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Overcoming Five Key Challenges to Successful Virtualization

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WHITE PAPER

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Introduction

Virtualization poses unique challenges that are difficult to manage with traditional, non-virtualization-specific solutions. Managing a growing and increasingly complex virtual infrastructure, its underlying physical infrastructure and dependent applications places a heavy demand on staff — resources that are usually limited and specialized.

On top of these complexities, organizations still face having to deliver on the virtualization promise of reduced costs and increased efficiency. Not to mention getting the full benefit of their virtualization investment. Yet as the Gartner analyst firm states, "Virtualization — as an IT hub — does take investment; the savings are not a given"[1]. Thus, virtualization technology today is more the cornerstone to the ongoing success of the efficient use of IT. Virtualization enables a more dynamic data center, while facilitating virtualized cloud environments for added business benefit.

This white paper will offer insight into how you can overcome five common challenges to successful virtualization and the management practices, tools and techniques needed to do it.

[1] Virtualization Reality, Dawson, Philip. 30-July-2010 Gartner research #G00205779

Challenge One: Finding the Performance Bottlenecks

Ensuring constant availability and performance is a primary concern in virtualized environments. The upside to virtualization is evident in the cost savings that result from greater efficiency, lower overhead and improved agility. The downside often includes unaccounted risk in performance, without the staff expertise, tools or processes in place to properly manage it.

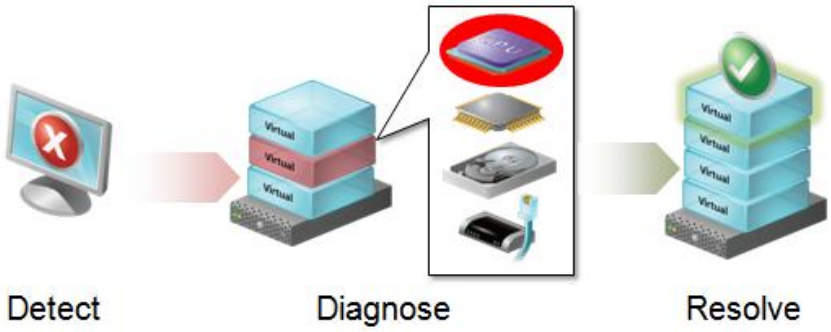

Figure 1 – Detect, diagnose and resolve process flow

Gartner, a leading information technology research and advisory company, says "[Virtualization] changes how you manage, how and what you buy, how you deploy, how you plan, and how you charge.[2]" Therefore, getting the right tools to detect, diagnose, and resolve performance bottlenecks becomes critical to ensuring the ongoing success of your virtual environment.

Detect

One of the chief functions of an effective monitoring tool is the ability to properly and accurately detect problems that threaten the availability and performance of the virtual environment.

There are four types of problems to be detected:

1. Predictive problems that warn of what roadblocks may be ahead
2. Best practice issues highlighting a departure from a known ideal state or rule
3. Behavioral problems that reveal errant patterns of use within the system
4. Conditional issues that highlight performance risks to the system under certain conditions

An effective tool should also account for the underlying physical infrastructure and any dependent applications. Finally, an effective tool needs an alerting ability that contains not only intelligence on the current state of health, but also proactive warnings based on analysis of trends and activity.

[2] Ibid

Diagnose

Once a performance issue is properly detected and classified as either predictive, best practice, behavioral or conditional, an ideal solution will diagnose the problem quickly and accurately. This is critical to the virtual environment; new operational challenges from virtualization can arise from a complex infrastructure supported by shared resources. The value of proper diagnosis cannot be overlooked; without it, IT risks slow, cumbersome resolution and delay of productivity to the greater organization. Proper diagnosis delivers real understanding of the root problem(s) at hand, providing both visual cues and in-context intelligence.

Resolve

Getting resolution on issues is imperative. The ideal tool should not only resolve, but do so quickly. Having the tools to further guide, recommend, or even automate the resolution of the performance problem supports the desire for short time-to-resolution.

Problem-resolution guidance should take on many forms. After diagnosing the cause, you can rectify the issue using best practices customized to your unique environment. Furthermore, you should consider using a tool that provides a path to resolution by suggesting workflow fixes, then automates the execution from the context of the problem (otherwise known as alert remediation).

Challenge Two: Confidently Virtualizing More

Visibility into Application Layer

Many organizations are successfully virtualizing and consolidating low-hanging fruit such as file/print servers, non-critical applications and the like. As virtualized workloads continue on a growth trend, organizations search for ways to instill stakeholder confidence and minimize risk even further into the application stack.

As virtualization technology evolves, so do the processes and solutions to keep a virtual system on track. Such solutions include increased visibility into the application stack and supporting infrastructure. Visibility must be exploitative (not simply aware), which is to say that you must be able to clearly see component resources and their relationships within the virtual environment.

Many organizations are ill-prepared or poorly equipped with the tools and/or processes to manage availability and uptime deep into the layers of critical application infrastructure. Problems worsen when organizations must manage the complexity of mixed physical and virtual implementations in which only partial components are virtualized, while others still reside in purely physical environments.

It is important to have accurate and meaningful key metrics from both the virtualization layer and application layer, side-by–side, to gain a clear understanding of where in the stack performance problems exist and where potential risks may be present. This clarity for individual components of a business-critical application (such as Microsoft Exchange and the Active Directory) in context with the underlying virtual or physical infrastructure, is the key to maximizing the full capabilities set of any virtual infrastructure. Success in server virtualization then depends on thorough performance-management technologies and practices. Those of you virtualizing Tier 1 applications and their supporting infrastructure need solutions that manage and monitor performance across the multiple, diverse components within physical and virtual environments alike.

Storage in Virtualized Environments

In addition to virtualizing further up the stack, organizations are experiencing obstacles in attempting to manage down the stack and into the supporting physical-storage infrastructure.

Storage is often blamed as the underlying cause of poor application performance. Issues such as insufficient bandwidth and throughput, disk hot spots, and I/O bottlenecks have made storage monitoring and optimization an extremely difficult process.

The introduction and subsequent proliferation of server virtualization complicates things further. Virtualization adds layers of abstraction that hide key physical-storage performance information. When virtual machines (VMs) or entire virtual infrastructures begin to perform poorly, you can't see beyond logical data stores to determine whether physical-storage components such as fiber-switches, LUNs, arrays and filers are actually causing the problem. Conversely, traditional storage administrators cannot see which VMs are overloading their physical-storage devices and are unable to properly balance storage resources across entire virtual infrastructures.

The only way to thoroughly tune virtualized applications is to understand their relationships to the physical storage fabric beneath their assigned data stores. Unfortunately, today's current hypervisor management tools do not include physical storage in their performance monitoring reports and topology (architectural) diagrams. This simply means that you don't know whether poorly performing VMs are the result of underlying network connectivity and/or storage problems. Rather, you have to rely on storage administrators to research the I/O issues affecting your VMs, virtual hosts, and entire virtual infrastructures.

In a similar vein, successful server-virtualization initiatives depend on IT organizations to provide acceptable performance for newly virtualized applications. Here again, a critical component of virtual-application performance optimization is the ability to monitor and tune the physical storage beneath virtual infrastructures. Thus, the answer is to provide storage transparency by gathering the key storage performance, capacity, and topology information necessary to optimize I/O operations for individual VMs and entire virtual infrastructures. This allows you to work with storage administrators to ensure that virtual-storage performance problems do not negate the significant savings realized by server virtualization.

Challenge Three: Infrastructure Reporting

After you have justified the initiative to your organization and started the process of virtualizing, you must maintain the environment. To do this, you should seek tools that will provide reliable data on performance, inventory and configuration while displaying this information in a way that can be easily interpreted by all stakeholders.

Reporting and Dashboards

To run your virtualization initiative successfully, your organization depends on timely, accurate feedback on the environment. How is the environment performing? Where are the performance bottlenecks? Which core resources are being over- or under-utilized? You should report on the environment in the context of how it is serving your organization's virtualization goals.

One common goal is the reduction of capital expenditures in the IT environment — a direct result of the higher utilization rates afforded by virtualization. However, by aiming for higher utilization, your organization risks inadvertent over-utilization the system. For example, stacking too many VMs onto a single ESX(i) host can cause VM slowdown on that host.

Another example is CPU-ready time – the waiting time it takes for a VM to get scheduled on an ESX(i) host – to deliver the CPU requested by the VM. In this case, the CPU scheduler can't service the requests quickly and builds a queue as a result. This, too, can be a substantial performance challenge in getting VMs to run efficiently and serve their intended use for the environment.

Real-Time Dashboards: The Ideal Solution?

To mitigate risks of over-utilization, the ideal solution will include real-time dashboards with historical reporting. Real-time dashboards provide current status on resource utilization and identify performance bottlenecks. Short-term historical reporting (e.g. the last four hours of performance data) brings visibility to infrastructure changes like VM movement. When change is known to be the most common cause of performance and availability problems, visibility to this data is imperative to effectively resolve system problems.[3]

Taken together, the different reporting elements allow you to correlate cause to effect. For instance, say you get an influx of performance complaints from others in the organization. A quick look at a real-time dashboard will reveal any highly or over-utilized CPUs, and a historical report will show recent changes. This combination of real-time and historical reporting allows you to correlate performance problems with root causes, so a resolution can be reached and the desired service level can be swiftly restored. This powerful mix of reporting allows you to manage virtual environments proactively.

Automated Reporting

Another common goal of virtualization is the reduction of operational expenditures through automated reporting as a means to free up administrative time for other projects. For example, in the dynamic virtualized environment, infrastructure can change frequently. You add or remove hardware from VMs all the time. These changes make reports equally dynamic over time.

Larger environments that depend on reporting can demand one or two full-time employees to support this need. In some cases, just running reports on a large environment's storage data alone can occupy the time of one resource almost exclusively. Automating these reports allows you to have desired information at your fingertips to share with stakeholders, and keeps you focused on higher-level projects to support the environment. Strong reporting on

[3] "Something Has Changed?" Condy, Mike. September 30, 2010.

performance and the state of the environment serves to fulfill the organizational goal of reducing operational expenditures.

Perhaps a final goal served by quality reporting is that of understanding the various costs of resources in the environment. You know the cost of each CPU, of memory and disk space alike. With inventory reports, you can apply environment costs as a means of understanding overall costs. How many VMs are running on how many CPUs? How much disk space is being used? How much memory? How are these resources allocated across the environment? Such data reporting is necessary to support administrative chargeback analysis.

Administrators of successful virtualization implementations require solutions that deliver environmental data via reliable, robust reporting that can be readily scheduled and accessed for easy interpretation by organizational stakeholders.

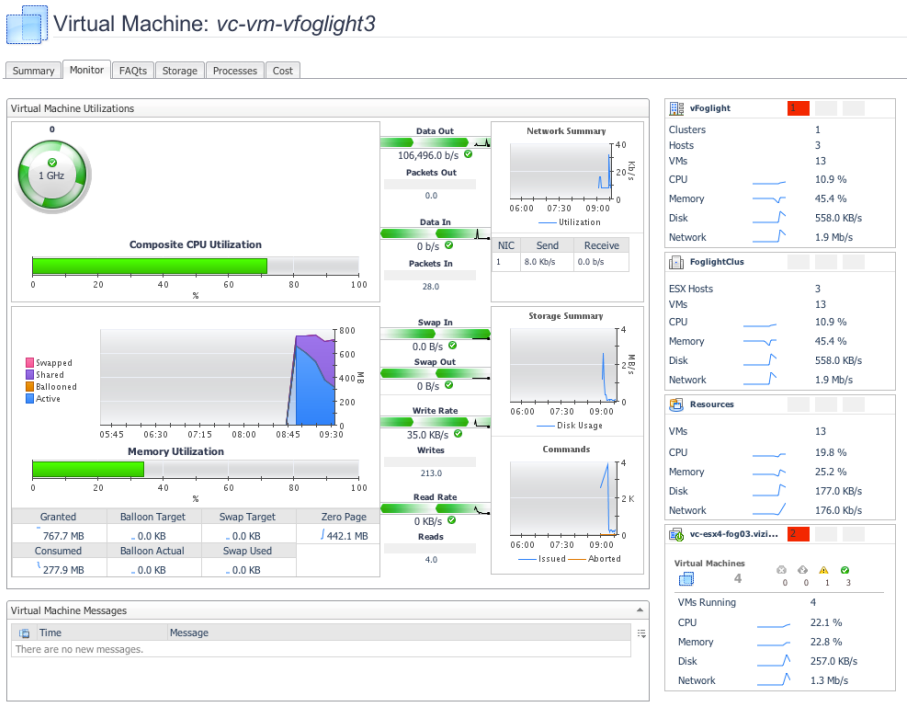

Figure 2 – Real-time information and historical data are important to better detect and diagnose performance –related issues alongside the VM relation to host, resource pool and cluster

Accounting for the Unique Nature of the Virtual Infrastructure

Virtual infrastructures have a unique resource structure between VM, host, cluster and resource pools. Likewise, good monitoring solutions take into account the relationships between these resources and can properly illustrate their data in a connected way. For example, when troubleshooting a slow VM, you want to clearly attribute that VM's performance to the host or even to the cluster or resource pool. Visibility within these relationships supports the kind of root-cause analysis required to resolve issues quickly. You should seek monitoring solutions that understand and illustrate these unique relationships as a means to ensure the targeted performance of a virtual infrastructure.

Challenge Four: Understanding and Planning for Capacity

Virtualization's inherent extensibility and mobility brings great value to the IT infrastructure, but it also introduces challenges in terms of balancing the capacity of systems with the demands of users. The dynamic nature of virtual infrastructure presents additional challenges in consistently managing the optimal amount of capacity for the virtual infrastructure.

Capacity changes can be both predictable and unpredictable. As an example, a new, coordinated application release could include new functionality expected to increase the demands on resources. This planned, predictable change prompts you to prepare sufficient resources to handle the new functionality.

Unpredictable changes are less visible and more difficult to manage. Without warning, the business could add a new group of users to an application or drive a new marketing campaign that directly impacts a system's resources. In either case, lack of understanding and poor capacity planning can drive your IT organization to either (a) overspend on under-utilized resources incurring unnecessary costs or (b) cause the business to lose revenue for over-taxed resources that are unable to meet required service levels. Managing the capacity demands of a dynamic virtual infrastructure is therefore critical to virtualization success.

Many organizations already collect some capacity-related information and work regularly to solve problems, plan for changes, and implement new resources. However, few organizations routinely perform the necessary capacity-planning best practices to balance supply against user demand while containing costs.

The primary goal of capacity planning is to provide satisfactory service levels to users in a cost-effective manner. To accomplish this goal in your virtual infrastructure, you must take changes into account that are both expected and unexpected.

Planning for expected change requires a way to determine how that change will affect the resources in your virtual infrastructure. Once the change is made, figure out when new resources will be required to maintain a high performance virtual infrastructure. Ultimately, over time the organization will need a way to monitor virtual infrastructure for unforeseen events that could negatively affect performance and availability.

Determine how Changes will Affect Current State

When planning for change, visibility is needed into whether the current virtual infrastructure can handle the new requirements; and if not, how much additional capacity is required. Lack of visibility into a proposed change may result in overspending. Modeling what-if scenarios is one way of determining the effects of a change.

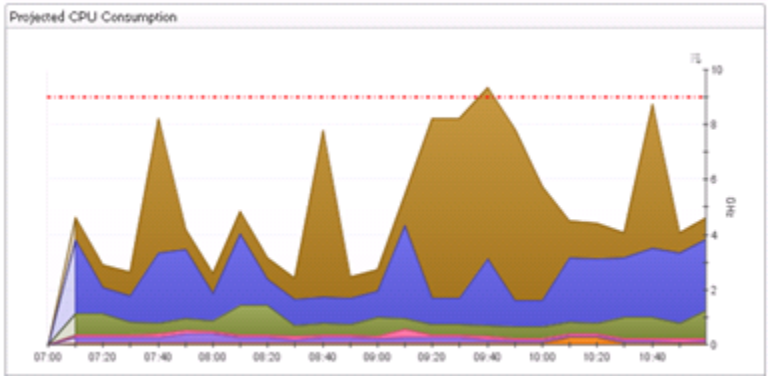

Figure 3 – Projected CPU consumption based on a modeling scenario

For example, in a modeling scenario you can create a ghost virtual host and assign proposed workloads to understand how many and which ones make sense. Using this approach, you can determine the exact configuration for CPU (Figure 3), memory, and disk you'll need to purchase for a host. Such information is critical for IT organizations that need to operate a high-performing virtual infrastructure on a tight budget.

Another example of a modeling scenario would be an investigation into the number of VDI sessions that can be assigned to an existing cluster or host without adverse performance issues. Knowing the number of VDI sessions prior to purchase is useful in projecting the total cost of virtual infrastructure needed to support a new VDI project. Modeling what-if scenarios offers valuable insight into the effect of change on virtual infrastructure and helps in making the right capacity adjustments for your environment.

Forecasting for Future Growth of Existing Infrastructure

When managing virtual infrastructure over time, you need a way to determine when new resources will be required to maintain the expected high level of performance and availability. Lack of planning for future capacity can result in significant project delays due to lengthy hardware purchase cycles and installation work.

Trending is the process of performing consistent baselines for capacity and performance of the virtual infrastructure, then reviewing those baseline trends to understand future resource requirements. By analyzing historical capacity and performance trends, you can forecast when a specific cluster will run out of CPU and memory. By forecasting growth trends and communicating capacity requirements you'll be able to avoid delays caused by long purchase and installation lead times and control the resources necessary to grow (Figure 4).

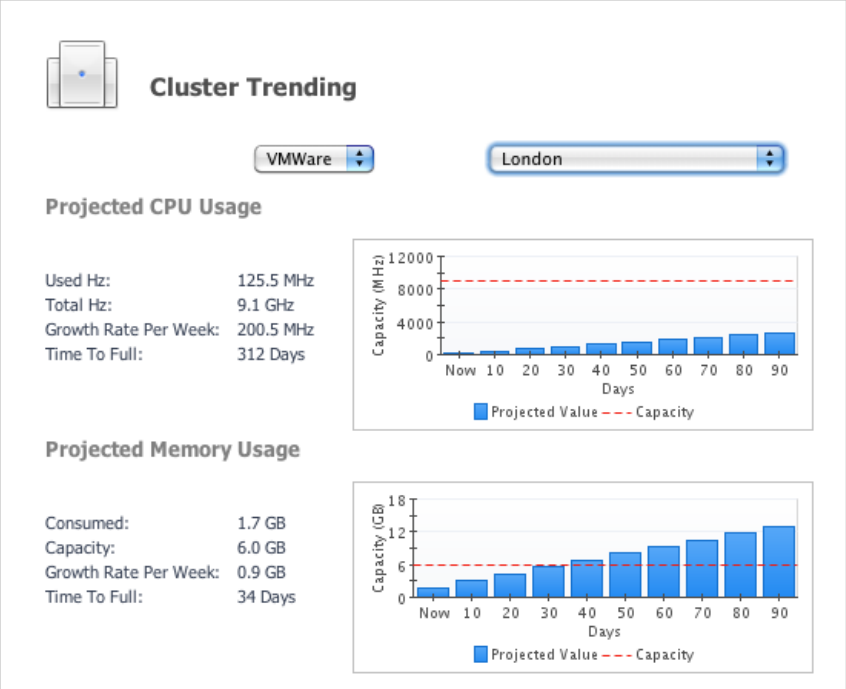

Figure 4 – Project CPU and memory trending for a cluster of hosts

Monitoring for Unforeseen Events

In a rapidly growing environment, you need a way to monitor the virtual infrastructure for unforeseen performance and availability events. Without a monitoring system that includes capacity-planning intelligence, you risk losing control over a quickly changing and increasingly complex virtual infrastructure.

Monitoring for throughput involves identifying and resolving capacity-related issues before end-users are affected or service levels are breached. Organizations typically conduct capacity planning periodically, but since virtual

infrastructures change quickly and are increasingly complex, alarms are required to notify you if a capacity change is required. For example, an intelligent alarm will notify you that a data store will be filled to capacity in 30 days without additional resources. By monitoring your virtual infrastructure for capacity, you can reveal unexpected growth and react in a timely manner to maintain high levels of performance and availability in your infrastructure.

The key to understanding and planning for capacity is ensuring adequate resources are available as needed, at the lowest cost possible. To be successful, you need best practices that plan for both unexpected and expected changes and growth in your virtual infrastructure. A high-performance solution is required to model different resource scenarios, forecast additional capacity based on historical trending, and monitor intelligently for unexpected capacity increases. That way your IT organization can indirectly increase revenue by maximizing availability, decreasing application downtime, and improving end-user response time. Additionally, cost can be directly decreased through higher-capacity utilization, just-in-time upgrades, and greater oversight. Bottom line: monitoring allows the highest level of return on your virtualization investment.

Challenge Five: Meeting SLAs in Virtualized Environments

The promise of virtualization centers on the ability to deliver IT services to the business more efficiently — faster than before and with less cost. The preceding sections of this paper make clear that delivering on this promise becomes more difficult as virtualization becomes more dominant in the traditional data center. The difficulty centers on the additional complexity introduced by virtualization and its disruption of established IT processes and procedures. In recent years, there has been extreme pressure for your department to become more strategic and better align with business objectives, proactively seeking cost avoidance rather than remaining a cost center.

IT has made great strides in process improvement (e.g. through ITIL processes) through a large initiative to better support business needs with established service-level agreements and increased agility that enables cutting-edge business initiatives. With the introduction of virtualization into the data center, service management practices should be established. Successful virtualization implementations will establish SLAs that incorporate relevant and accurate virtualization management solutions to address the nuances of both the underlying virtual and supporting physical infrastructures.

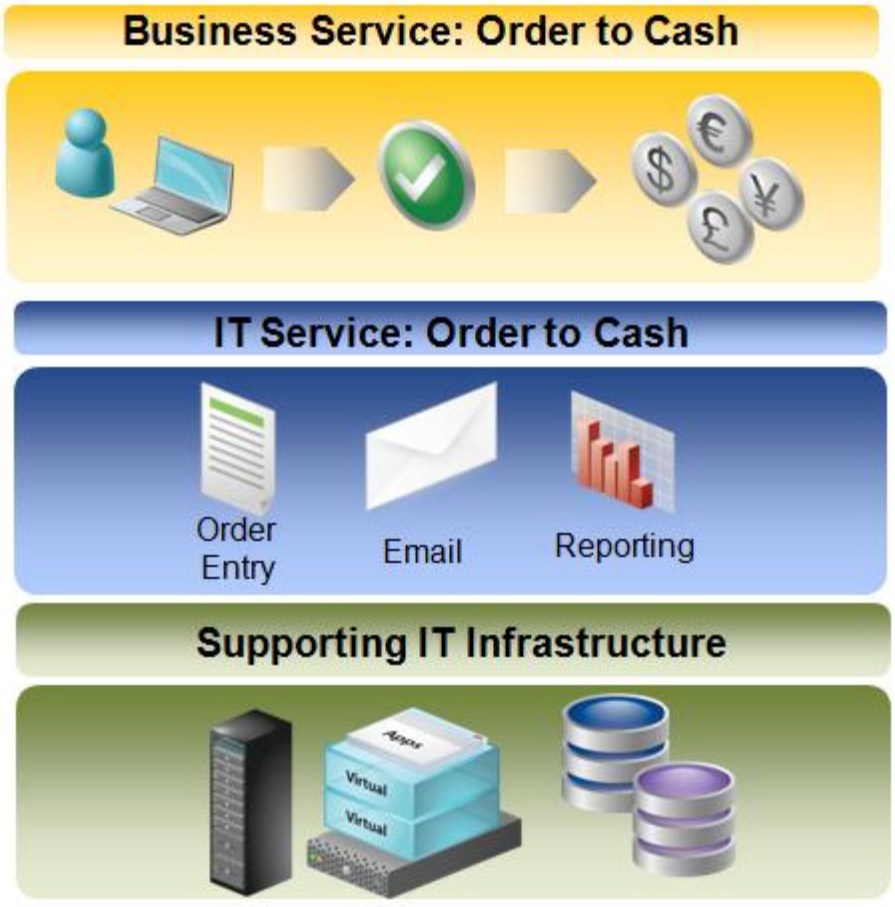

Figure 5 – The business service and supporting IT resources

The first step in effective service management is to define the service itself. Think of this as either an IT Service (such as Exchange e-mail) or a broad business service (such as order entry) in which email may be a component of the

overall service. Each service depends on underlying infrastructure, whether physical or virtual, and a service-management view shows logical groupings with direct links from the business service to underlying IT resources.

To simplify management and better align to the business, it makes sense to start grouping systems logically by department, customer, application or whatever best represents the business priorities. Groupings can be static (group systems together and give it a name) or dynamic based on machine name (physical and virtual), where the machine is tied to the service it supports regardless of where it resides in the infrastructure (a requirement in dynamic virtualized environments). Using service views, both IT and business stakeholders now have an understanding of how their service behaves in-context with underlying IT infrastructure, as well as a clearer understanding of which IT components are supporting each service, plus reporting on trends, uptime, and adherence to imposed service levels.

A service view can be visual. Instead of getting an alarm from an obscure machine name like vmsewin00105, you can recognize that this VM actually supports the critical order-to-cash business service. When a problem occurs that affects service health, you get informed as to what part of your environment is affected and how it ties to the critical business service. You can then initiate the proper resolution process, set in motion by an essential alert, which provides accurate diagnoses to root-cause and fast repair of the underlying issue, thereby restoring overall service health.

Service management, including comprehensive service views and reporting, overcomes the ongoing challenge of aligning IT closer to the business. The goal is to enable the business to become more proactive, efficient and agile, ultimately gaining competitive advantages through cutting-edge information technology.

Conclusion

As virtualization technology and its uses mature, so do the needs and requirements of effective management. The preceding five challenges address common obstacles that organizations face when virtualizing, both higher into the application stack, and deeper into the supporting infrastructure.

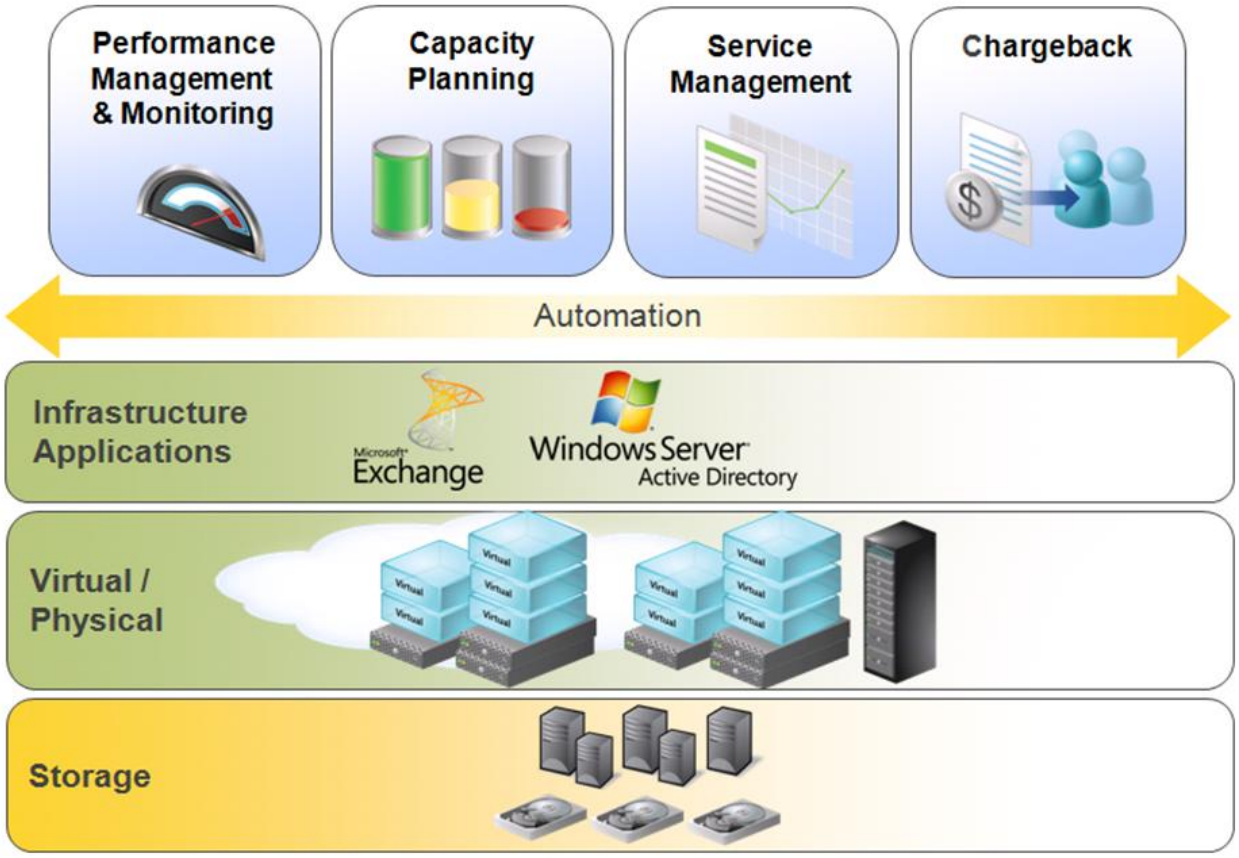

Figure 6 – Supporting virtualization high up into the application stack, and deep into the supporting physical infrastructure

Many organizations are experiencing the notable benefits of virtualization technology. However, they are also discovering many negative side effects that prevent them from realizing the true possibilities of virtualization.

To unlock full potential of virtualization, organizations must implement a solution that includes supporting processes that combat performance issues and ensure availability. The optimal solution will address a concise performance-management regimen of detect, diagnose and resolve, enabled by intelligent automation for fast resolution. The solution must be built to support robust reporting, capacity-planning and chargeback capabilities across multiple vendor-hypervisor platforms. It must also be supported by a scalable and flexible common repository platform. By following these tenets, the well-managed, virtualized infrastructure will become the catalyst for greater success in an agile and dynamic private-cloud endeavor.

About the Authors

Ben Scheerer manages product marketing for Quest Software's vFoglight virtualization monitoring solutions. Scheerer's 18 years of industry experience includes positions with CA and Vizioncore and has spanned software sales, consulting, and product and solutions marketing. His contributions include numerous speaking engagements, published articles and white papers on IT management related topics. Scheerer holds a master's degree in computer information systems from the University of Denver, an undergraduate degree in marketing from Western Michigan University and is ITIL® V3 Foundation certified.

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Updated—December, 2010

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