

Brocade® VM Insight

Visibility into Individual VM Storage Traffic

Highlights

- Enable end-to-end VM visibility and monitoring across the SAN
- Nondisruptively monitor VM flows of interest and obtain VM I/O insight
- Optimize VM performance by fine-tuning infrastructure based on VM utilization of physical infrastructure
- Improve VM troubleshooting by quickly identifying abnormal VM behaviors and thereby application impact
- Remove the dependency for VMID support on the storage array with VMID+

Introduction

This document is intended for virtual infrastructure and storage architects who evaluate, design, and deploy enterprise IT infrastructures. The reader should be familiar with virtual server infrastructure, storage networks, and management operations. This document explains VM Insight, VMID, and VMID+ and provides an example of how VM Insight is used to instantly discover the root cause of application storage performance degradation and the steps for remediation.

Overview

As virtual environments scale, understanding how each virtual machine (VM) impacts the underlying infrastructure becomes a necessity for efficient data center design and timely issue diagnosis. Capturing this information, however, typically requires complex and costly manual processes. These issues are often particularly challenging across the network, generating a “fog” that hides data congestion and impedes identifying a resolution. A new technology standard delivers automatic VM awareness across the entire data path without the need for additional tools. Leveraging this technology, Brocade® VM Insight delivers visibility into each VM across the storage network for a more efficient data center at scale.

Tracking VMs is available within the storage network via Brocade VM Insight technology, as well as from Fibre Channel adapters with VMID technology or with Broadcom Emulex® adapters. This technology enables virtual machine visibility and monitoring of VM flows across the SAN nondisruptively. It results in granular insight into the application health and performance for each VM to allow you to fine-tune your infrastructure or quickly identify abnormal VM behaviors to ensure performance optimization and quick troubleshooting.

The following types of VM-level information are monitored:

- Throughput at the flow level to monitor bandwidth utilization per workload
- Total I/Os at the flow level to monitor workload profiles over time
- First Response Time (FRT) for I/O request latency (maximum and average)
- Exchange Completion Time (ECT) for I/O completion latency (maximum and average)
- Outstanding I/Os in the queue (maximum and average)

The Need for VM Insight

Virtualization of servers is a mainstay of modern IT. Historically, however, it has encountered a number of challenges with both the infrastructure team and the application owners. The application owners were initially skeptical of the ability of a virtualized platform to meet the needs of their applications, and they frequently resisted the idea of giving up the stand-alone server that had been their application's platform in favor of a virtualized environment that shared server infrastructure with other applications. While the scale and adoption of server virtualization has grown, a few items continue to be an issue. One of the most consistent complaints is the lack of visibility into the actual metrics of the virtual machine where I/O is concerned. Lack of visibility is due to the hypervisor (in the case of VMware vSphere ESXi server), which abstracts the physical disk to virtual disks placed on a data store, with all the I/O to the data store from all the VMs on the hypervisor as an aggregate. So although the overall performance of the I/O subsystem on the server can be seen, the granular level of visibility to the actual VM and the application is an unknown.

With VMs and applications sharing the same physical infrastructure, a common scenario is where an application or applications become “victims” while a “bully” application consumes the majority of the available resources and specifically for storage IOPS/bandwidth. The lack of visibility to the root cause tends to be further obscured by the behavior that the first application owners to complain about the performance tend to be the victim applications as opposed to the “bully” that caused the issue. How is the VMware administrator to know what, if any, actions to take regarding the problem? Similarly, there can be an issue where a “performance tool/monitor” exists in a given application and indicates an infrastructure constraint or problem to the application owner that is not visible to the hypervisor administrator. Since the tools available to the hypervisor administrator may not indicate the same issue or any issue at all, confusion develops between the teams as to how to address the situation.

This issue is by no means a recent development in the virtualization infrastructure. Over time this issue has resulted in an operational behavior pattern on the part of hypervisor administrators where upon receiving a performance complaint from an application owner, the default is to perform a vMotion to migrate that application to another hypervisor. Whether they were moving the bully away from the victim, moving the victim away from the bully, or merely causing a reset that cleared some other issue was unclear, although the storage traffic still goes to the same data store (unless a Storage vMotion is performed). But the practice has become the “quick-and-easy” first filter on interaction problems between applications on the same hypervisor. It has proven to be an incomplete solution, however, in that it frequently fails to address the root cause of the application performance problem. And if it is a “victim” that is moved away, additional “victim” applications might soon follow with the same complaint. The true goal is to be able to provide a root-cause analysis of the performance issues (perceived or real) and provide definitive evidence to support the resolution.

Enterprise data centers continue to increase application density, facilitated by the combination of dense-compute server virtualization and container architectures. This resource utilization efficiency requires physical and virtual infrastructure to support a broad set of workloads with different SLAs and storage performance requirements.

The business criticality of an application drives availability and performance requirements, which often change throughout the application’s lifecycle. It is difficult or impossible to predict application requirements and plan placement accordingly from the initial deployment. However, hypervisors provide the ability to move VMs between physical hosts without downtime and to migrate storage when necessary to load-balance compute or storage needs. Continuous visibility into the individual VM’s storage consumption is critically important in order to effectively manage the underlying compute and storage resources.

Brocade VM Insight enables unprecedented end-to-end health and performance visibility into each VM workload. A variety of VM-level metrics are provided from the physical server to the data store (backed by LUN or NameSpace ID) using standards-based VM tagging (VMID) of Fibre Channel frames. VM Insight integrates with Brocade Monitoring and Alerting Policy Suite (MAPS) to enable threshold monitoring and alerting on VM-level flows. This proactive monitoring and alerting will help detect issues that could lead to application performance degradation or potential outages.

VM Insight continuously monitors VM-level application performance flows and can be used to baseline workload behavior. It quickly detects and alerts a storage administrator of an issue and can be used to determine the source of storage performance anomalies. With a better understanding of the resource requirements for each VM, a storage administrator can optimize the underlying physical infrastructure throughout the VM lifecycle to ensure that SLA objectives are met.

VM Insight is available on Gen 6 platforms (Fabric OS® 8.2 and later) and on all Gen 7 platforms, and it supports VMware vSphere ESXi 6.5 and later. For more information on VM Insight, refer to the *Brocade Fabric OS Administration Guide*.

How VM Insight Works

VM Insight provides unprecedented monitoring of individual VM storage traffic for troubleshooting and optimizing performance. It enables effective storage resource utilization while meeting application SLA requirements. VM Insight provides visibility into each VM flow across the physical SAN between host and storage. It is the only networking technology that provides visibility from a hypervisor to the underlying physical infrastructure.

With VM Insight, storage performance visibility is provided from the VM and virtual abstraction layer on the hypervisor through the SAN to the storage array. This visibility enables administrators to monitor VM-level application storage performance, understand baseline workload behavior, and quickly determine the root cause of storage performance anomalies. VM Insight simplifies the ability to meet or exceed the SLAs of virtualized applications. With this information and visibility, it is possible to identify (and visualize) any contention or impact on the VMs.

VM Insight is supported on Brocade Gen 6 and Gen 7 switches and directors with storage arrays that support VMID. Brocade Gen 7 switches and directors enable VM Insight with any storage array through VMID+ without requiring the array to support VMID.

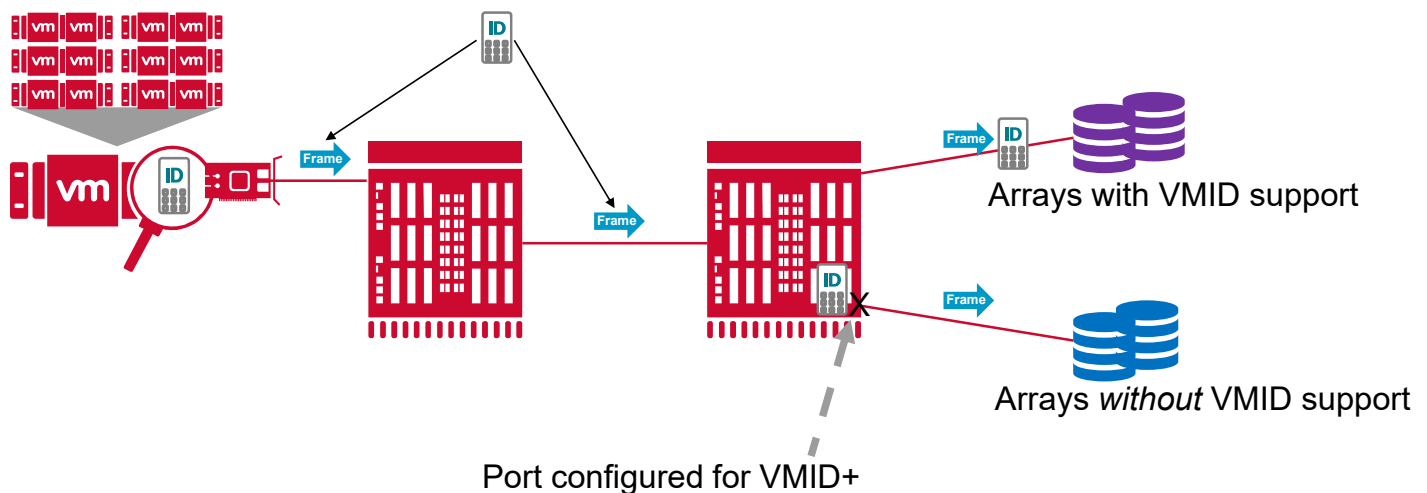
VMID

To provide visibility into individual VM flows, VM Insight monitors virtual machine performance throughout a storage fabric using a standards-based virtual machine application identifier tag. The Fibre Channel fabric provides a unique VMID to each VM (which is associated with the VM's universally unique identifier [UUID]). Once the application ID is assigned to a VM, the VM and HBA adapter on the hypervisor use the application ID (VMID) to tag all I/O frames for that VM. The VMID identifies the specific VM instance that is initiating the I/O and subsequent I/Os that are destined to the target. In this fashion, the IO Insight telemetry that Brocade FOS tracks for standalone servers is extended all the way to the virtual machine. However, the VMID tag is applied only if the storage array also supports VMID. The telemetry data is streamed off the switches into SANnav, where the VM Insight data can be viewed graphically and used in investigative mode to troubleshoot individual VMs.

VMID+

VMID+ removes the dependency on the storage array to support VMID tagging. VMID+ is configured on the ports of the SAN fabric where the storage array is connected. When VMID+ is enabled, frames sent from the hypervisor to the storage array have the VMID tag removed by the Brocade Gen 7 switch at the egress port attached to the storage array. Frames sent by the storage array to the hypervisor have the VMID tag added to the frame by the fabric. The fabric switches maintain the mapping and the collection of VM telemetry data. As a result, VMID+ enables VM Insight in storage environments with arrays that do not yet support VMID.

Figure 1. VMID+ Provides VM Insight for All Storage Arrays

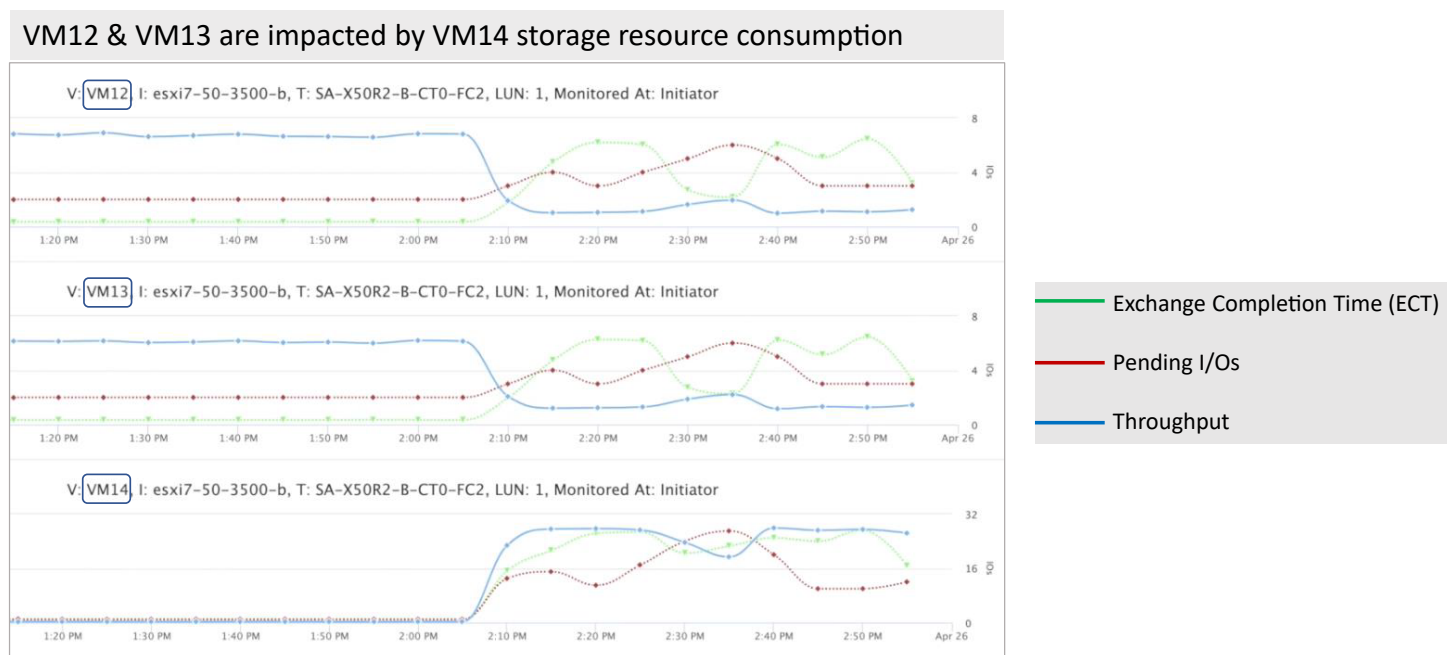


Example

The following example illustrates the value and insight achieved with VM Insight. We have three VMs using the same data store on the hypervisor, which is backed by a single LUN. The application owner of VM12 complains that the application's performance has been sluggish since just after 2:10 pm. Using Brocade SANnav™ Management Portal, the storage admin decides to investigate and display the VM Insight statistics for VM12, VM13, and VM14, which share the same LUN.

As shown in Figure 2, VM Insight provides storage admins with visibility into individual VM flows and contention for storage resources. In this example, the storage admin has selected three statistics for the VMs sharing the same LUN. You can visually see that around 2:10 pm, VM14 drastically increased data throughput to the LUN, severely impacting VM12 and VM13 and increasing pending I/Os and Exchange Completion Time (ECT) for all three VMs sharing the LUN. The demand from VM14 is clearly beyond the capacity of the shared storage LUN, impacting the application performance on the other VMs. Without contention for storage resources, VM14 would likely perform better as well. The storage admin notified the application owner of VM14 and discovered that the application does periodic data ingestion weekly at 2:00 pm. By understanding the exact root cause and impact, the storage admin can act accordingly to ensure that the SLAs are met for all three VMs sharing the LUN.

Figure 2. Example of VM Insight Investigation in SANnav Management Portal



Summary

VM Insight with VMID+ delivers unprecedented visibility into the storage traffic of individual VMs, thereby increasing the capabilities for effective monitoring and control of the virtualized data center:

- When troubleshooting application performance, VM Insight with SANnav Management Portal provide instant visibility into “bully” and “victim” flows as applications contend for the same storage resources.
- Better resource utilization of storage is achieved when VM Insight visibility into VMs can enable organizations to pack more onto the same storage footprint without cross-interference to meet application SLAs.
- With VM Insight, the root cause for application storage performance impact is readily determined to be SAN congestion, array exhaustion, or limited VM resources (CPU or memory).