

Virtualization and Automation Drive Dynamic Data Centers

Table of Contents

Executive Summary

SECTION 1: CHALLENGE 2

Meeting the Challenge of Data Center Evolution

The Unsustainable Over-Provisioning Model

The Dynamic Data Center Model: A Work in Progress

SECTION 2: OPPORTUNITY 4

Virtualization and Automation Drive Dynamic Data Center Model

SECTION 3: BENEFITS 8

Transformation Complete: Benefits Accrue

SECTION 4: CONCLUSIONS 9

Executive Summary

Challenge

The over-provisioning model used by data centers for years is rapidly becoming unsustainable, and a new, dynamic data center model is emerging, driven by virtualization and automation. You face challenges managing your physical and virtual environments and the fact that you must centralize, optimize and maintain both. You must still maximize business returns and protect your company's reputation, prevent service outages, meet compliance mandates and deploy new features quickly while keeping costs low. Meanwhile, facility and management costs are dramatically increasing, driving the need for more efficient use of existing resources. A new breed of data center management strategies and tools is necessary to meet the rapidly growing demand for business services and applications.

Opportunity

The dynamic data center model, driven by virtualization and automation, requires sophisticated monitoring and management technologies. The process and infrastructure decisions you make in the next 6 to 12 months will profoundly affect your ability to support new applications and business requirements. Key capabilities you will need include:

- Management platform visibility into dependencies, performance and utilization across both virtual and physical systems
- Automation of provisioning and change management tasks across network, server and application layers
- Policy-based resource allocation based on real-time performance metrics and service priorities

Benefits

Adopting a dynamic data center model addresses the problems of over- and under-provisioning resources associated with a lack of automation. You gain operational efficiencies, control costs — particularly skyrocketing power and energy costs — reduce infrastructure complexity and risk, and gain better control of your capital investments. By dynamically shifting resources among applications and services based on business priority and demand, you can control escalating operational and capital expenditures.

Your enterprise benefits because critical infrastructure and resources are readily available based on changing business priorities. You will also be able to drive consistency across your data center and reduce manual intervention — freeing up resources for strategic tasks that will help you create further differentiation.

The resulting operations and facility efficiencies will translate into better customer experience, reduced environmental impact and increased capacity for future services.

Meeting the Challenge of Data Center Evolution

In all probability, you are in the early stages of an evolutionary process that will transform your data center from a technology-based cost center into a strategic business asset. This transformation can have a positive impact on your organization's bottom line and, more importantly, deliver a competitive advantage.

It is getting through the process — beginning with an over-provisioning model that is proving unsustainable, to the challenges created by virtualization, to a new model based on anticipating need and utilization — that poses challenges. You must deal with the problems of both the existing and emerging models. To manage your evolutionary process requires meeting the challenges of both.

As with all evolutionary processes, this one has its roots in need. In this instance, the need lies in the vast amounts of information required for successful business operations, and the underlying infrastructure that supports the flow of that information — with your data center at its heart.

The Unsustainable Over-Provisioning Model

Today's data center is built on the over-provisioning model. When an application is deemed necessary, estimates are built on what resources it will take to run it. Then, because service level requirements do not apply only to average transaction processing, those resources are doubled, or even tripled, to address peak demands. As a result, the additional servers generally only handle the peak hour rush. The problem arises when the rush is over. Most servers run at only 5-10 percent utilization and, as a result, offer a poor return on investment (ROI).

There are additional challenges. To maximize business returns and protect your company's reputation, you must prevent service outages, meet appropriate compliance mandates and speed deployment cycle times for new features — all while keeping costs low.

Yet, you live in a world of diverse applications and system platforms — virtual, physical, clustered — and security and other devices, provided by different vendors. Configurations change constantly. Numerous processes and standard best practices, such as ITIL®, proliferate. You must manage this complex and diverse environment and align with business goals using inadequate manual processes and tools.

Overall, the increased scale and complexity of the data center environment, including the proliferation of virtual servers, is rapidly overpowering the over-provisioning model. For this and several additional reasons, the over-provisioning model is not sustainable over the long term.

RUNNING OUT OF POWER AND SPACE The transformation of the data center is also bringing the concern of energy consumption and costs to the forefront of your mind. The over-provisioning of server resources is a huge drain on energy and cooling systems. Research shows that, even when idle, servers consume 30 percent of the power as when running at peak capacity. Electrical and cooling expenses over the life of a server are now significantly higher than the initial hardware and support investment so your facility costs for power, cooling and the mechanical infrastructure outstrip the cost benefits originally gained through over-provisioning.

The dynamic data center model enables you to anticipate demand and deploy physical and virtual resources immediately, when and where they are needed. As a result, you can maximize server utilization for physical, virtual and clustered machines.

If the current situation weren't alarming enough, some estimates indicate that, in 2008, nearly 50 percent of data centers worldwide will lack the necessary power and cooling capacity to support high-density equipment. If more energy is required than is available, you must either cut resources or build new data centers. With the power shortage, it may no longer be possible to add a server or two at a moment's notice, not to mention the increased capital investments.

CONFIGURATION MANAGEMENT OUT OF CONTROL Meanwhile, your customer support and operations teams struggle to keep up with the growing numbers of systems and applications — and the never-ending configuration changes (authorized and unauthorized) — that support critical business services and strategic initiatives. The objective of configuration auditing and management in the over all data center is to assure adherence and compliance to policies and regulations, but configuration drift can affect the performance of servers and applications. The effects of an unauthorized change in the data center can be staggering. Even though you may have strict change control processes in place to prevent unauthorized and potentially expensive changes, there are still situations which arise where a change has taken place and cause a degradation of services in the data center.

Using the current management processes and tools — which are either manual or performed on a scheduled basis — you cannot respond effectively to service issues and new server and application provisioning requests within prescribed service level and ticket resolution times. Increased auditing and reporting requirements place an additional burden on overworked IT staff.

VIRTUALIZATION INTRODUCES NEW COMPLEXITY Finally, introducing virtual machines (VM) into environments with monitoring and managing tools designed only for physical devices adds a new level of complexity that makes tracking VM sprawl, performance management and ongoing maintenance increasingly difficult. Your existing systems management tools no longer provide adequate control over this mixed environment. The result is inefficient use of server resources and slower problem resolution due to a lack of skilled labor or a mismatch of skills. All of this has the potential to skyrocket your operating and capital expenses.

The lack of automation and centralized management tools makes it difficult, if not impossible, for you to maintain service levels and align with business goals.

The Dynamic Data Center Model: A Work in Progress

Rather than relying on an over-abundance of physical servers, the dynamic data center model enables you to anticipate demand and deploy physical and virtual resources immediately, when and where they are needed. As a result, you can maximize server utilization for physical, virtual and clustered machines.

Chances are, you have already moved in this direction by consolidating multiple small and medium application environments on virtual servers, taking advantage of capacity already purchased. While it is an excellent first step, the implementation of virtual environments comes with its own set of challenges.

Like their physical counterparts, virtual servers are deployed on a variety of best-of-breed platforms, resulting in a complicated mixture of physical, virtual and clustered machines. Each virtual machine generates its own environment and systems to track, along with its relationships to the physical host servers. Unfortunately, most of the systems management tools available to you do not discover or manage the virtual-to-physical server relationship or support the breadth of platforms available. This lack of centralized monitoring and management simply creates another level of operational complexity and makes it impossible to monitor your mixed environment.

Perhaps the most unanticipated problem growing out of the move to virtualization is virtual sprawl. Because it is easy to create and configure virtual machines, they are deployed almost at will, then either lost or not fully utilized. Unless you can manage and monitor virtual environments — which requires centralized capabilities — and reign in virtual sprawl, the promise of virtualization is likely to go unrealized. You need a new model and a new breed of management strategies and tools to meet the rapidly growing demand for business services and applications, and manage the evolving complexity in your data center.

If the challenges seem overwhelming, there is help at hand. New technologies are available — or emerging — that can help you manage the over-provisioning model as well as the evolution to the new, dynamic data center model.

SECTION 2: OPPORTUNITY

Virtualization and Automation Drive the Dynamic Data Center

To manage your transition from the over-provisioning model to the dynamic data center model and help turn your data center into a business asset requires sophisticated IT process management and monitoring tools. Virtualization and automation are obviously the critical components of the new model. Virtualization gives you the power to proactively deploy servers, easily adjusting and allocating resources when and where they are needed. Automation means that many critical server and system resources can manage themselves, flawlessly completing tasks that once required a human catalyst.

Virtualization

A recent study sponsored by CA indicates that server virtualization is, in fact, the future. More than 64 percent of those interviewed are currently investing in virtualization technologies. And another 36 percent plan to do so. Meanwhile, 68 percent consider centralizing the management of multi-platform virtualized and physical environments as a critical priority.

Managing your virtual and clustered environments requires the same capabilities and technologies as your physical environment. However, they can be trickier to implement for several reasons, not the least of which is the very nature of virtual servers. There is no physical entity to track, making it easy for virtual machines to disappear.

Additional layers of complexity generated by virtualization are implemented in operating system, server and clustering environments. This complexity requires that you have granular visibility into infrastructure components and processes. You also need real-time performance and utilization information on every machine, physical and virtual, and the ability to respond in real time to business demands.

"To increase IT efficiency, agility, and cost savings, the essential tools and features will be those that allow for the automation of processes such as change management, provisioning, deployment, and configuration tracking — really, any task or processes that can be automated."

To address these issues, you require advanced capabilities, including advanced discovery and visualization, unified cluster management and, perhaps most importantly, the ability to dynamically allocate resources based on demand and policy.

That reality can change today. For your data center operations to be effective, automating IT processes and resources and aligning them with the business services they support is key. This means creating an infrastructure that is agile and dynamic, capable of meeting business priorities in real time.

Automating certain standard processes required to deploy, configure and manage hundreds of servers gives you that agility. You can automate a broad range of tasks, including dynamic provisioning of servers when thresholds are breached, the comparison of server configurations to gold standards, and the delivery of software packages and scripts.

As the move to automation grows, a number of features and capabilities have been identified as key to success. These include centralized and secure management, discovery, monitoring and performance analysis, configuration and change detection, imaging and software delivery and policy-based dynamic server provisioning.

Independent Research Firm Defines Data Center Automation Stages¹

"This evolutionary course has a three-phase strategy:

- Phase one: IT service operation. The first phase of the journey, known as IT service operation, calls for monitoring and managing the broad set of infrastructure elements, such as networks, servers, applications, and associated storage devices.
- Phase two: IT service management. The next evolutionary step, known as IT service management, arranges a set of processes that interact and cooperate with each other to ensure that the quality of IT services meets the standards originally agreed on with the client.
- Phase three: data center automation. It takes time and effort to maintain an IT environment and to plan, create, check, and execute service-level agreements. IT labor is the most expensive part of managing and maintaining the data center. To increase IT efficiency, agility, and cost savings, the essential tools and features will be those that allow for the automation of processes such as change management, provisioning, deployment, and configuration tracking — really, any task or processes that can be automated."

¹ Evelyn Hubbert. "Data Center Automation Defined" February 26, 2008

Dynamic Data Center Technologies

Both automation and virtualization require a set of technologies and capabilities to function effectively.

ADVANCED DISCOVERY AND VISUALIZATION — GET THE FULL PICTURE You cannot manage, prioritize or understand a resource's relationship to other resources, much less align them with business goals, if you cannot find your virtual machines. Advanced discovery enables you to locate your virtual servers and manage virtual sprawl. You can map every aspect of the virtual host, its sessions and its clustered environment, gleanable valuable knowledge about performance and availability.

To improve data center utilization and productivity, you must identify your resources, determine why you have them, and how they are being used. This information is the basis for integrating your inventory with IT and business processes and service level agreements (SLAs). A strong discovery, monitoring and performance analysis capability delivers real-time performance metrics for managed servers, identifies those with problems or that are over/under-utilized, and provides in-depth information on critical elements in your data center environment.

CENTRALIZED AND SECURE MANAGEMENT — NORMALIZATION OF DATA You can manage your data center environment more effectively through centralized, secure management that lets you enforce best practices and create workflows and processes through a single interface. Dashboard views of the real-time status of variables such as server utilization and configuration, events and system status provide the information you need to keep your servers operating at peak performance. Role-based administration helps reduce risk and enforce compliance with policies and best practices. Through centralized event logging, you can reduce mean-time-to-repair (MTTR) and support auditing and compliance requirements. Finally, task and service specific user interfaces simplify the management and administration of your data center services.

CONFIGURATION AND CHANGE DETECTION — MAINTAIN COMPLIANCE Because your server environment is in constant flux, the automation of configuration and change detection is critical. You can create snapshots in real time of configuration states and quickly establish baselines or gold standards throughout your data center to ensure compliance and standardization. Problems such as configuration drift affect performance and, ultimately, your adherence to compliance rules and regulations, so they must be detected quickly. An event or change triggers an audit of your configuration, which significantly reduces the impact that configuration drift has on your data center. Ultimately, you can detect compliance violations or configuration problems before they affect performance.

PERFORMANCE ANALYSIS — BASELINE AND OPTIMIZE You have experienced the heightened demand for around-the-clock services and instantaneous response times, and recognize the need to shift to a proactive model to meet these demands. Understanding resource performance and utilization will be critical to enabling a dynamic data center model.

You can improve the availability of critical business processes by applying policy-based management and automation based on granular and detailed performance and utilization data. Your infrastructure can then respond dynamically to changing demands and move resources to where they are most needed to support business goals.

In-depth, real-time and historical system performance information of both physical and virtual resources help you diagnose performance problems quickly and make informed decisions about dealing with them. In addition, performance information can easily be extracted for a variety of uses, including trend analysis and capacity planning. For example, correlating real-time and historical data helps you with long-term capacity planning. Spikes in performance or a breach of a threshold can also trigger an audit of your configuration. This will significantly reduce the impact that configuration drift can have on the performance of your data center. By understanding how your systems perform and map to business processes, you can achieve business continuity and improve operational efficiency.

ADAPTIVE AND DYNAMIC RESOURCE ALLOCATION

- **Imaging and software delivery** Automating imaging and software delivery can assist you with dynamic provisioning by pushing applications packages to remotely managed servers based on policy and demand. Software distribution and operating system installation management help you quickly and securely configure and provision a machine. A good delivery system will distribute software either on demand or according to defined rules and policies.
- **Policy-based dynamic server provisioning** You understand the effort it takes to configure a machine manually from bare metal to a fully functioning email, Web or application server. Policy-based dynamic server provisioning adjusts resource usage in real time to meet the demands of your organization and maintain service levels. If approval is not required, you should expect to be able to create as many rules or policies as needed to take various actions including:
 - Add, remove or set CPU and memory shares
 - Power up/down or suspend virtual machine
 - Power up/down physical machines
 - Provision operating system, physical servers or virtual machines
- **Dynamic resource allocation** Manually balancing resources in a virtual environment with 10 virtual servers — each of which can have 25 or more virtual machines — is simply not sustainable. You must be able to allocate resources dynamically in this environment. This level of management relies on intelligent, policy-driven automation that can respond to changing business demands. Using performance information and pre-defined policies, system resources such as CPU, memory, disk space are proactively allocated and re-allocated in real time from one virtual machine to another. By optimizing your virtual system resources in this manner, you maximize the value of your virtual server investments. Underutilized servers go back to work, power consumption is minimized, and you have made a significant move toward “going green” and protecting the environment.

Transformation Accomplished: Benefits Accrue

By evolving into a dynamic data center, you can use powerful technologies such as virtualization and automation to align your infrastructure with business goals and transform your data center into a true business asset. Information critical to your business success and the day-to-day operations of the enterprise reaches those who need it, when they need it.

The obvious benefits of the new model, whether in the virtual or physical world, include:

- Better utilization of servers, including virtualized machines, which improves ROI of your data center initiative
- Automation of manual tasks, which improves operational efficiency, helps control costs, and eliminates the need to hire highly skilled labor
- Sharper focus on strategic IT projects, resulting in business growth
- Improved response time to dynamically changing business demands
- Improved infrastructure availability, including reduced mean-time-to-repair
- Centralized management of diverse technologies, which streamlines your day-to-day operations and facilitates better cost control
- Improve capacity planning, as a result of historical analysis of your data center performance and utilization rates

However, some benefits are not as obvious. The new model technologies also contribute to the Green Computing initiative and cut power costs in the process.

Going Green

By implementing key automation and virtualization technologies to address server underutilization, you can take a significant step in supporting Green Computing initiatives and reduce your organization's carbon dioxide footprint — while realizing cost savings by reducing power usage. Servers and the cooling required for equipment eats up 70-75 percent of the power delivered to your data center.

In a typical scenario, 20-35 percent of data center electricity powers servers. These servers are most efficient, power-wise, when they reach the higher ranges of utilization. You can save significant amounts of power by running your server infrastructure at 70 percent, rather than in the more common range of 25-30 percent. By maximizing server use, you can achieve those higher utilization levels and reap the benefits of lower power costs.

For example, it costs approximately \$59,000 a year to run 100 mid-sized servers, assuming a normal usage pattern. By powering off idle servers, you can save between \$6,213 to \$10,343 yearly.

Another 50 percent of the power delivered to data centers is used for cooling. The rest is diverted to lights, telecommunications equipment and other facility services. When you employ dynamic provisioning, you reduce the number of redundant servers that need to be cooled. You eliminate additional cooling requirements by automatically allocating and reallocating servers based on peak demand.

SECTION 4: CONCLUSIONS

Emerging technologies can help you transition from the over-provisioning model to the new dynamic data center model and transform your data center into a strategic business asset, giving you that competitive edge to grow your business. Technologies such as automation, virtualization and dynamic resource allocation can help you establish a dynamic data center model that quickly and easily moves resources where they are needed, significantly improving server utilization rates. From there, it's a quick step to a better ROI, cost reductions and increased availability.

To learn more about CA's Data Center Automation and Virtualization solutions, visit ca.com/dca.

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