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Server Consolidation to a Virtual World

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Server Consolidation to a Virtual World

Server consolidation isn't a new trend, but the methods by which businesses are consolidating servers have changed greatly over the past decade. Server consolidation is a concept as old as the client/server model itself, but what does server consolidation really mean to businesses? As with any other function of operating a business, there must always be a cost/benefit analysis performed for each capital expenditure. In the 1990s when businesses were heavily investing in Microsoft Windows Server technologies, best practices dictated that application roles should be separated. Although the Windows Server family of products from Windows NT Server 4.0 to the current Windows Server 2008 system have proven to be robust and reliable platforms, maintaining the highest levels of uptime is critical to success.

What Is Virtualization?

Businesses simply couldn't afford to take chances with application and role conflicts. More often than not, it was more expensive to test for and correct these application conflicts than it was to simply provision new servers for the tasks that were needed. All too often, this resulted in a "server sprawl" effect. Even a smaller business could quickly find that between testing, development, and production, the costs to maintain such a disproportionately large server infrastructure was cutting into the bottom line.

As server performance and application compatibility improved, corporations embraced the concept of again running multiple applications and roles on a single server. However, this was still not without challenges. Server capacity planning was a problem. Even though hardware costs were decreasing while performance was increasing, businesses were buying much higher performing equipment than they needed in most cases. These new servers represented a greatly underutilized resource.

When virtualization entered into the mainstream, businesses began to realize that server consolidation didn't have to be a physical process. What if a business could take advantage of the increases in power and efficiency on modern servers to get decreased costs with ease of management and quick disaster recovery?

Benefits of Virtualization

The benefits of virtualization quickly started to become evident. The first item businesses looked at was the hard cost savings. Physical servers represented a significant cost from several angles. There was an investment in the hardware itself for each new application or role deployed, but also software licenses for each server. Additionally, each server had power requirements whether or not they were fully utilized. Third-party management tools needed to effectively monitor and maintain a sprawling server farm contributed to the costs as well.

Soft costs also added up. All too often overlooked, aspects such as employee salaries and benefits for personnel required to manage these servers represented a large portion of spending. By reducing the number of servers to manage and making those management functions easier to perform, reassignment of human resources for other projects was now possible.

Virtualization also introduced simplified workload migration. This concept is unfamiliar to many in the physical server world because it isn't possible to do with any ease. The closest similarity one can think of in the physical world is load balancing or clustering. Both of these physical technologies require expensive redundant hardware and either software solutions or advanced technical talent to implement and support. Virtualization introduced an inexpensive means to take the workload from one server and transfer it to another server. Workload migration meant that existing servers and future purchases could take advantage of the previously unused processing overhead to create redundancy. The process of workload migration requires some groundwork that can be difficult, especially as the number of servers and size of the corporation increases. A business must analyze current server utilization by discovering servers, documenting application use, and creating a migration plan that fits the business, all while offering little or no downtime.

Another challenge in the physical world that is not present in the virtual world is the migration from leased hardware. Many businesses choose to lease their hardware for low costs of entry and amortization of the server costs over the life of the lease. This is a great way for businesses to get into more expensive technology for a much lower initial investment. However, the hardware must be returned at the end of the lease, often for replacement by more modern equipment. All server operating systems (OSs) are tightly tied to the underlying hardware on the server. The OSs rely on drivers to communicate between the software and hardware. When new servers are introduced, they are almost always a newer generation with different hardware than the ones they are replacing. Migrating in a physical world is a delicate balancing act of trial and error with getting a system optimized for one platform to now run on another. Different drivers and hardware features make this process difficult at best. Even the best imaging technologies can't always get it right. Being able to move virtual servers onto new hardware is a considerably easier task.

In a virtual world, the hardware presented to the virtual server is synthetic. Although a physical server could be from HP, Dell, or any other manufacturer, each with different processors, network cards, and video cards, the virtualization platform presents a set of synthetic hardware devices to the virtual server. This virtual hardware is the same no matter what physical platform is used. This prevents the business from being tied to any particular vendor or generation of server. It also means that the business doesn't need to keep duplicate hardware sitting idly by in the event that a server suffers a catastrophic failure and needs to be replaced. A virtual server residing on a physical server is portable. It can easily be moved between physical servers. In most cases, this is as simple as a file copy. Virtual servers appear to the virtualization platform as single files.

Analysis of Costs and Savings

The biggest driver of server consolidation is the cost savings associated with a smaller and more manageable infrastructure. Power and cooling expenditures represent the largest hard costs for a server farm outside of the hardware and software.

When performing a calculation of power costs and savings there are several factors to take into account:

- Number of physical servers before consolidation
- Average power usage per server
- Cost per kWh
- Average CPU utilization before consolidation
- Target CPU utilization after consolidation
- Overhead for the virtualization platform

A calculation based on these factors will determine how many physical servers, approximately, can be consolidated to support the same number of virtual servers performing the same workloads. This will also provide cost-savings estimates for power consumed before and after consolidation.

Additional costs associated with a large number of physical servers are numerous. The supporting infrastructure associated with sprawling physical servers such as cabling, networking equipment, and data center space represent a large capital outlay. Although port density costs have come down considerably for core networking switches and routers, any chance to decrease the number of networking ports will translate to direct savings. A business can effectively keep spare networking gear on standby for the same costs as it previously had in production. This allows the IT staff to quickly replace failures without increasing costs. Instead of this hardware being used in production, the reduced servers and consolidated load can decrease networking hardware by 50% or more. Cage and cabinet costs for both owned and leased data centers also represents a large portion of a server infrastructure capital outlay. Typical data centers charge for three items:

- Power usage
- Physical space (cabinets and cages)
- Bandwidth

The first two items will decrease significantly in a virtual environment. The third item is a fixed cost based on the workload and not the number of servers. Although bandwidth isn't a factor in consolidation cost savings, the power usage and physical space requirements represent large variances between physical and virtual servers.

Technical Challenges and Solutions

Although it might have numerous advantages, virtualization isn't without challenges. Some of the problems that affect the physical world also affect the virtual one. Just as it was possible to have too many physical servers to manage, it can be possible to have too many virtual servers. Server sprawl quickly becomes a problem in the virtual world because underutilized servers now can support several virtual servers. The temptation exists to create and run as many virtual servers as the hardware supports, without fully analyzing why new servers need to be provisioned. Instead of balancing which roles and applications are known to work well together on a single virtual server, each role and application often is assigned to a new virtual instance. In short order, the virtual servers outnumber the previous physical ones and the cost savings begin to diminish. In order to prevent server sprawl in a virtual environment, a thorough analysis of needs must be performed. Using an automated solution for analysis of the workloads greatly assists. This process should begin before any decisions about a virtual platform and hardware to support that platform are made. Ensuring that the new virtual infrastructure meets the demands of the existing physical infrastructure is crucial to a successful migration.

Perhaps the single greatest challenge to a successful virtual server consolidation is the downtime required for migration, testing, and pilot. In the early days of virtualization, this was mostly a manual process that more often than not resulted in creating new virtual servers and then manually configuring those virtual servers for the roles and applications that existed on the physical ones. This was a labor-intensive and error-prone process. Physical server builds were not always documented appropriately and dependencies could be missed.

Specialized third-party tools now exist to make this process seamless. When looking for a solution for migration, it is important to look for one that enables a live migration from physical to virtual. For mission-critical environments, the solution must allow a transition from physical to virtual without disrupting the production environment. Being able to migrate from a live environment to a virtual environment is a requirement of any solution, but ideally, a solution should be able to migrate incremental changes from the live environment to the virtual environment. In this method, the decision to cut over to a production virtual environment can be made at any point along the way. Once successful testing has been performed, IT management can determine exactly when to transition to virtualization for production systems. The ability to do so in incremental steps represents a faster and more accurate representation of the physical servers as they are migrated to a virtual platform. This same concept can be applied not just for physical-to-virtual but also for virtual-to-virtual consolidations.

The next steps in moving toward a virtual server consolidation are fairly straightforward. The first action involves identifying the current workloads that exist throughout the infrastructure. This should already be a part of a well-documented network, but this will serve as a chance to review this documentation if it already exists or create it if it is missing or incomplete. The second action is to perform an analysis of which workloads are suitable for virtualization. Ideally, all the workloads are suitable for consolidation, but this action item will take into account factors such as required processing power and disk I/O needs. This will require tools for properly profiling the workloads over a period of time to ensure capacity planning is accurate. Third-party software solutions designed specifically for this goal are highly recommended, particularly for large-scale consolidations.

Summary

Server consolidation isn't a new trend, but the application of server consolidation to virtualization has opened up a new world of opportunities for increased productivity and decreased costs. Although virtualization itself isn't a solution to all the problems of server management, it provides businesses of all sizes with a means to take advantage of increased server capabilities with a new set of tools to make management easier and less expensive. Decreasing servers through consolidation has consistently proven to be an effective cost-cutting mechanism. The consolidation of servers using virtualization has extended these savings into new areas and given businesses of all sizes a means to do more with less.