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The Definitive Guide™ To

Virtual Platform Management

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Chapter 10: Evaluating Virtualization Management Solutions

IT organizations are often aware of the fact that costs associated with managing new technology can far outweigh the initial deployment costs. Virtualization is no exception. Although the ability to run multiple isolated workloads on the same hardware can provide immediate cost savings and benefits throughout the environment, the associated administration tasks involve significant time and effort.

Throughout the previous chapters, I have covered a wide array of practices and recommendations for gaining and retaining control over virtualized environments. The primary challenge is that properly managing an environment that contains dozens (if not hundreds) of virtual machines can be very difficult. When these tasks are performed manually, IT organizations must absorb significant costs.

Fortunately, there's a better way—through the use of virtualization-aware enterprise automation solutions much of the work can be simplified or even eliminated. With the proliferation of virtual machine technology, literally dozens of products are available for meeting these needs. The focus of this chapter is on presenting factors that should be considered when evaluating these solutions. I'll present details related to the overall goals of virtualization management, along with specific features IT organizations should look for in products that will help manage their mixed virtual and physical infrastructures.

Virtualization Management Challenges and Goals

In some ways, the tools and techniques related to managing virtual machines are similar to those that are used for managing physical workloads. Each virtual machine contains its own virtual hardware configuration and a base operating system (OS) with necessary drivers. This forms the basis for the true goal of the virtual machine—providing access to applications and services. Many of the considerations related to managing these components are similar for both virtual and physical systems. Figure 10.1 provides an example of some of the most common tasks that are performed by IT systems administrators.

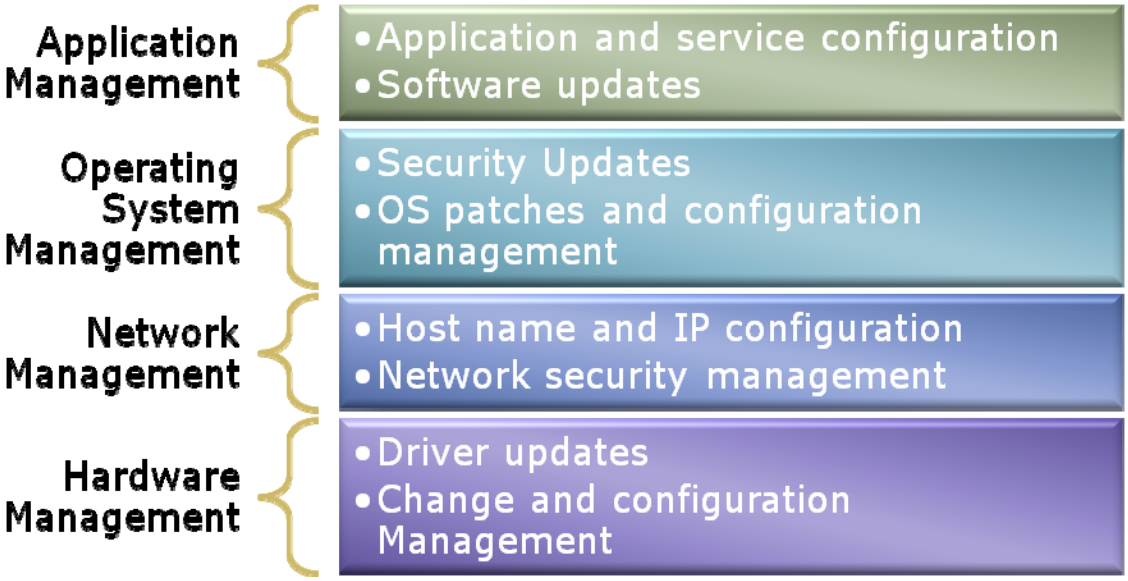

Figure 10.1: Common management tasks that apply to enterprise workloads.

Although the tasks and goals are often similar in nature, there are important differences for managing virtual systems. For example, "hardware" management for virtual machines actually refers to properly configuring the virtual hardware based on requirements. Considerations include the storage and network design as well as CPU and memory allocations.

Phases of the Workload Management Life Cycle

IT departments must consider the management of applications and services during their entire life cycle. Figure 10.2 provides steps in a typical life cycle management process. These general steps apply to all types of workloads—whether they are running on physical or virtual machines. From a technical standpoint, however, virtualization presents additional challenges, which will be covered later in this chapter.

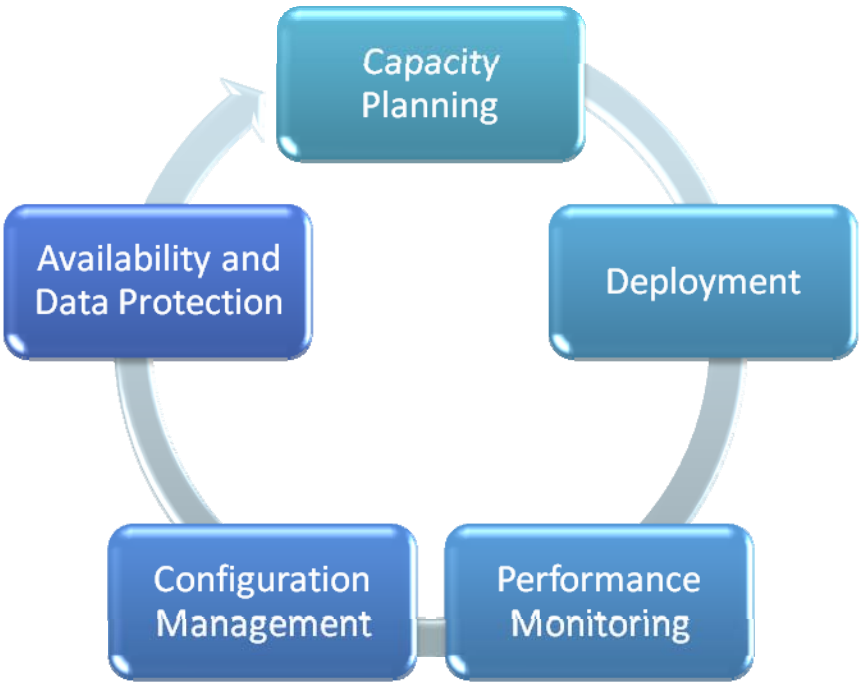

Figure 10.2: Phases of a workload management life cycle.

Many organizations initially focus on the immediate benefits provided by virtualization. The most readily noticeable of these is cost reduction through workload consolidation and reduced deployment times. However, as with physical machines, the deployment process is generally only the beginning of a longer sequence of tasks. When evaluating virtualization management solutions, organizations should keep these tasks in mind.

Capacity Planning

To maximize benefits from virtualization, organizations must have the ability to determine the distribution of virtual machines on their host computers. The goal is to calculate the ideal distribution of virtual machine placement. Details that must be considered include:

- Resource requirements—Technical hardware utilization statistics for CPU, memory, storage, and network resources are important aspects related to determining which virtual machines should be placed on which servers. The general approach is to ensure that the sum of all these requirements is below the total capacity of the host server. Additionally, virtual machines should be "load-balanced" so that, for example, two CPU-intensive workloads are placed on different physical servers.
- Security considerations—Although virtualization technology provides isolation of different workloads that are running on the same computer, there may be cases in which certain applications cannot co-exist on the same physical machines. Common examples include security, licensing, and regulatory compliance rules.
- Network issues—Like physical machines, the applications and services that execute within a virtual machine can generate significant network activity. Organizations must plan for supporting these requirements by providing adequate bandwidth and the required physical network connections on host hardware.
- Storage issues—Disk capacity and performance are often important factors for determining where virtual machines should be placed. Host systems must have sufficient storage bandwidth and storage space for accommodating all the workloads that are running on the system.

Additional considerations are related to usage patterns. Virtual machines that reach their peak usage at the same time should be segregated onto different systems. For example, two reporting-related applications that are used heavily at the end of every week will ideally be placed on different host computers.

Manually evaluating all these parameters prior to deploying new workloads can be a difficult, time-consuming, and error-prone process. Virtual environments tend to change quickly and the portability of applications and services make them moving targets.

Deployment

The technical steps required to deploy new virtual machines is simple. Often, all that is involved is creating or copying a few files and then registering them with the appropriate virtualization management layer. Although the process is fairly quick to perform manually for a few virtual machines, the deployment and provisioning process for larger virtual environments can be overwhelming. An ideal automated solution would provide users and IT staff with the ability to configure virtual machines based on their requirements. It would then obtain the necessary approvals. Assuming that the deployment is approved, the steps required to configure details such as the computer name, network address, and other virtual machine–specific settings can be performed without manual intervention.

Performance Monitoring

Through the use of virtualization, organizations can quickly adapt to changing requirements. Applications that require more memory or CPU time, for example, can be easily reconfigured to avoid bottlenecks. Monitoring virtualization performance is complicated by considerations related to tracking both host and guest performance statistics. An automated workload management solution can quickly and easily perform the necessary tasks to ensure that performance is optimized. Figure 10.3 provides an overview of the typical steps.

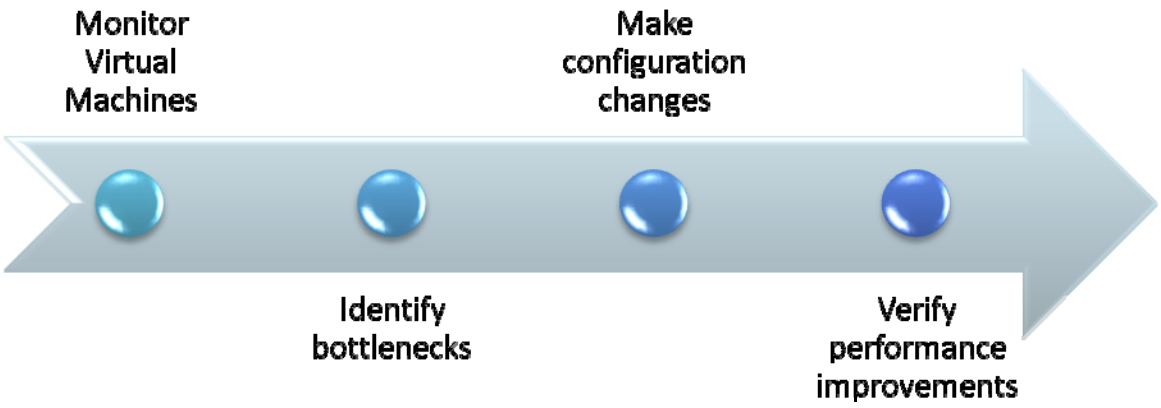

Figure 10.3: An automated performance optimization process.

When performance issues are detected, the simplest method of addressing them is to dynamically reconfigure the virtual machine. For example, an automated system can detect that a virtual machine is experiencing significant memory-related paging and can change the virtual memory configuration. If the host server does not have sufficient capacity to meet the requirements, the virtual machine can be moved to another host server. Continuous monitoring is an important benefit, as performance problems are often difficult to predict.

Configuration Management

As business needs change over time, it is often necessary to reconfigure virtual applications and services. Organizations should treat virtual OSs and workloads in a way that is similar to their physical counterparts. All installations and modifications should be subject to an approval process. Changes that are committed should be logged so that they can be reviewed later. Configuration management is particularly important for virtual environments because modifications are easy to perform.

Availability and Data Protection

Most workloads have the need to limit data loss and downtime. Monitoring for availability helps ensure that Service Level Agreements (SLAs) are being met. From a data protection standpoint, it is important to ensure that the contents of virtual machines are routinely backed up. An automated virtualization management solution can verify that backups have been performed for all relevant virtual machines and can track virtual machines as they are moved between physical host servers.

Unifying Physical and Virtual Management

To simplify systems management tasks, administrators should be able to use a single user interface to work with both physical and virtual machines. Virtual machines often contain a wide variety of software types. An automated virtualization management product should provide support for a broad range of different types of systems and applications. In addition, it should provide a method of supporting many different kinds of virtualized and non-virtualized systems. Organizations have the ability to choose from several virtualization platforms; the product will ideally provide a way to use consistent management methods across hypervisors. Figure 10.4 provides an example of some of the specifics.

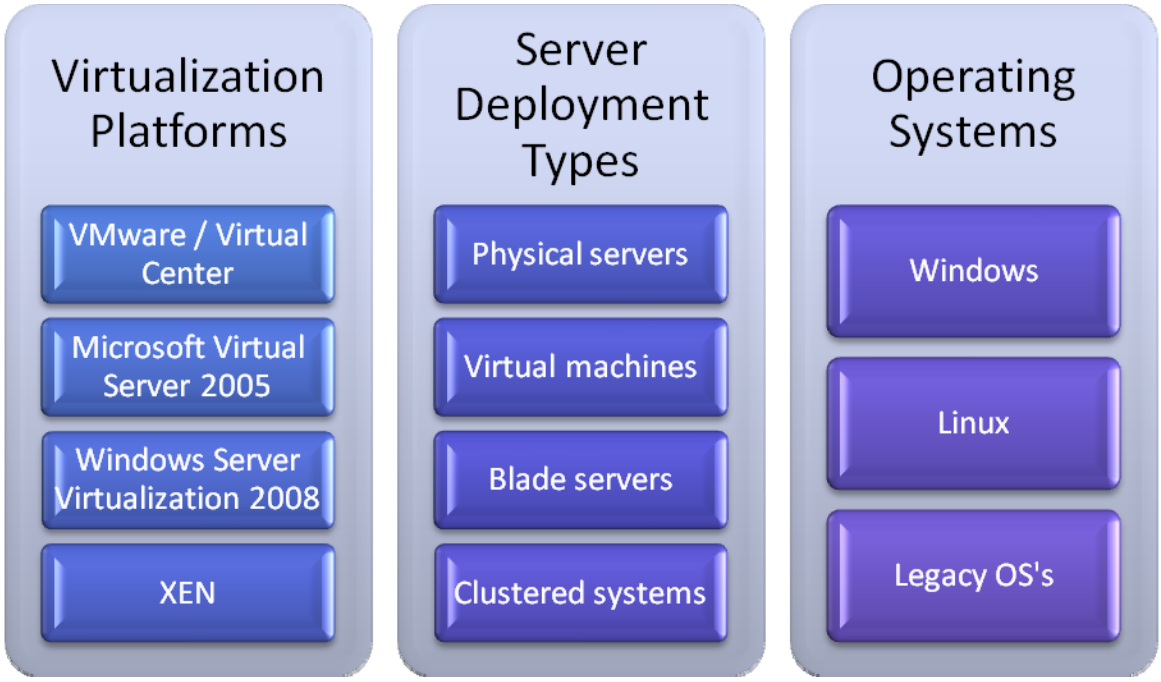

Figure 10.4: Considerations for implementing a unified view of an enterprise IT infrastructure.

Supporting Multiple Virtualization Approaches

In addition to these types of systems, organizations have the ability to choose from among different types of virtualization solutions. Each has its own benefits and drawbacks, but all of these solutions must be managed. Figure 10.5 presents examples of the different approaches.

📖 For more information about these approaches, see Chapter 3.

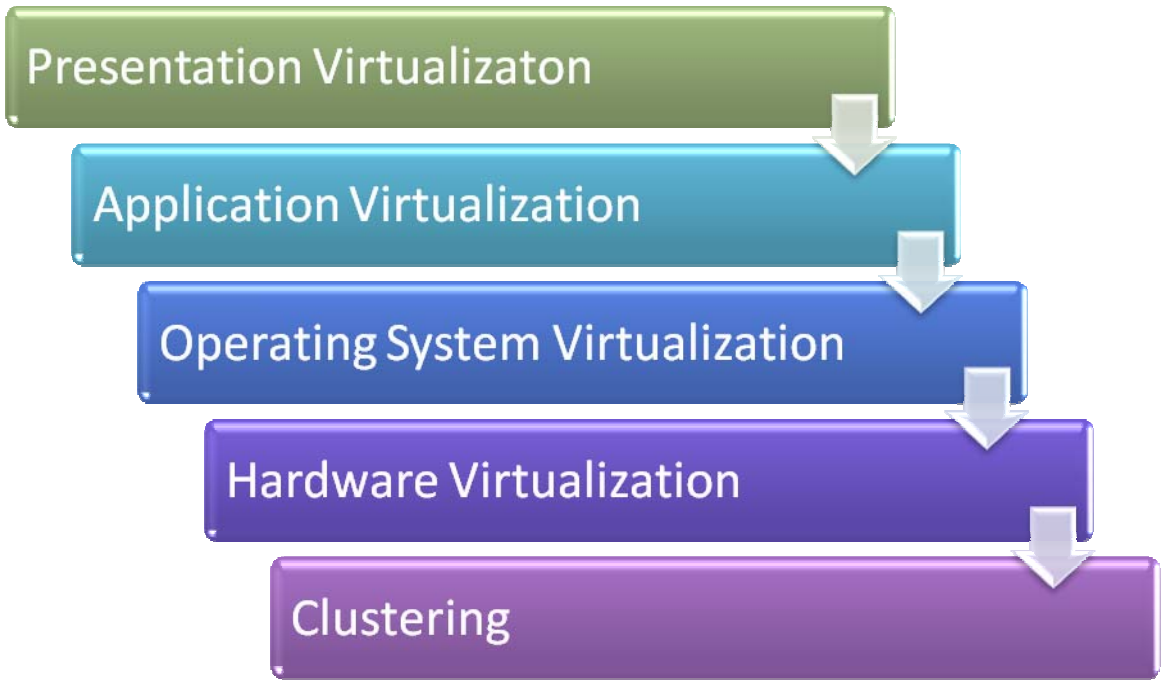

Figure 10.5: Various types of virtualization solutions.

In addition to these approaches is the use of physical machines (or the absence of virtualization at all). The goal for an automated virtualization management solution is to present all these methods in a consistent manner so that systems administrators can efficiently administer them.

Benefits of Unified Management

There are numerous benefits of using a unified view of the entire environment:

- Centralized management—By providing the ability to use a single console to access systems throughout the environment, systems administrators can quickly and easily manage large numbers of systems. This also makes them less likely to overlook critical components of the infrastructure.
- Security—Centralized management tools can integrate with directory services and other authentication mechanisms to create an additional layer of security in the environment. Rather than requiring direct access to all the many physical and virtual systems individually, changes can be validated and approved within the system and then automatically deployed throughout the environment.
- Decreased training—A major challenge for many IT organizations is ensuring that the proper expertise is required to support the many different workloads in the environment. When these tasks are performed manually, administrators with virtualization expertise are often a required. When the view of physical and virtual systems is "normalized," however, basic systems administration tasks can be completed by any administrator, regardless of the type of system that is being managed.

Overall, the ability to consistently manage many different types of systems can provide a significant advantage to IT organizations and the users that they support.

Evaluating Virtualization Management Features

Thus far, I have presented information about the high-level challenges of managing mixed physical and virtual environments. Organizations should evaluate enterprise automation and management solutions based on the major virtualization management challenges and goals. In the following sections, I will cover specific capabilities that can help reduce costs, simplify administration, and lead to an optimal IT infrastructure.

The list of features in this chapter is designed to help identify factors that can help organizations optimize the management of their mixed virtual and physical environments. It is important to recognize, however, that the virtualization management industry is evolving. Although it is unlikely that any single product will meet all the administrative requirements for an IT organization, staff should look for as many of these capabilities as possible.

Simplifying Management

A primary goal for any automated solution is to reduce the amount of time and effort that is required to manage the entire environment. Well-designed features can help reduce human error and can automatically complete many common tasks. These features help free IT staff to focus on more important issues rather than "fighting fires."

Policy-Based Management

Although change is inevitable in all organizations, it is also the cause of many potential problems. Many IT-related changes involve users, managers, and technical staff from throughout the organization. To help ensure that the environment remains manageable, it is often necessary to implement configuration-related policies. These policies will state the expected configuration of physical and virtual systems.

Manually validating systems against policy requirements can be a complicated task in environments in which virtual machines can move across host systems. In order for IT departments to ensure that policy terms are respected, an automated solution should have the ability to validate change requests before they are deployed into the production environment. For example, if a user requests additional memory for one of her virtual machines, the automated system can automatically collect the necessary approvals before the change is made. If any of the requested configuration settings are inconsistent with policy requirements, they should be highlighted and/or prevented.

Consistent User Interface

IT staff members are typically tasked with managing large numbers of systems, each of which has its own nuances and complexities. Earlier, I mentioned the importance of providing a unified view of both physical and virtual systems. In addition to providing support for a heterogeneous environment, the actual management tools that administrators will use should be easy to learn and understand. For example, the presentation should clearly identify the relationships between virtual workloads and the physical computers on which they're located. Other details, such as the CPU, disk, memory, and network configuration should be readily available. Consistent user interfaces help minimizing the learning curve for new administrators. This can significantly reduce costs by spreading administration duties to more IT staff.

Notification Management

Keeping track of large numbers of physical and virtual systems can be a difficult and time-consuming task. Ideally, an enterprise management solution will have the ability to quickly detect and resolve common types of problems. But what should happen if there is no automated corrective action? This is typical for complex systems that have many dependencies. Knowledgeable technical staff will be required to isolate and resolve the problem. Or what if manual decision-making is required? For example, the decision to move a virtual machine often requires management approval.

To manage these situations, it is important for a virtualization management solution to be able to notify the appropriate staff members. Prompt notifications can help alert the necessary people to an event of issue. The most common notification methods are through the use of email or pagers. Data center staff and IT managers should have the ability to quickly and easily obtain complete details about the affected system(s). Figure 10.6 provides examples of the information that should be provided.

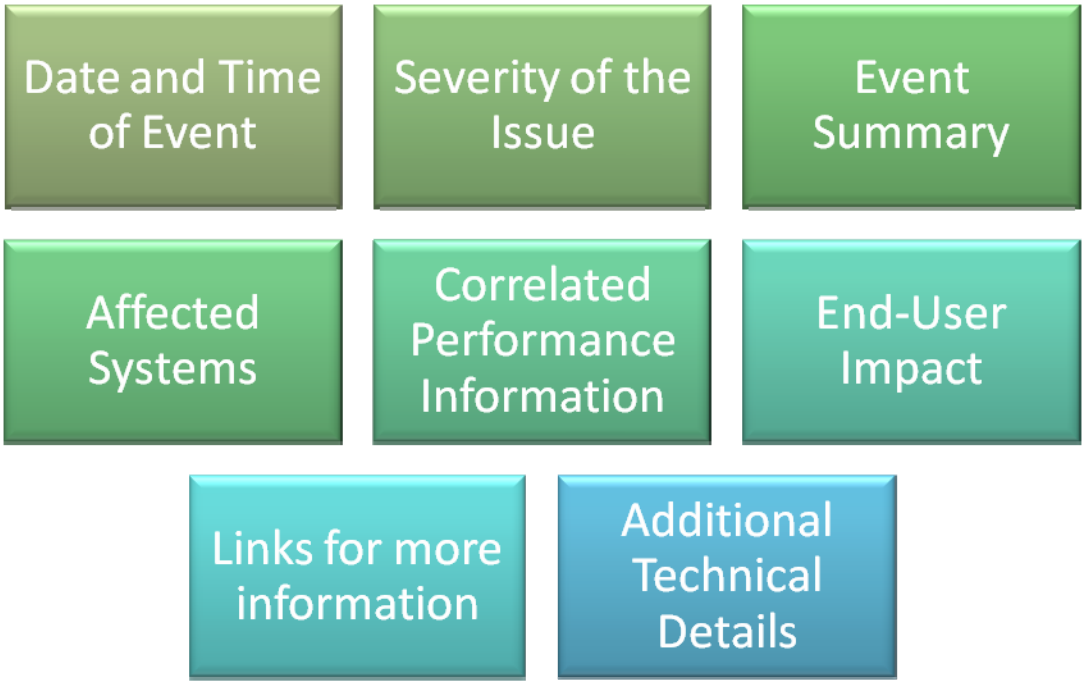

Figure 10.6: Typical details that should be included in an automated notification.

In addition to basic notification features, an automated solution should provide a method by which tasks are assigned and escalated. For example, if a high-impact outage has not been responded to within 15 minutes, a senior-level support member can be notified. Notification rules should also be configurable based on administrator work schedules and areas of expertise. All these features can help ensure that important issues are responded to quickly and that the time to resolution is minimized.

Support for Future Platforms—Extensibility

Technology improvements are notoriously difficult to predict. IT infrastructure components evolve rapidly and new types of workload configurations will undoubtedly be deployed over time. For example, new versions of OSs, virtualization products, and applications often come with additional technical requirements. In order to "future-proof" administration solutions, an enterprise automation product should have the ability to support new technologies. A modular approach is often one of the most powerful methods for handling these requirements. The architecture of the product provides customers with the ability to purchase the management modules that they need for specific applications and services. Figure 10.7 provides examples.

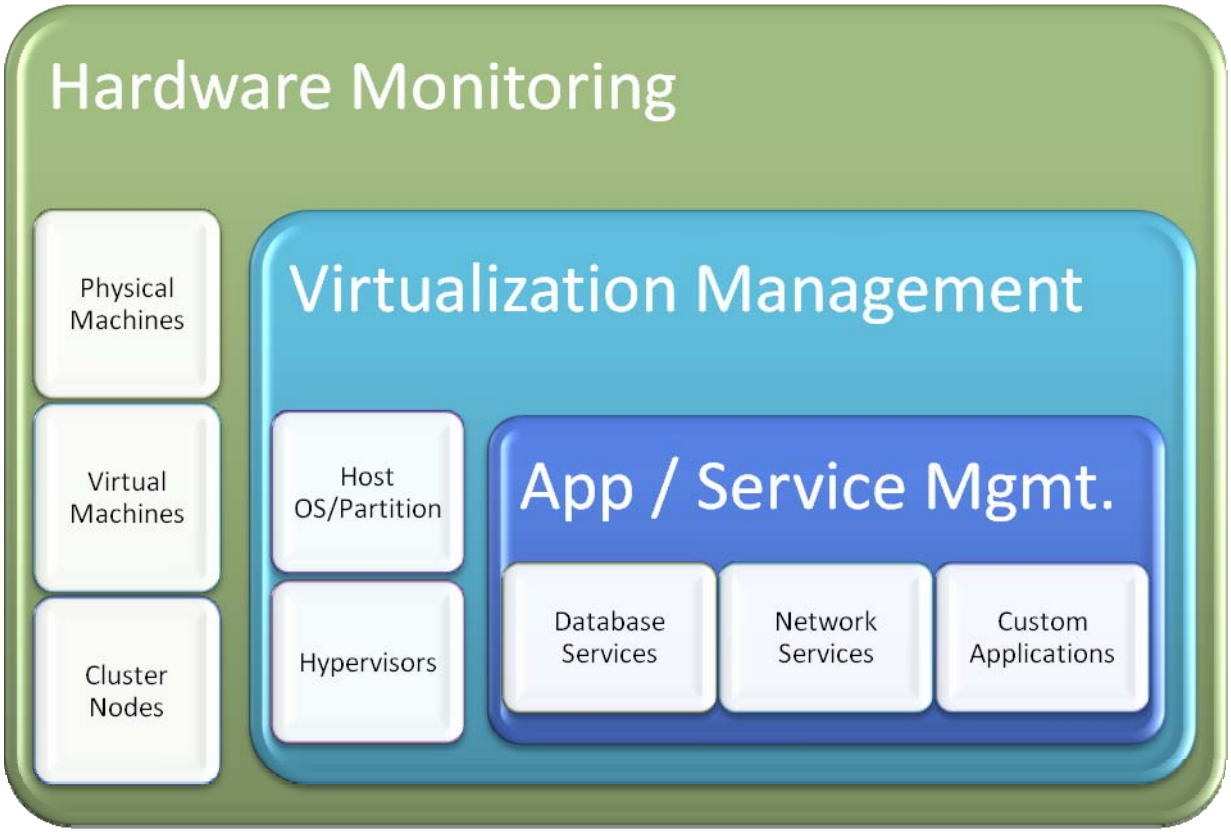

Figure 10.7: Examples of modules for managing virtual environments.

When new products and technologies become available, the enterprise management solution should provide a consistent method of supporting them. This helps reduce the learning curve for systems administrators and provides an enterprise-wide solution for supporting current and future components.

Directory Services Integration

Managing security in a complex and heterogeneous environment can be difficult. The major requirement is to ensure that administrators have the appropriate permissions on all the resources that must be managed. However, from a security standpoint, it is necessary to provide only those permissions that are required based on job functions and requirements. In order to simplify this process, enterprise management tools should have the ability to leverage security information stored in an organization's directory services database. Permissions can be managed based on standard group membership rules and by using familiar administration concepts.

Remote Management Features

Most IT departments have the need to manage a geographically dispersed environment that consists of many locations. Central data centers typically contain the vast majority of computing resources. Remote offices also have their often infrastructure that must be managed. In order to simplify the administration of these systems, a virtualization management platform should provide the ability to remotely access all the computers in the environment. This will allow administrators to spend less time connecting to the systems that they need to configure and troubleshoot and more time on actually resolving problems. Wherever possible, remote management features should provide a consistent experience for connecting to a wide range of different types of systems.

Integration with Other Management Tools

In order to provide a complete enterprise management solution, it is often necessary for several pieces of software to work together. Virtualization management tools should have the ability to leverage information from other systems wherever possible. For example, the ability to coordinate data in a virtual infrastructure management solution with information stored in a separate change or configuration management system can be useful. Figure 10.8 shows some other possible inputs.

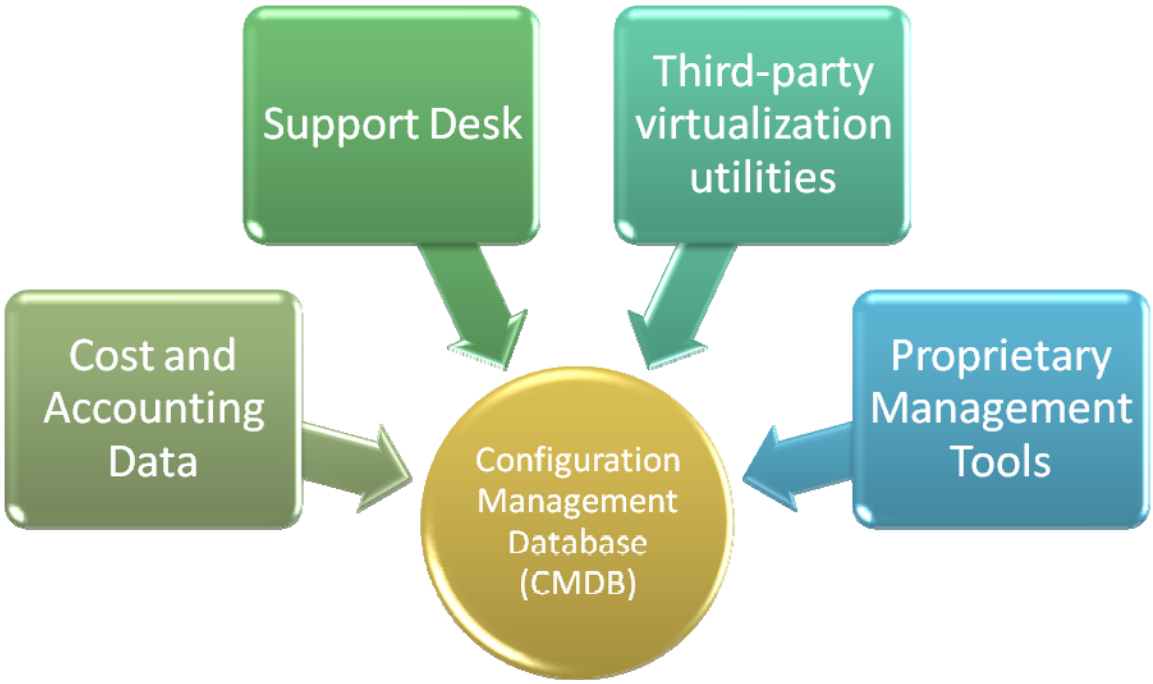

Figure 10.8: Possible integration points for virtualization management solutions.

It is common for third-party utilities or platform-specific tools to be used. In the area of virtualization, a common example is physical-to-virtual (P2V) conversion programs. Additionally, support desk ticket information can be a useful input. It can help isolate and correlate potential configuration issues in the virtual infrastructure.

The most logical place for this information to reside is within a Configuration Management Database (CMDB). How this integration is implemented can vary, and in some cases might require the import or export of data. However, since no enterprise management solution is likely to meet 100% of organizations' requirements, integration capabilities can be helpful.

Automating Performance Management

In addition to basic performance monitoring capabilities, an automated enterprise resource management tool should be able to autonomously make configuration changes based on resource needs. In this section, I'll cover some features that can help optimize organizations' virtualization investments by ensuring that systems are properly configured.

Prioritization of Resources

By default, virtualization platforms assume that all the workloads that they are supporting have equal access to system resources. Realistically, however, organizations often have different needs and levels of importance for virtual machines. For example, a single server might hold a temporary virtual machine that is used by only a small number of users. The overall cost of performance-related issues would be limited. On the same server, a virtual machine that provides support for mission-critical applications should be given a far higher priority. Figure 10.9 provides examples of some typical categories of virtual machine priorities and their characteristics.

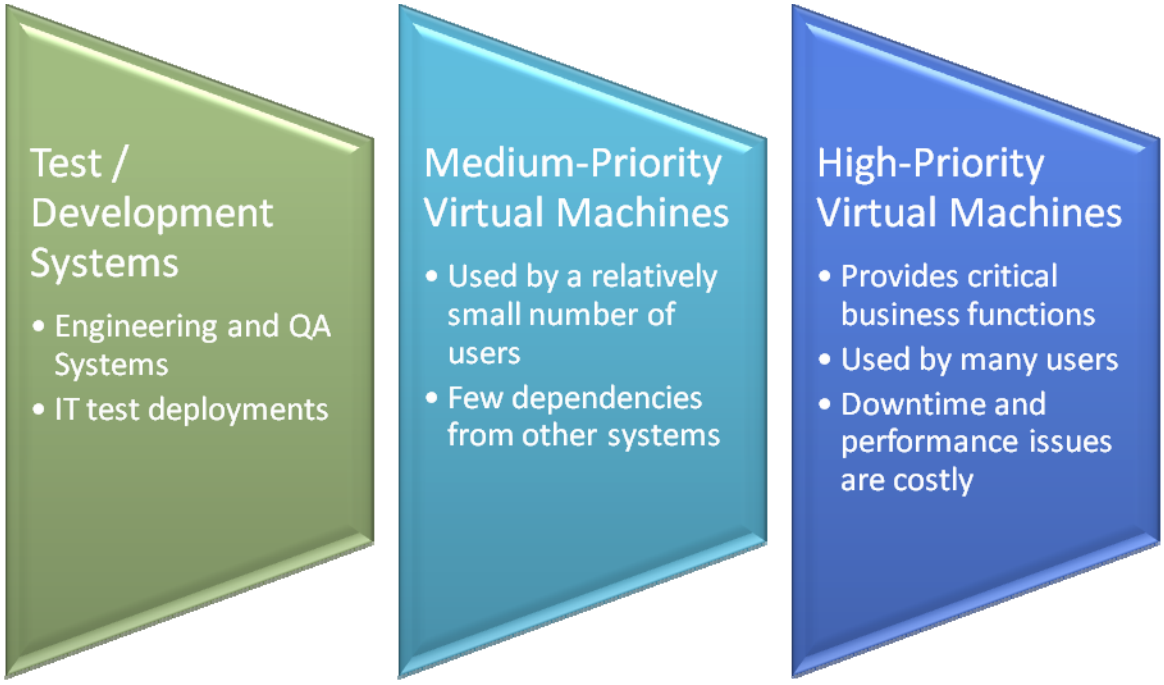

Figure 10.9: Comparing different levels of virtual machine priorities.

Enterprise automation solutions should provide administrators with the ability to define resource allocation priorities for their virtual workloads. This is often done through the use of relative weighting values or by implementing constraints for maximum and minimum resource utilization. Whenever physical hardware resources are limited due to higher-than-expected system usage, prioritization rules are used to decide which workloads will receive a preference. The benefit is that more important applications and services continue to receive the resources they need to prevent performance or stability problems.

Server-Level Resource Provisioning

When provisioning new virtual machines, systems administrators are tasked with determining where the virtual machine should reside. When done without statistics and performance data, this task involves an element of guess-work. A less-than-ideal selection will result in either performance problems for all the workloads on the server or untapped potential on the physical computer.

Provisioning physical servers often involves numerous steps and processes. The end result is typically a rack-mounted computer that has power, network, and storage connections. It is easy to visualize these relationships because these machines take up space and consume resources such as switch ports. When a new virtual machine is deployed, however, it can be much more difficult to measure its true impact.

Like their physical counterparts, virtual machines require disk space, access to network connections, and CPU and memory resources. IT staff must be able to use this information to ensure that server capacity is being adequately utilized. An automated performance management solution should be able to keep track of host server resource utilization. Ideally, the data will be collected by analyzing real-world usage patterns. If a server is consistently found to have additional capacity, it should be considered a candidate for hosting more workloads. However, if the server frequently experiences performance issues, it should not be used to support additional load.

When a new virtual machine is scheduled for deployment, the automated solution should be able to make recommendations about where to deploy it. The system should combine expected resource utilization requirements with available resources within the entire infrastructure. These features can help simplify the process of load balancing and help avoid performance and availability issues.

Dynamic Resource Brokering

The process of predicting application usage patterns can be complicated and error-prone. Over time, more users will start using one system while stopping the use of others. And, unexpected technical interactions between dependencies can lead to performance problems that are difficult to resolve. Environments that support hundreds of virtual machines can benefit from dynamic resource brokering—the ability to automatically reconfigure virtual machines based on their current needs. For example, if an application is typically utilized only at the beginning of the month, CPU and memory resource allocations can be automatically reduced during other times. This results in additional capacity for other workloads while still ensuring that users' needs are being met. Overall, dynamic resource brokering automatically responds to changes to ensure that the allocation of valuable hardware resources remains optimally allocated over time.

Scripting and Automating Capabilities

Many systems administrators and software developers are familiar with writing programs that are used to automate common processes. The ability to quickly and easily create scripts or software for managing common tasks can be very useful when managing virtual environments. An example of a useful script is one that is scheduled to run just prior to the deployment of a new virtual machine. OS-specific customizations can be included in the script to ensure that all settings meet business and technical requirements. Some solutions also provide the ability to collect and store script results for later analysis. Overall, the ability to use programming technologies can simplify management and can allow for more efficient management of the entire environment.

Collecting and Analyzing Virtual Infrastructure Data

To make better decisions about managing the current and future IT operations, decision-makers should have the ability to collect and report on their entire environments. A primary advantage of using a virtualization management solution is its ability to provide this data.

Centralized Configuration Management

Although the configuration details of physical machines, virtual machines, and clustered systems can vary significantly, it is the responsibility of IT departments to ensure that all the information is properly tracked. Although physical inventory mechanisms are not possible for virtual machines, these systems do represent significant resource usage costs. Additionally, modern applications and systems have many inter-dependencies. Figure 10.10 provides an example.

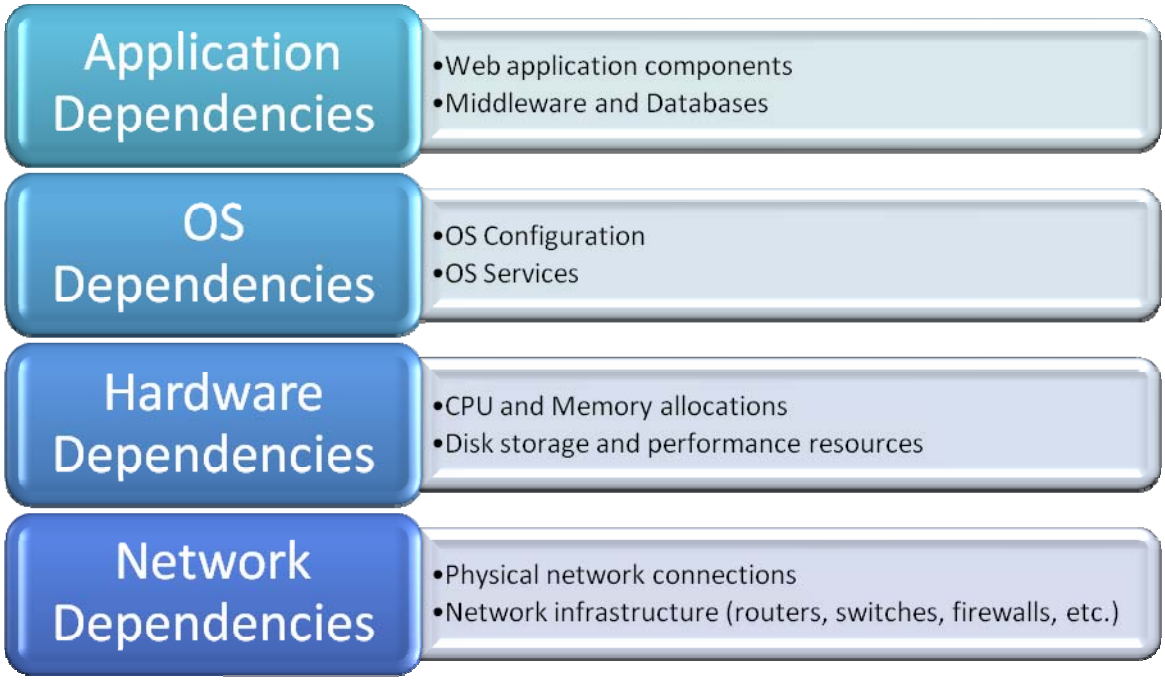

Figure 10.10: Typical dependencies for an enterprise application.

The true goal for monitoring the environment should be to ensure the best possible end-user experience. The failure or incorrect configuration of any of these dependencies can result in downtime.

A common management challenges is that configuration information is stored in a wide variety of different locations. Examples include:

- Network device configuration files
- Server configuration data
- OS configuration information
- Application dependencies

A recommended approach for managing all this complexity is to store all the data in a single Configuration Management Database (CMDB). This database can be used to collect and store configuration information. Systems administrators can use the data to view information from throughout the entire environment without having to access multiple management systems.

Advanced Reporting Features

Managing heterogeneous environments can be simplified through the use of strong reporting capabilities. Another benefit of using a CMDB is the ability to generate a wide variety of different reports about the current environment. Examples of useful types of reports include:

- Capacity planning projections—By using performance information that has been collected from real-world usage data, organizations can get a better sense of the amount of total capacity they have available. The information in these reports can be used for planning and budgeting purposes.
- Average server resource utilization—This report can be used to identify under- and over-utilized physical computers in the environment. IT managers and administrators can use this data to better balance workloads across physical systems.
- Virtual machine resource utilization over time—Virtual workloads often have changing characteristics based on usage patterns. This type of report can help identify potential performance problems before they are noticeable to end users. Figure 10.11 shows an example of graphs showing memory utilization for several different workloads.

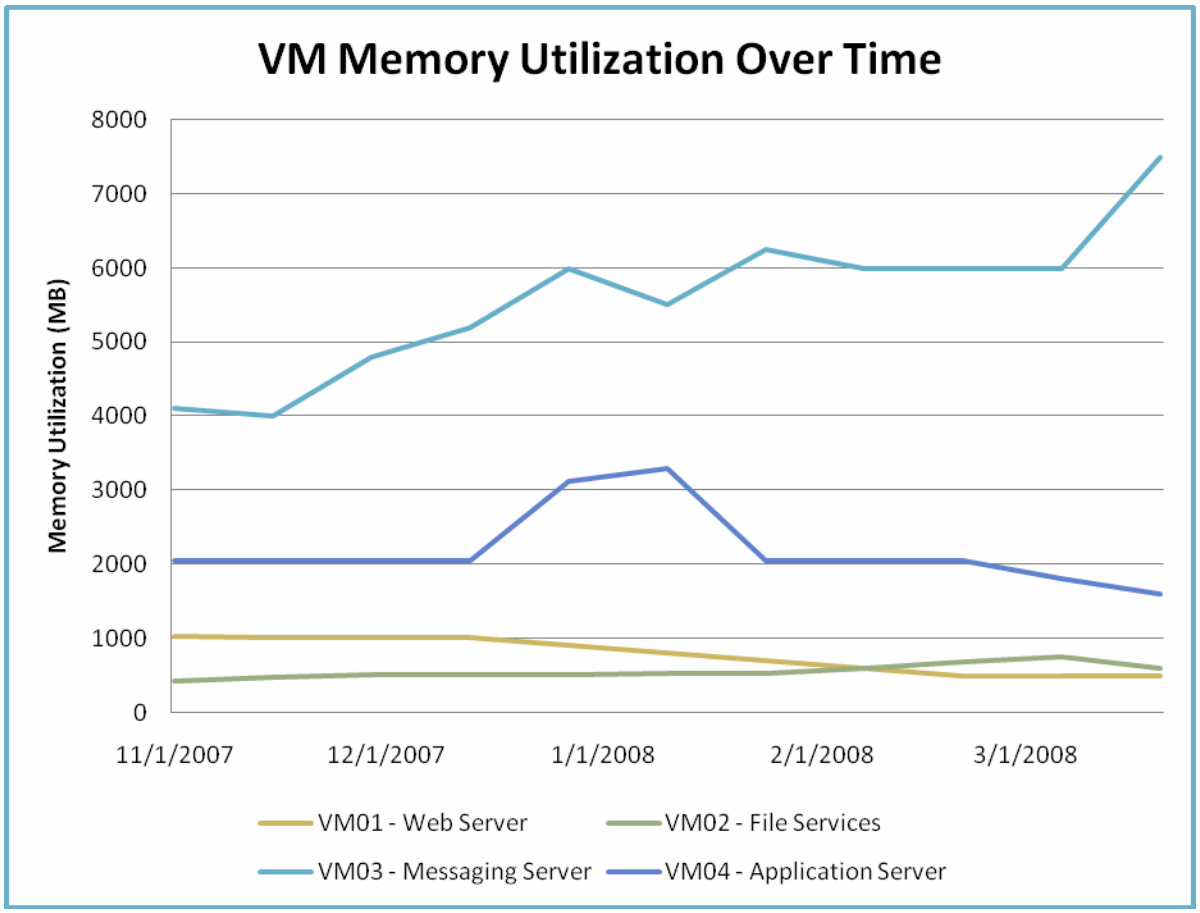

Figure 10.11: Monitoring virtual machine memory utilization (in Megabytes) over time.

Trend-related information can be extremely useful for making better decisions about future capacity needs and for optimizing the placement of servers in the current environment. Gaining this type of insight without the use of automated reporting tools can be very difficult.

Verifying Regulatory Compliance

In addition to performance and capacity-related reporting, IT departments often have the need to demonstrate adherence to regulatory compliance requirements. As with other types of reporting, it can be very difficult to assess an entire environment manually. Especially when virtual systems can be started, stopped, and relocated in a matter of minutes, it is important to ensure that no part of the infrastructure is overlooked. Automated reporting features can generate reports about security configuration settings, audit logs, and other details. These reports can then be provided to regulatory agencies and auditors to prove that guidelines are being followed for all physical and virtual machines.

Summary

The focus of this chapter was on defining virtualization management challenges and using this information to evaluate virtualization management solutions. The first step in evaluating an automation solution is to understand the phases in the typical workload management life cycle. Considerations include capacity planning, deployment, performance monitoring and optimization, configuration management, and availability. Based on these requirements, the ideal method for managing complex, heterogeneous infrastructures is to use a consistent view that allows for managing physical and virtual assets using similar methods.

Automation also provides the potential to significantly simplify the administration tasks. By using policy-based management, organizations can ensure that the entire infrastructure is in compliance with requirements. Other features, such as support for remote management, notification capabilities, and directory services integration can make the solution easier to manage. Automation is the key to reducing costs, so organizations should look for solutions that can monitor and optimize performance without requiring manual oversight by administrators. Finally, it is important to be able to collect and analyze information about all the hardware and virtual devices in the environment. Through the use of reporting and compliance-checking features, businesses can be assured that all components of the infrastructure are being properly managed.

This chapter concludes *The Definitive Guide to Virtual Platform Management*. Overall, when deployed and management properly, virtualization technology can provide tremendous value to IT organizations. The challenge then becomes not whether to implement virtualization but rather *how* to manage mixed virtual and physical environments. I hope that the content in this guide has helped to identify potential virtualization management challenges and has presented many methods and practices that can be used to resolve them.

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