-flash players. The IT team chose All-Flash FAS because of its proven performance combined with the integrated data management capabilities of clustered Data ONTAP, including NetApp SnapMirror for replication, and FlexClone® for low-overhead clones. The combination of these technologies also gives the company the ability to do nondisruptive DR testing.

Flexible Options for VDI Deployment

At NetApp, we recognize that a VDI deployment can be complex and that storage is only one piece of the puzzle. We've done extensive testing to make sure that our storage solutions work with the broadest range of VDI software, including VMware Horizon View, Citrix XenDesktop, and Microsoft VDI. We've fully tested and characterized All-Flash FAS in many of these environments. All VDI configurations are rated at 50% utilization, so they can deliver full performance, even during a controller failure.

Figure 4) NetApp clustered Data ONTAP integration with popular hypervisors.

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|---------------------------------|--|
| VMware vSphere™ ESXi | <ul style="list-style-type: none">■ Virtual Storage Console (VSC) for vSphere WebClient■ VAAI and VASA Provider■ Backup and Restore VMs■ VVOL Support |
| Citrix XenServer | <ul style="list-style-type: none">■ Virtual Storage Console (VSC) for XenCenter■ Sharefile Integration■ Virtual Storage Console for Cloud Platform / Cloud Stack |
| Microsoft Hyper-V™ | <ul style="list-style-type: none">■ PowerShell Script Support■ Citrix PVS VDI Provisioning Script for Hyper-V 2012■ Shift VMDK to VHD Migration Script |

Source: NetApp, 2015

See the Reference section at the end of this document to learn more about deploying NetApp storage in different VDI environments.

Deploying VDI on FlexPod

The large number of solution components involved make it a challenge to properly architect, deploy, and manage a virtual desktop infrastructure (VDI). That's why NetApp and Cisco have teamed to create FlexPod® reference architectures for VDI deployments. [FlexPod integrated infrastructure solutions](#) from NetApp and Cisco create VDI infrastructure with all the necessary hardware and software components carefully defined to accelerate deployment and simplify management. (Refer to the Reference section for available FlexPod reference architectures.)

Medical Provider Chooses All-Flash FAS for VDI

In healthcare, faster access to data and greater availability translates to better patient care. A clinical service provider chose All-Flash FAS for all of its applications, including its VDI environment and electronic medical records. These two applications are critical in clinical care environments because they allow medical staff to move within and among facilities with full access to patient information, and patient data remains secure in the data center to meet compliance requirements.

The Right Storage Choice for VDI Deployment

If you're looking for an all-flash array to satisfy the needs of VDI, you have to pay careful attention to the architecture. The right solution must combine excellent write performance with the ability to handle bursts of activity created by boot and login storms. Data reduction capabilities can significantly reduce your overall storage costs, as can flexible data management options. Finally, data availability, scale-out, and nondisruptive operations features are essential to keep your desktop environment running.

All-Flash FAS combines an optimized write architecture with proven data reduction and data management features to create a storage environment that is ideal for VDI. With full support for popular hypervisors and available in FlexPod configurations designed to accelerate VDI deployment, All-Flash FAS is a great choice for your VDI needs.

References

- [NetApp All-Flash FAS Solution for Nonpersistent Desktops with VMware Horizon View](#)
- [NetApp All-Flash FAS Solution for Persistent Desktops with VMware Horizon View](#)
- [VMware Horizon View 5 Solutions Guide](#)
- [VMware Horizon View 5.2 on NetApp Clustered Data ONTAP at \\$35/Desktop](#)
- [Design Guide for Citrix XenDesktop on NetApp Storage](#)
- [Shared Desktops and On-Demand Applications with XenDesktop and vSphere 5](#)
- [CVD: FlexPod Datacenter with Citrix XenDesktop 7.1 and VMware vSphere 5.1](#)

About Chris Gebhardt

Chris Gebhardt has 17 of experience working in IT, with 11 years at NetApp. As Senior Technical Marketing Engineer for NetApp, Chris leads the VMware End User Computing solutions in the Partners, Solutions & Enablement Group. He has authored a number of technical reports on virtual desktop infrastructure, including *NetApp All-Flash FAS Solution for Nonpersistent Desktops with VMware Horizon* (TR-4307), *NetApp All-Flash FAS Solution for Persistent Desktops with VMware Horizon* (TR-4335), and *NetApp & VMware View Solutions Guide* (TR-4181). Chris is a VMware-Certified Professional and a VMware vExpert.

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