Top 5 Things You Need in a Virtualization Management Solution

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Synopsis

For any size data center, having a proper management solution is critical for ensuring an orderly, smooth-running and problem-free environment. Without one, your data center can quickly turn into a wild jungle with servers growing out of control with no regard for discipline or limits. A data center should be like a well-run city with all parts of it communicating and interacting with each other. The mayor of that city should know about everything that happens within it, so he can make the right decisions when needed to ensure everything runs smoothly. It shouldn't be like a group of isolated villages that never speak to each other and have no idea what everyone else is doing. Having visibility into all aspects of your server environment is critical, but the amount of information that is monitored can easily be overwhelming, and not knowing how to interpret the information can make dealing with it difficult. Therefore, you need a management solution that can highlight the important information for you and also provide you with dashboards to make interpreting the information as easy as possible.

Virtualization technology has many benefits and most companies are now implementing it or planning to at some point. But the management of virtualized environments can be quite different from traditional physical environments, and the solutions designed to manage physical environments will not be as effective at managing a virtual environment. Implementing a management solution that is designed specifically for virtual environments is critical to ensure that you are monitoring the metrics and issues that are unique to virtual environments to ensure you are able to keep up with the higher rate-of-change and can scale as your virtual environment grows.

In this white paper, we will look at the top five areas that you should be looking at when choosing a management solution for your virtual environment and also covering the reasons why you need to use management solutions that are designed specifically for virtualization.

Virtual Environments Have Unique Challenges

Virtual environments have unique challenges and requirements that are not present in traditional physical environments. If you try to manage a virtual environment as you would a physical one, you will run into problems. When a server becomes a virtual machine, you can no longer manage it like a physical server. The guest operating system on a physical server has direct and exclusive access to the physical server hardware. In virtualization, a VM has virtual hardware that is emulated by the hypervisor, which controls all access to the underlying physical hardware. Virtualization is a layer that is inserted in between the hardware and the guest operating system. This is all transparent to the guest operating system, which is unaware that it does not have exclusive access to the hardware.

Virtualization is essentially a game of smoke and mirrors—the hypervisor needs to trick virtual machines into thinking they have exclusive hardware access as guest operating systems are not designed to share server hardware. The hypervisor performs the translation and mapping between the virtual hardware of the VM and the

physical hardware of the server. This delicate balancing act requires the hypervisor to manage resources in a way that is fair to all virtual machines running on a host, so they do not starve for resources. The hypervisor deals with the four main resource groups in different ways as outlined below.

CPU

Virtual machines only see the amount of vCPUs that are assigned to them regardless of the amount of physical CPUs a host may have. The hypervisor utilizes a CPU scheduler that uses queues to schedule and process any VM requests for CPU time on the physical CPUs of the host. A hypervisor will typically utilize all CPUs/cores to handle VM CPU requests. It uses a proportional share-based scheduling algorithm that can prioritize requests if needed. This scheduling process can cause a tiny delay as the hypervisor tries to find an available CPU to handle the request. On a busy host with many VMs all competing for CPU time, this delay can grow longer as the hypervisor struggles to handle the many requests coming in to the limited amount of physical CPUs. VMs with multiple vCPUs can further complicate the scheduling process as the hypervisor tries to co-schedule CPU requests simultaneously.

MEMORY

Virtual machines are assigned a fixed amount of memory, and the hypervisor maps the virtual memory pages to the physical memory pages. It is possible to over commit memory on a host and assign more virtual memory to VMs than the host physically has available. The host handles this by creating a virtual memory swap file on disk for each VM. When host physical memory is exhausted or if physical memory limits have been placed on a VM, the host utilizes the swap file to store VM memory pages. Because disk is significantly slower than RAM, this can have a major impact on the performance of a VM. To help avoid this, the host uses special memory techniques to try to conserve physical memory. One technique is called transparent page sharing (TPS), where memory pages are broken down into small chunks, and identical pages are consolidated together in a manner similar to de-duplication. Another technique involves using a memory balloon driver inside the VM that inflates and deflates to help force the guest OS to implement its own memory management techniques in order to reduce memory usage. In addition to the memory assigned to a VM, there is also extra overhead memory used by the hypervisor for managing the virtual hardware.

NETWORK

A virtual host has a whole virtual network running inside it similar to that of a physical network. This consists of virtual NICs, virtual switches and virtual firewalls that are all connected back to the physical network through the physical NIC uplinks in a host. While the virtual network functions much like a physical network, the traffic on it is not always visible to the physical network. All the virtual network components on a host exist only in the host's memory, and traffic between VMs in certain network configurations stays within the host. This can make monitoring and measuring VM traffic with physical tools difficult as they are not able to see all VM traffic. Virtual switches (vSwitches) typically have a limited number of physical NIC uplinks that support many VM virtual NICs. As a result, VMs on a vSwitch are all competing for bandwidth with other VMs as the hypervisor handles the mapping from the virtual NICs in a VM to the physical NICs of a vSwitch.
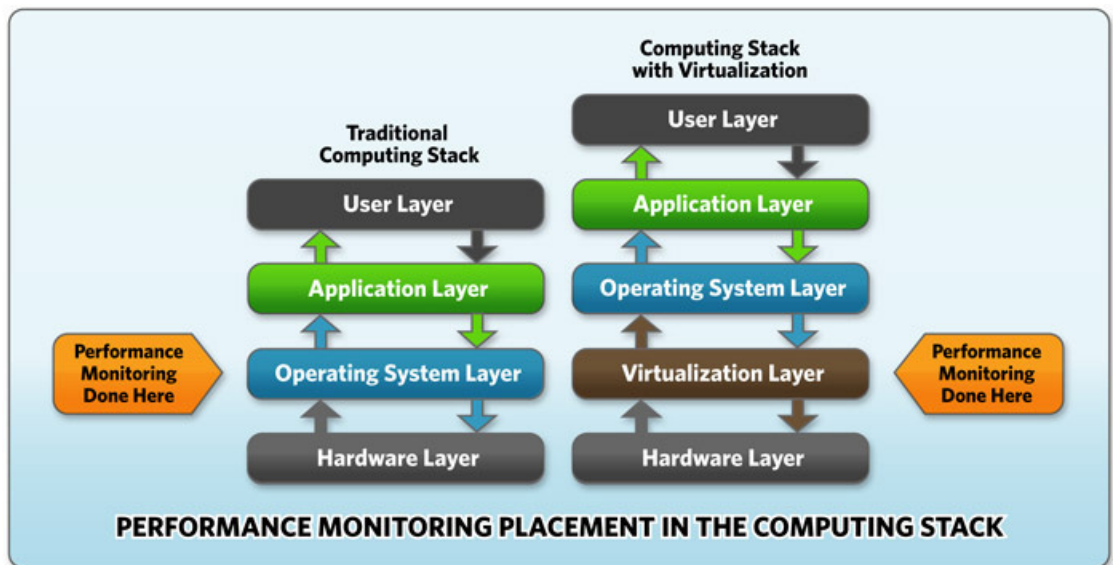
DISK

A physical server has disk partitions that exist on physical storage devices. A VM's virtual disk exists as a single large file that resides on one of the host's datastores. A host datastore consists of a physical storage device, either locally or shared storage that has directories for each VM where its virtual disk and other configuration files are stored. Unlike physical servers that have a dedicated storage controller to connect to their storage device with, VMs have virtual storage controllers that all share the physical storage controller of the host. VMs running on the host are completely unaware of the underlying storage subsystem that exists from the host, storage controller to the target storage device. Disk I/O requests are queued for each VM, and on a very busy host there can be a delay in processing requests. With disk being the slowest host resource, having too much disk I/O on a host can severely impact the performance of VMs running on the host.

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What it all boils down to is this: Virtualization is all about sharing the resources of a single physical hardware device with many servers. While this can make the most effective use of your resources, it also introduces new and unique challenges when it comes to the management and monitoring of your environment.

A Virtual Management Solution is Needed for a Virtual Environment

Because virtual environments are quite different than traditional physical environments, the tools and methodologies that are used in physical environments don't always work well in virtual environments. Virtualization is an added layer of the computing stack that traditional physical tools don't understand properly. Since virtualization is designed to be transparent to guest operating systems, any management tools that are looking at the guest operating system layer to see the hardware layer are looking right through the virtualization layer without seeing it. As a result, they are only seeing what the hypervisor wants them to see, which is the virtual hardware of the VM and not the actual underlying hardware. This can lead to inaccurate results as statistics gathered from the guest operating system are not a true reflection of the actual statistics of the host.

The techniques used in virtualization are designed to fool the guest operating system into thinking it has exclusive access to server hardware, so when a performance problem occurs, trying to identify it at the guest operating system layer is largely ineffective. While a resource bottleneck may be noticeable from within a VM, the actual cause of it is not. You need to look instead at the virtualization layer where you can see the actual hardware, and look at key metrics that are unique to virtual environments. A good virtualization management system can help you pinpoint where bottlenecks lie and help monitor and report on the many different areas in a virtual environment that are not present in physical environments.

Computing Stack with Virtualization

- User Layer
- Application Layer
- Operating System Layer
- Virtualization Layer
- Hardware Layer

Performance Monitoring Done Here

Traditional Computing Stack

- User Layer
- Application Layer
- Operating System Layer
- Hardware Layer

Performance Monitoring Done Here

PERFORMANCE MONITORING PLACEMENT IN THE COMPUTING STACK

While focusing on the virtualization layer is the key to properly managing and monitoring a virtual environment, you shouldn't solely focus your efforts there and completely ignore the guest operating systems. There is some monitoring and managing that is more effective at the guest OS level as not all statistics generated inside the guest OS are skewed by the virtualization layer. Therefore, a good solution will focus on both the virtualization layer and the guest OS layer to provide you with the right information you need to effectively manage your hosts and virtual machines. Using tools designed for virtualization is a must for virtual environments because without them, you are not seeing the entire picture. When you lack the proper visibility into all areas of your virtual environment, the risks are greater than in a traditional environment as even little things can have big impacts.

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There is More to Management Than Management: The Big Picture is Important

In addition to changing how you monitor performance, virtualization also introduces some other unique challenges to your data center. You can't just focus on managing virtual machines. You need to also focus on managing your virtual environment as a whole. A virtual environment is like a busy city that must be carefully monitored and maintained to ensure it operates smoothly. You can't just monitor things at the street level; you also need to take to the air to get a better perspective of everything that's going on. Virtual environments have many components that must all work together to ensure a smooth running operation. Even one small problem can have a big ripple effect on the whole environment. Because of this, it is important to stay on top of everything in your environment to ensure that ripples don't become waves that can swamp your whole environment.

As part of managing the big picture with virtualization, you also need to focus on the growth of your virtual city; more specifically, both planning and controlling it. Virtualization makes it very easy to create new VMs—in fact, too easy! With physical servers, you must order hardware, wait for it to arrive and build and configure it before you can use it, which is a process that can take days at a minimum. In virtualization, with just a few mouse clicks, a new VM can easily be created and be up and running within minutes. Many people think VMs are free and that you can create them whenever needed, but there is a resource cost associated with each VM created, though many choose to ignore that fact.

A common term in virtualization is "VM Sprawl," which refers to the rapid growth of VMs in a virtual environment without any regard for resource usage. If the growth is left unchecked, it can easily overwhelm your hosts and consume any spare capacity that they have as well as create I/O bottlenecks. The more VMs you create, the fewer resources you have available for the other VMs running on your hosts. Consequently, having tight control over your virtual environment is necessary to stop runaway growth. In addition to control, you can also implement a chargeback system for VM resource usage, which implements a cost model for VMs, so people realize they are not free. By doing this, you can make people think twice before requesting a new VM and also ensure that VMs are deleted when they are no longer needed. A pragmatic first step towards chargeback is something called "showback," where reports on consumption of resources (and possibly theoretical costs) can be shared with end users to encourage good behavior.

Besides controlling growth in your virtual environment, you also need to plan for any future needs you may have for additional VMs. Capacity planning is important to make sure you have enough capacity across all your host resources. For example, you may have plenty of spare disk capacity on your hosts and datastores in order to be able to create new VMs, but if you don't have enough host memory available, you won't be able to create them. Therefore, capacity planning is a balancing act to make sure you have adequate resources available in all areas for the creation of new VMs. At the same time, resource needs for existing VMs can change over time, so you need to watch this and factor it into your planning. Another factor that can complicate capacity planning is maintaining enough spare capacity to support host failures. If you are using a feature like VMware HA so that VMs from a failed host start automatically on other hosts, you need to ensure you have adequate capacity available to support one or more host failures. Having enough capacity available for this is very important. If you don't, you can easily overload your other hosts, which can ultimately slow down your entire virtual environment.

All in all, focusing on the big picture in your virtual environment is just as important as focusing on the components that are part it. From growth to capacity to performance, maintaining a smooth running virtual environment requires collecting and interpreting data as well as acting on it. Having a proper virtualization management solution can make this task much easier and also ensure that you are looking at the right information, so you can make informed decisions.

The 5 Areas Your Virtualization Management Solution Should Cover

There are five key areas that a good virtualization management solution should cover to effectively manage your virtual environment. By focusing on these areas, you can ensure that you stay on top of the big picture and also eliminate any potential threats that may disrupt or impact the proper operation of your virtual machines.

The five key areas that you should ensure that your virtualization management solution addresses include:

THE **5** AREAS YOUR **VIRTUALIZATION MANAGEMENT** SOLUTION SHOULD COVER

1. **Performance Management** – Having good performance is critical in a virtual environment where the same resources are being shared by many virtual machines. Nothing can kill a virtual environment faster than not having adequate performance for all the virtual machines running in it. When virtual machines are all fighting for the limited host resources, you need to ensure that you not only have enough resources available but you also prioritize their usage. Staying on top of performance is one of the most important tasks in a virtual environment - if you don't, you're asking for trouble. Virtualization Manager can help you identify problem areas that can affect your performance to determine what resource areas are experiencing contentions. Through the use of dashboards, automated alerts and reports targeting the key areas that can impact performance, Virtualization Manager can help ensure that your virtual environment performs well and stays healthy.

2. **Capacity Planning** – Maintaining sufficient capacity and planning for future growth is a non-stop job in a virtual environment. Knowing what resources to add when they are needed ensures that you always have enough capacity and are also not needlessly wasting money on resources that you do not need. Because resources are shared, capacity planning can be a tricky job; you need to think of your environment as a whole when adding capacity so you make sure you add the right type and amount of resources where needed. Virtualization Manager can help you understand when you will run out of resources and automatically notify you if you have a pending resource shortage. It can also help you with your host failover capacity planning to ensure that you always have enough spare capacity to handle host failures. You can also do advanced what-if analysis so you can create models of scenarios that will impact your resource availability. Finally, all VMs are not created equally, so understanding what applications and services these VMs support is critical so that you can set the right allocation priorities and make smart capacity management decisions. Surprises are not good in virtual environments and Virtualization Manager can help make sure that you never experience any.

3. **VM Sprawl Identification** – It's not always easy to spot VM Sprawl, especially when you manage your virtual environment on a day-to-day basis where growth over time may not be easily noticeable. Monitoring VM lifecycles and growth patterns is critical to being able to identify VM Sprawl; in fact, it's really about applying best practice configuration management policies to your virtual environment as you have in your physical. Looking at a picture of your environment from month-to-month instead of day-to-day can help you better understand how it is growing. Virtual environments hardly ever shrink and most continually grow from the day they are implemented. Virtualization Manager can help monitor growth trends so you can understand where your virtual environment has been and where it is going. With Virtualization Manager, you can easily identify un-used and zombie VMs as well as orphaned files and VMs that have more resources then they require.

Let Virtualization Manager help you control that growth so you can get a handle on VM Sprawl and prevent your environment from getting overwhelmed by virtual machines.

4. **Chargeback and Showback** – Using chargeback and showback in a virtual environment can help you control its growth, as well as track resource consumption. Host resources all have a cost associated with them and it can be extremely difficult to determine what virtual machines are using what resources. Chargeback allows you to break out individual VM resource usage so you can see exactly what each VM is costing you in terms of resource usage. Virtualization Manager can help you provide a business perspective to your virtual environment so you can understand the business context of your resource usage. Using Virtualization Manager, you can publish resource usage reports by business consumer so you can show what's driving their IT costs. Additionally, you can use chargeback to help fight VM sprawl and ensure that all resource usage is truly relevant.

5. **Storage I/O Bottleneck Identification** – Having a storage I/O bottleneck is perhaps one of the biggest threats to performance in a virtual environment and also one of the more challenging issues to identify and resolve. Bottlenecks can happen as the result of many things from simple configuration settings to improper architecture designs. Many bottlenecks are the result of improperly designed clusters and managed resources. Having a good management solution can help identify potential bottlenecks before they occur. SolarWinds Virtualization Manager can help by giving you detailed visibility into your storage subsystem so you can identify bottlenecks and deal with them. Using detailed storage metrics such as latency, throughput and IOPs, you can see how your storage is performing and exactly what areas need to be addressed. SolarWinds Virtualization Manager can help you stay on top ofyour storage I/O and proactively alert when problems occur across all your storage tiers.

Summary

As you can see, virtual environments have their own unique challenges and issues that must be dealt with by using the proper tools. If you are going to invest in virtualization, you should invest in the proper management tools as well. Virtualization has enormous benefits and is a key enabler for other areas like cloud computing and disaster recovery. But if virtualization is not managed properly, there is also the potential for creating problems in your datacenter that can easily erase all the benefits that are achieved. SolarWinds Virtualization Manager can help you get a handle on your virtual environment by covering the 5 key areas that can make or break your virtual deployment. If you want to make sure you have a healthy and well-performing virtual environment, then it's time to try SolarWinds Virtualization Manager.

About the Author

Eric Siebert is an IT industry veteran, author and blogger with more than 25 years of experience, most recently specializing in server administration and virtualization.

Siebert has published books, including his most recent, *Maximum vSphere* from Pearson Publishing and has authored training videos in the Train Signal Pro series. He also maintains his own VMware information web site, vSphere-land.com, and is a regular blogger and feature article contributor on TechTarget's SearchServerVirtualization and SearchVMware web sites. Siebert has presented at VMworld in 2008 and 2010 and has been recognized as a vExpert by VMware in 2009 and 2010.

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SolarWinds Virtualization Manager

SolarWinds Virtualization Manager is our award-winning, comprehensive virtualization management software that delivers integrated capacity planning, VMware® performance monitoring, VM sprawl control, configuration management, and chargeback automation all in one affordable product that's easy to download, deploy, and use.

Download a free trial, and in less than an hour you can start getting answers to tough questions such as:
- How many VMs do I have, and which ones are over- or under-provisioned?
- How do I optimize my virtual environment for VMware performance and licensing costs?
- Where are the VMware performance bottlenecks in my virtualized environment?
- How are my VMs configured?
- How many app servers will fit in my current environment, and when will I need more resources?

For additional information, please contact SolarWinds at 866.530.8100 or e-mail sales@solarwinds.com.
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