What's New in VMware vSphere® Flash Read Cache®

TECHNICAL MARKETING DOCUMENTATION
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vmware®

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Introduction

1.1 Software-Defined Datacenter

The annual user conference for VMware, VMworld 2012, featured the introduction of its software-defined datacenter (SDDC), a visionary cloud architecture in which all the pillars of the datacenter, including compute, storage, networks and the associated services, are virtualized.

In this white paper, we focus on one pillar of the software-defined datacenter of VMware® – storage. Focusing on this pillar, we draw attention to a new product released with VMware vSphere® 5.5 called VMware vSphere Flash Read Cache®, looking at its role in the pillar and its part in the overall vision of SDDC.

1.2 Software-Defined Storage

The plan of VMware for SDDC focuses on a set of VMware initiatives around local storage, shared storage and storage/data services. In essence, we want to make vSphere a platform for storage services.

Software-defined storage is designed to provide storage services and service-level agreement automation through a software layer on hosts that integrates with and abstracts the underlying hardware.

This document examines in detail vSphere Flash Read Cache, a solution that provides persistent Flash-based storage tier services by utilizing local Flash-based devices on vSphere hosts.

1.3 What is vSphere Flash Read Cache?

vSphere Flash Read Cache is a new Flash-based storage solution from VMware that is fully integrated with vSphere. The vSphere Flash Read Cache design is based on a framework that enables the virtualization and management of local Flash-based devices in vSphere.

The framework provides a centralized management platform for all locally attached Flash-based devices, and it maximizes their utilization throughout virtualized infrastructures.

The vSphere Flash Read Cache framework design is based on the following two major components:

- vSphere Flash Read Cache infrastructure
- vSphere Flash Read Cache software

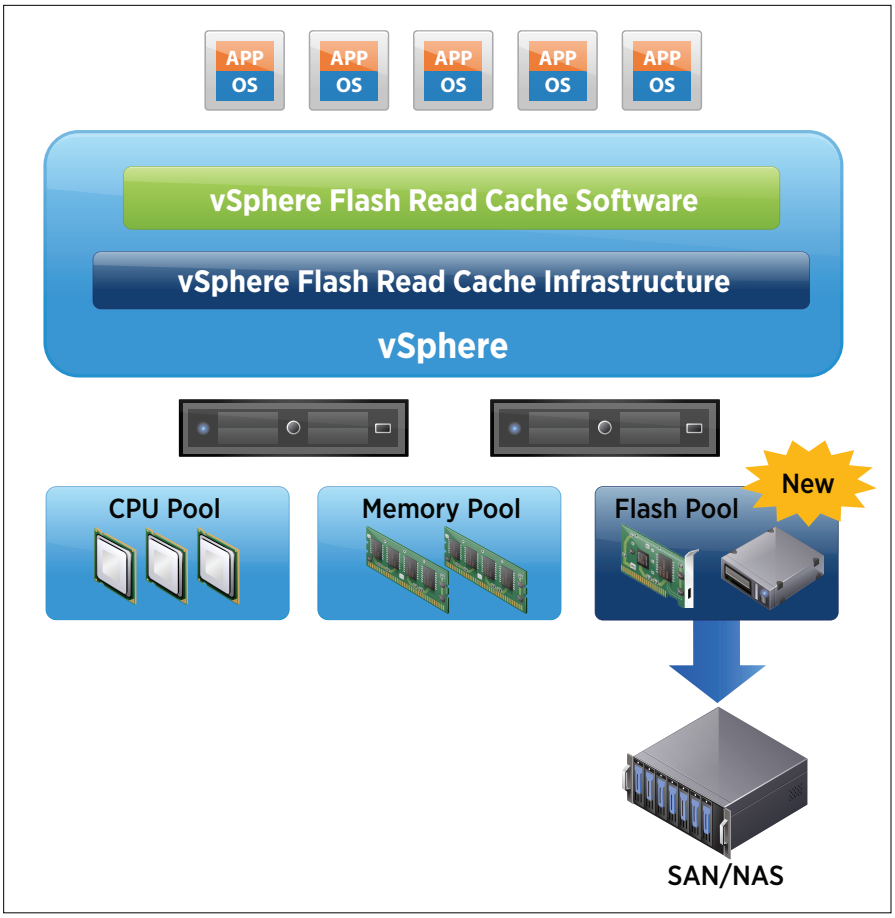

Figure 1.

vSphere Flash Read Cache enables the pooling of multiple Flash-based devices into a single consumable vSphere construct called a Virtual Flash Resource. The Virtual Flash Resource is consumed and managed in the same way CPU and memory are done today in vSphere.

1.3.1 vSphere Flash Read Cache Infrastructure

The vSphere Flash Read Cache infrastructure integrates the vSphere hosts' locally attached Flash-based devices into the vSphere storage stack. This integration delivers a Flash management platform that enables the pooling of Flash-based devices into a Virtual Flash Resource.

The vSphere Flash Read Cache infrastructure becomes the resource manager and broker for the consumption of the Virtual Flash Resources and it also enforces admission control policies. The Virtual Flash Resource construct is a shared resource and consumable by two features called Virtual Flash Host Swap Cache for VMware vSphere Hypervisor and Virtual Flash Read Cache for virtual machines.

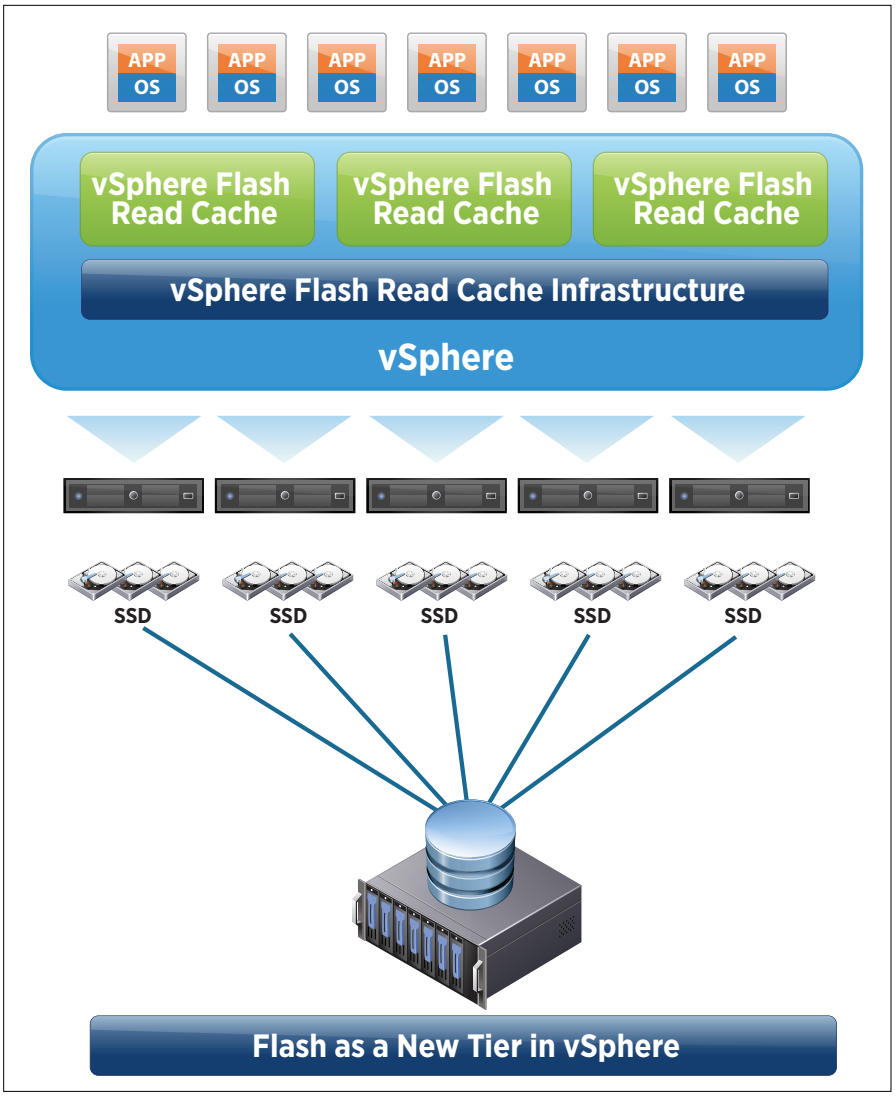

Figure 2.

The vSphere hypervisors consume the Virtual Flash Resource in the form of a Virtual Flash Host Swap Cache for host memory–caching purposes. Virtual Host Flash Swap Cache replaces the swap to SSD feature previously introduced with vSphere 5.0.

A vSphere hypervisor can utilize as much as 4TB of the Virtual Flash Resource total available capacity for Virtual Flash Host Swap Cache. Regardless of the power state of the vSphere hypervisor, the assigned Virtual Flash Resource capacity is reserved and it is never returned to the Virtual Flash Resource for virtual machine consumption.

1.3.2 Virtual Flash Read Cache Software

The Virtual Flash Read Cache software is natively built into the vSphere core hypervisor. Virtual Flash Read Cache provides a write-through cache mode that enhances the performance of virtual machines without the modification of applications and operating systems (OSs).

The performance enhancements are introduced to virtual machines based on the placement of the virtual Flash read cache. The Virtual Flash Read Cache is placed directly in the virtual machine's virtual disk data path.

Virtual machines do not respond to the described behavior and the allocation of Virtual Flash Read Cache. At this point, the caching software provides the suitable algorithms to manage the virtual machines' I/O requests.

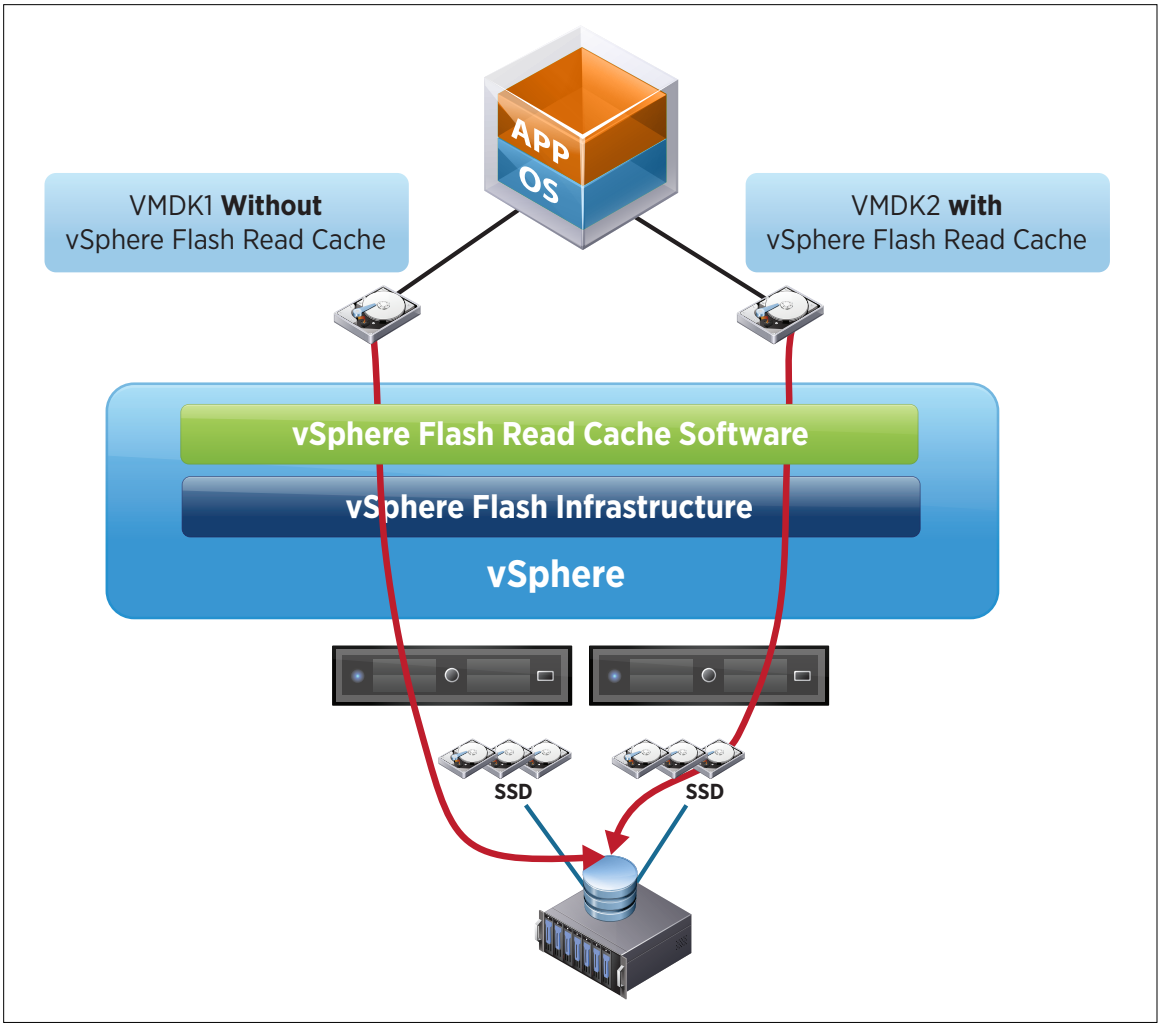

Figure 3.

Virtual machines consume the Virtual Flash Resource in the form of a write-through cache mode also known as read mode. The Virtual Flash Read Cache working sets are assigned in the form of reservations on a per-VMDK basis. Virtual machines consume only their individual Virtual Flash Read Cache working set when they are powered on.

1.4 vSphere Flash Read Cache Integration with vSphere

vSphere Flash Read Cache tight integration with vSphere 5.5 delivers support and compatibility with vSphere enterprise features such as VMware vSphere vMotion®, VMware vSphere High Availability (vSphere HA) and VMware vSphere Distributed Resource Scheduler™ (vSphere DRS).

After they are powered on, Virtual Flash Read Cache–enabled virtual machines can be migrated with vSphere vMotion. vSphere DRS automates the initial placement of virtual machines based on resource availability. Advanced vSphere Flash Read Cache content migration settings, shown by the VMware

vSphere Web Client, provide the ability to migrate or discard the virtual machine's Virtual Flash Read Cache content during migration events.

- **Always migrate the cache contents –** Virtual machine migration proceeds only if all of the cache contents can be migrated to the destination host. (Guaranteed)
- **Do not migrate the cache contents –** Drops the write-through cache. Cache is rewarmed on the destination host.

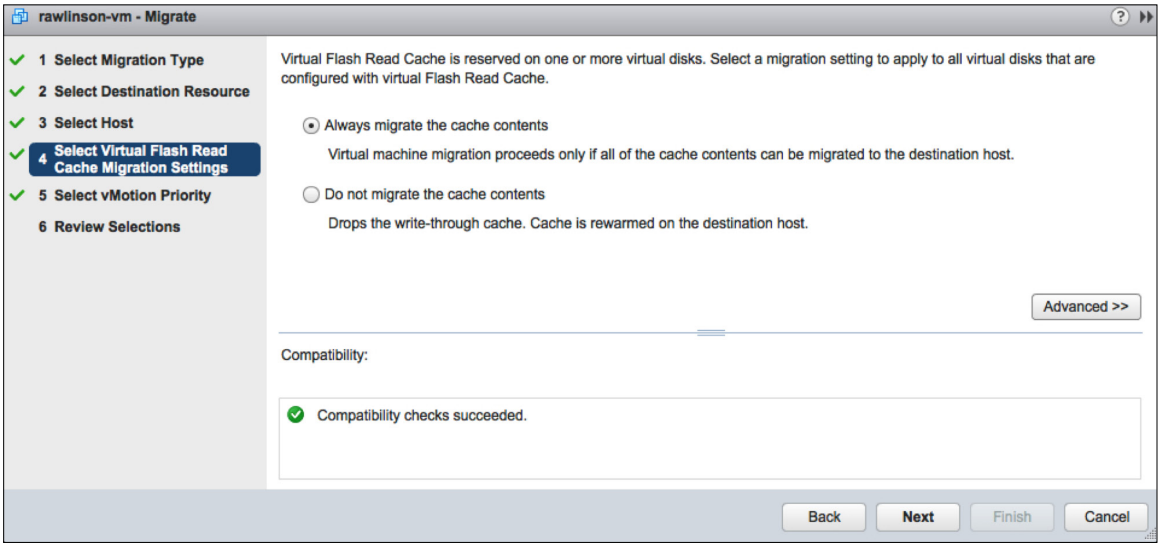

Figure 4.

1.5 vSphere Flash Read Cache Use Cases

vSphere Flash Read Cache enhances virtual machine performance by accelerating the performance of read-intensive workloads in a vSphere environment.

For the most part, workloads with read-intensive operations and high percentages of data locality requirements are good candidates for vSphere Flash Read Cache. A majority of the targeted candidates are categorized through database warehousing and enterprise server workloads such as Web proxy servers, monitoring servers and many others.

Another use case for vSphere Flash Read Cache is Virtual Desktop Infrastructure (VDI). VDI workloads such as VMware Horizon View™ can benefit from using vSphere Flash Read Cache in cases when a virtual machine's swap disks are vSphere Flash Read Cache enabled. In this case, vSphere Flash Read Cache acts as a cache tier between memory and swap disk located on storage. This might help when virtual machines are overprovisioned in terms of memory resources.

2. Requirements

The following section details the hardware and software requirements necessary to create and enable vSphere Flash Read Cache.

2.1 vSphere Requirements

2.1.1 vCenter Server

vSphere Flash Read Cache is supported on vSphere 5.5 and later with VMware vCenter Server™ 5.5 or later. vSphere Flash Read Cache can be managed by both the Windows version of vCenter Server and the VMware vCenter Server Appliance™. vSphere Flash Read Cache is exclusively managed by and configured via vSphere Web Client version 5.5.

2.1.2 vSphere Hosts

vSphere Flash Read Cache is supported on vSphere 5.5 and later. Although vSphere Flash Read Cache works with a single vSphere host, using multiple hosts in a cluster enables vSphere Flash Read Cache to leverage other vSphere features such as vSphere vMotion, vSphere DRS and vSphere HA.

2.1.3 Virtual Machines

vSphere Flash Read Cache is available only to virtual machines with hardware version 10 (VMX-10). All legacy virtual machine hardware must be upgraded to hardware version 10 to use Virtual Flash Read Cache.

2.2 Storage Requirements

2.2.1 Flash-Based Devices (SSD, Flash Cards)

Each vSphere 5.5 host must have at least one enterprise-level SSD or PCIe Flash card. Check the VMware Hardware Compatibility List (HCL) for an up-to-date list of supported Flash-based devices.

2.3 Network Requirements

2.3.1 Network

In cluster environments, all vSphere hosts should be configured with vSphere vMotion capabilities to leverage vSphere DRS.

3. Installation and Configuration

This section provides a description of the installation and configuration process of the following vSphere Flash Read Cache features:

- Virtual Flash Resource
- Virtual Flash Host Swap Cache
- Virtual Machine Virtual Flash Read Cache

3.1 Virtual Flash Resource Configuration

vSphere 5.5 is the first release that supports the new vSphere Flash Read Cache feature. Configuring a Virtual Flash Resource is accomplished by navigating to the vSphere host's management settings and selecting the Virtual Flash Resource Management object within the vSphere Web client.

Users can add capacity to the Virtual Flash Resource by selecting single or multiple Flash-based devices and adding them to the pool.

Upon completion of this task, a new file system called VFFS is created to pool together all Flash-based devices for consumption by vSphere hosts and virtual machines.

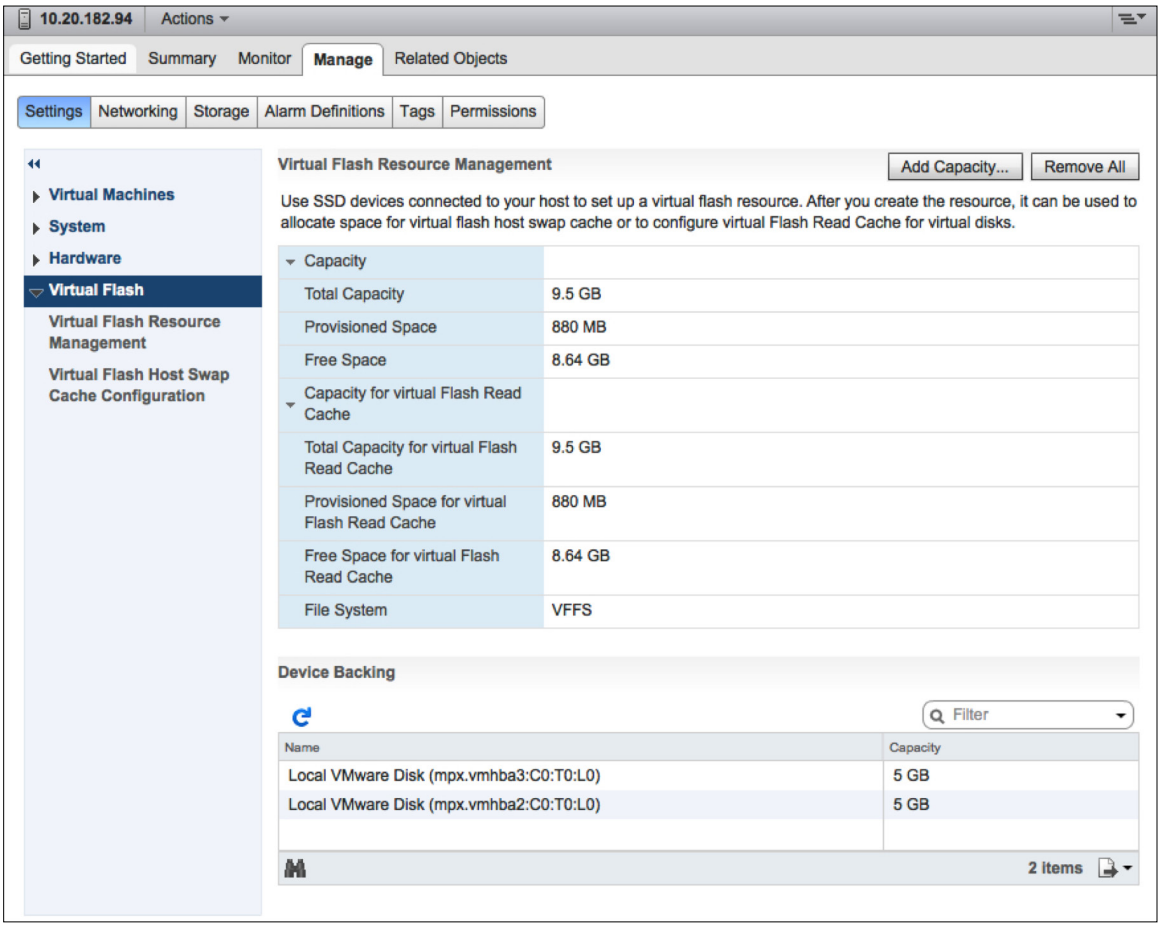

Figure 5.

3.2 Virtual Flash Resource Properties

The size of a Virtual Flash Resource is determined by the number of Flash devices added per vSphere host. Metadata overhead should be taken into consideration. The vSphere Flash resource configuration maximum settings are as follows:

- One Virtual Flash Resource (VFFS) per vSphere host
- Eight Flash devices per Virtual Flash Resource (VFFS)
- 4TB physical Flash-based device size
- 400GB of Virtual Flash Read Cache per Virtual Machine Disk (VMDK) file
- 4TB of Virtual Flash Host Swap Cache per vSphere host
- 32TB Virtual Flash Resource total size

3.3 Configuration of Virtual Flash Host Swap Cache

After the Virtual Flash Resource has been created, configuring the Virtual Flash Host Swap Cache can be done by navigating to the Virtual Flash Resource Management object within the vSphere Web client and selecting the Cache Configuration settings.

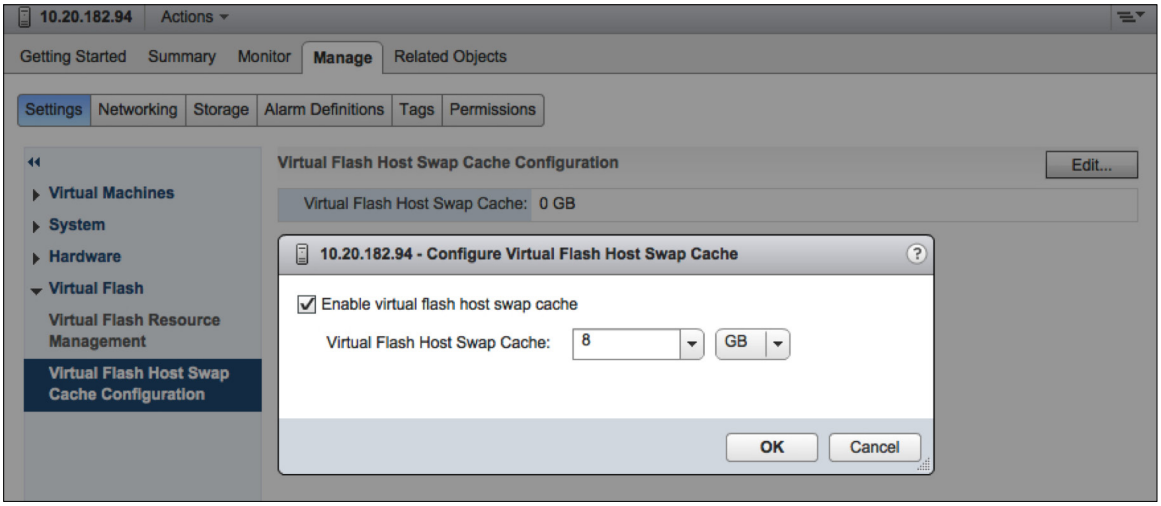

Figure 6.

3.4 Configuration of Virtual Flash Read Cache

After the Virtual Flash Resource has been configured, the Virtual Flash Read Cache working set can be added on a per-VMDK basis by editing the virtual machine's hardware settings. The Virtual Flash Read Cache settings are available only to virtual machines with virtual hardware version 10.

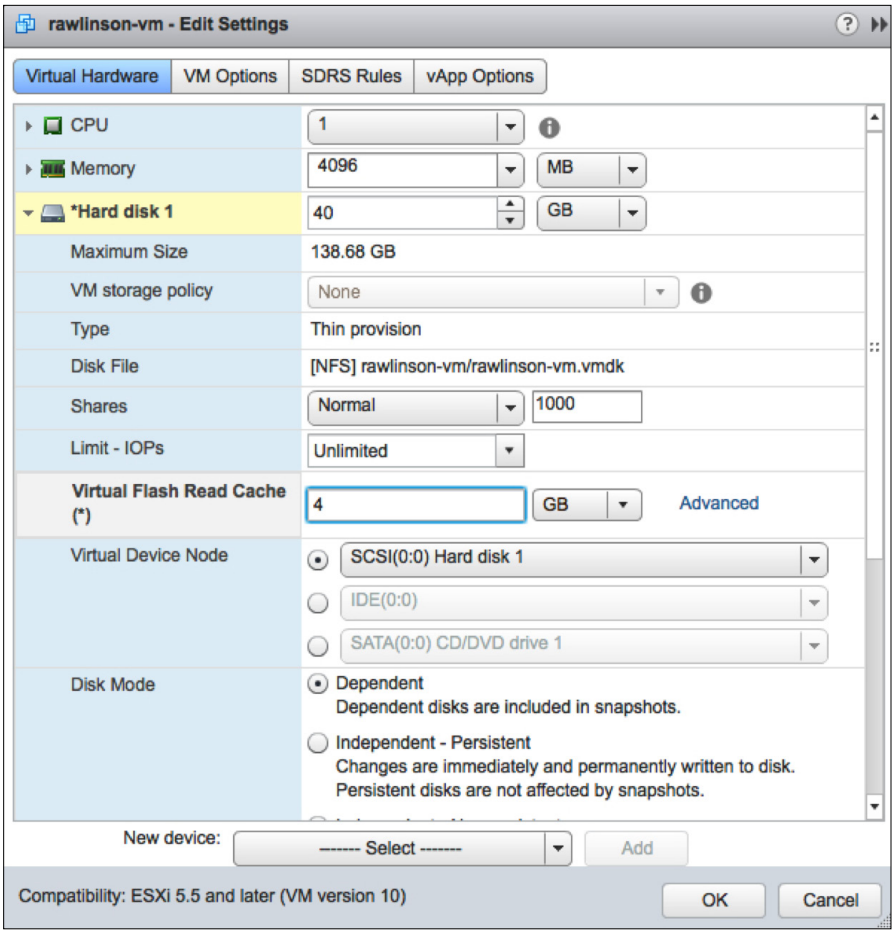

Figure 7.

The virtual machine Virtual Flash Read Cache block size can be modified in the advanced screen of Virtual Flash Read Cache settings. Virtual Flash Read Cache supports block sizes from 4KB to 1,024KB.

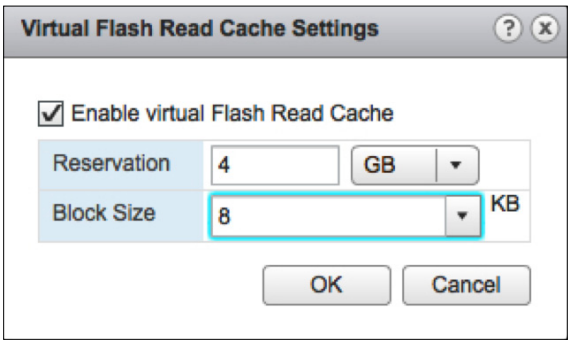

Figure 8.

Conclusion

vSphere Flash Read Cache is the new storage solution developed by VMware, included in vSphere 5.5. It provides a Flash persistent layer that is optimized for the consumption of Flash-based devices and integration with other key vSphere features.

Because the use of a host-based write-through cache is transparent to applications, the solution enables vSphere virtual infrastructures to use the Virtual Flash Resources without having to modify applications. The Virtual Flash Read Cache solution enhances the performance of read-intensive workloads and provides seamless integration with vSphere enterprise features such as vSphere vMotion, vSphere HA and vSphere DRS.

Acknowledgments

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Rawlinson is among the first VMware Certified Design Experts (VCDX#86) and the author of multiple books based on VMware and other technologies.

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