Virtualized Environments using Microsoft Virtual Server and NetApp

Aaron Spruit and Joel Danowitz, Avanade
Kevin Scott Karafa, NetApp
August 2008 | WP-7045-0808
TABLE OF CONTENTS

1 HOW AVANADE REVOLUTIONIZED ENVIRONMENT VIRTUALIZATION WITH NETAPP AND MICROSOFT ..................................................................................................................3
2 AVANADE TECHNOLOGY SOLUTIONS (ATS) CHICAGO .................................................................................................................................3
3 ATS CHICAGO VIRTUALIZATION HURDLES ..............................................................................................................................3
4 NETAPP TO THE RESCUE ..................................................................................................................................................4
5 AUTOMATING AND STREAMLINING VIRTUAL MACHINE PROVISIONING ..................................................................................5
6 CONCLUSION .........................................................................................................................................................10

DISCLAIMER

This white paper contains statements that may be related to the future development and direction of Avanade Inc. These statements may represent only current plans or goals of Avanade as of the date of publication and are subject to change without notice based on our technical and business judgment. Any reference to third-party companies does not imply any involvement with or endorsement of or by Avanade Inc. Other company, product, and service names mentioned in this document are registered trademarks or trademarks of their respective owners.
1 HOW AVANADE REVOLUTIONIZED ENVIRONMENT VIRTUALIZATION WITH NETAPP AND MICROSOFT

Virtualization provides many benefits, including stretching the IT budget, getting more out of hardware, and increasing efficiency. Through combining the storage power of NetApp, the virtualization technology of Microsoft, and the know-how of Avanade, the custom application development space has been completely revolutionized by virtualization.

Instead of having development and testing environments run on independent physical hardware, potentially taking days to deploy per environment, a complete virtual environment can be deployed in a matter of minutes using processes defined by Avanade. At its Avanade Technology Solutions center in Chicago, Avanade has created a process by which custom development environments, some consisting of up to six machines, can be created in a streamlined manner by using Microsoft® Virtual Server 2005 R2 SP1 on NetApp® FAS3000 series storage.

Using this streamlined virtualization process, composed of NetApp FlexVol® and Snapshot™ and an accompanying application from Avanade, ATS Chicago can demonstrate up to 60% reduction in storage requirements. In addition, the average time to provision a virtual machine has been reduced from 145 minutes to 23 minutes, a time savings of 84%.

These large reductions in both storage space requirements and provisioning time per virtual machine allow more virtual machines to be hosted per NetApp storage device, enabling the ATS Chicago application infrastructure team to be more efficient and to provide even more value-add solutions to its customers.

2 AVANADE TECHNOLOGY SOLUTIONS (ATS) CHICAGO

Avanade Technology Solutions (ATS) is a geography-based onshore consulting workforce for Avanade, a global IT consultancy dedicated to using the Microsoft platform to help enterprises achieve profitable growth. Currently there are two ATS centers in the United States, in Chicago and Houston, with more coming. The ATS centers are core to Avanade’s investment in multisource delivery. Customers get the right resources at the right time, the right location, and the right cost. The ATS centers provide a consistent, repeatable set of processes and methods to ensure high-quality, on-time delivery. This is accomplished through the use of Avanade Connected Methods™ and various Avanade Connected Architectures®, which reduce the time, cost, and risk associated with the development and delivery cycle of every project.

ATS Chicago specializes in application development as well as application management. ATS Chicago started out with a single customer and an application infrastructure consisting of individual physical machines. Now, with over 15 customers, 30 projects, and at least 3 environments per project, ATS Chicago needed a robust supporting infrastructure. The emergence of virtualization technology has allowed ATS Chicago to keep up with the environment demand of additional customers and projects.

3 ATS CHICAGO VIRTUALIZATION HURDLES

As is true in many development centers, virtualization has become a key enabling technology for ATS Chicago. Initially, with only one customer and one project under development, hardware and storage were purchased without much growth in mind. In fact, virtualization was not even used. There was no concept of shared storage and no justification for the cost associated with a multi-terabyte SAN. Therefore, all virtual servers and database servers were purchased with large amounts of direct-attached storage (DAS). The vast majority of environments consisted of a two or three tier setup: Web and database tiers or Web, application, and database tiers. Outside of the database servers, which were not virtualized, the virtual machines did not require a lot of disk space. This meant that processor and RAM utilization were the limiting factors on the host servers, not disk space.
Because of this, many of the virtual server hosts had excessive disk capacity because they were procured with a calculated average disk space. There was no way to aggregate all of this unused disk space; anywhere from 10% to 20% was wasted per machine. Typically this occurred because RAM resources had been completely consumed on the hosts and additional machines could not be added.

In addition to the wasted storage space, there were other hurdles:

- Difficulty managing storage across the virtual server host machines
- Limited I/O performance due to the small number of spindles in the DAS configurations
- Excessive amounts of time spent copying master “gold” images from a storage location to the virtual server host machines
- Wasted space across environments, because each contained about 90% identical data
- Error-prone, timely process of manually configuring virtual machine properties through the Virtual Server Web Console

Because of these issues, the ability to grow the customer base by using virtual server host machines was limited to about 50 virtual machines, with only local storage and the allocated support personnel. Simply trying to manage the virtual server hosts and juggle virtual machines between them became the primary task of the ATS Chicago application infrastructure team.

## 4 NETAPP TO THE RESCUE

In addition to the virtual machine storage issues, ATS Chicago was also having broader storage issues. As each new project was added, an additional 50 to 200GB or more of space, over and above the space needed for the virtual machines, was required for development purposes. The file servers purchased initially were not able to keep up with storage requirements. At this point, it was decided to move to a solution that could accommodate all of the storage requirements in one solution, instead of relying on multiple solutions.

When the NetApp FAS3050c arrived at the ATS Chicago Center, it was immediately set up and configured to support two new virtual server host machines. These new machines were purchased with minimal DAS, used only for the operating system. All other storage for the virtual server host machines was located on the NetApp FAS3050c.

To reduce complexity, virtual server host machines using the NetApp FAS3050c were set up in a similar fashion to the older virtual server host machines. This meant that there was one large LUN attached to the host machines.

To optimize I/O, the setup of the NetApp FAS3050c was to have two large aggregates, one on each storage system. The aggregates were then broken up into NetApp FlexVol volumes based on the virtual server host machines, and the LUNs (starting at around 150GB) were stored in the NetApp FlexVol volumes.

---


Many of the issues of the standalone host machines were solved by simply replacing the DAS storage with SAN storage, including:

- Difficulty managing storage across the virtual server host machines
- Limited I/O that that DAS was capable of because of few available spindles
- Unused storage on the virtual server host machines

By moving to the centralized storage on the NetApp FAS3050c, the ability to more easily manage storage resources, coupled with increased performance, allowed ATS Chicago to grow the number of customers by more than tenfold, to over 150 virtual machines. With the additional I/O performance, the delivery center was also able to virtualize database servers, further consolidating physical machines to the virtual server host machines.

5 AUTOMATING AND STREAMLINING VIRTUAL MACHINE PROVISIONING

Even with the introduction of the NetApp FAS3050c, not all of ATS Chicago’s issues were resolved. The remaining hurdles, which consumed the majority of time setting up environments and could not be remedied by replacing a piece of hardware, were primarily process-based issues, including:

- Copying master gold images from a storage location to the virtual server host machines
- Wasted space across environments, because each environment contained about 90% identical data
- Manually configuring virtual machine properties through the Virtual Server Web Console

To make further gains in these areas, a new process for creating virtual machines and environments needed to be designed.

Since the initial infrastructure configuration at ATS Chicago, imaging technologies had been used, which allowed a reduction in duplicated work for environments that were identical. As the center moved from physical machines to virtual machines, this same mentality was kept. In fact, virtualization technology made it easier, primarily because these master gold images were hardware-agnostic.

However, these images were quite large, and copying them from their stored location to the virtual machine host to duplicate virtual machines was the most time-consuming part of the process. Even with the gold images stored on the NetApp FAS3050c, they still had to be copied from a file share to the virtual machine host. Depending on the application and environment, these gold images could be larger than 20GB.

In addition, although Microsoft Virtual Server R2\(^3\) has excellent programmability through a COM API, the interface for configuring new virtual machines is not as sophisticated. It is a Web-based application, but configuration settings spanned multiple pages. Although not nearly as time consuming as copying the gold image, this time-consuming, manual process was prone to errors.

Figure 2) Automated steps with the process and application developed by Avanade at ATS Chicago.

---

To combat these issues, ATS Chicago developed and tested a new process and application that used NetApp Snapshot technology and Microsoft Virtual Server programmability\(^4\). As shown in Figure 2, most of the steps have been automated by the new virtual machine application process. In addition, an existing application called Avanade Build and Deployment System was used to automate the final step of building and deploying custom-built .NET applications.

Figure 3 shows the main screen of the application developed by Avanade to automate the creation of virtual machines. From here, the user can manage all of the Microsoft virtual servers in the environment. New virtual server hosts can be added by simply right-clicking the virtual host collection, selecting Add Virtual Host, and entering the server name. All of the virtual machines hosted on each server host are automatically discovered and appear below the virtual host node in the tree view.

Once the virtual server host machine has been added, new virtual machines can be created by right-clicking the virtual host and rolling over the Add New virtual Server menu item to display the list of gold images that can be used as the base for the new virtual server being created (Figure 4).

Virtualized Environments using Microsoft Virtual Server and NetApp

Selecting one of the gold images displays the configuration settings that must be set in order for the virtual server to be created and configured (Figure 5). The settings and properties that can be modified for a virtual server are customizable to fit the needs of the team managing the virtual hosts and environments. The minimum set of properties is:

- Assigning a name to the machine
- Assigning the amount of RAM to use
- Defining where the machine should be located (VHD root directory; this value is in relation to the virtual host on which the new virtual server was created)
- Selecting a network on which to run the virtual machine

Figure 4) Creating a new virtual machine by using the Avanade-developed management tool.

Figure 5) Configuring the newly created virtual machine.
When the settings are complete, right-clicking a virtual server and selecting Finalize New Virtual Server initiates the provisioning process. The application connects to the virtual server host machine, creates a Snapshot copy of the gold virtual machine to duplicate, mounts the Snapshot copy in read/write mode, and then creates a new machine in Microsoft Virtual Server. Selecting existing virtual servers provides the same properties and allows them to be altered and saved back to Microsoft Virtual Server.

The advantage of using NetApp Snapshot technology is that it provides a point-in-time copy of a file system. NetApp Snapshot technology is primarily used for recovery situations, and it is usually marketed that way. However, because Snapshot copies can be mounted in a read/write configuration, they can also be used as a writable point-in-time copy of a volume. Therefore, by making the volume consist of only the gold image, creating additional environments is as simple as creating a Snapshot copy of the volume.

As shown in Figure 6, each Snapshot copy is based directly on the gold image; there is no branching of the images because the mounted copies are tied to the gold image. To allow branching from the Snapshot copies, NetApp FlexClone® technology would be used. This allows the backup of the Snapshot copies to the original gold image to be removed. Once a FlexClone volume is created, it is at the same point as the original gold image, ready to be duplicated through NetApp Snapshot technology.

![Figure 6](image)

With NetApp storage systems, hundreds of Snapshot copies per volume can be made; and because it’s done in hardware, there’s no performance penalty. Therefore it would be feasible to host hundreds of copies of a gold image. At ATS Chicago, 10 to 20 copies of a gold image are typically used at any point in time. However, because development teams are usually larger than the number of required environments, virtualized developer machines could easily be hosted this way, providing each developer with his or her own Snapshot copy of the gold image.

Also shown in Figure 6, each virtual machine Snapshot copy based on the original gold image uses only a fraction of the original space. This is because NetApp Snapshot copies consume space only when either the original volume or the writable copy changes. Because the original volume never changes, only the Snapshot copies change with this scenario. The closer the configuration of the virtual machine to the gold image, the less space the Snapshot images consumes.

---


Figure 7 shows how much space duplicate virtual machine images consumed before using NetApp Snapshot technology. This figure shows how each duplicate image was basically using the same amount of storage space as the gold image. By moving to Snapshot technology (Figure 8), the data that would have been duplicated between the gold image and each virtual machine is greatly reduced. Instead, only the differences between the gold image and the virtual machine are committed to disk. With most environments, the difference is around 10% or less of the total disk space of the virtual machine (log files, user profiles, version differences in deployed applications, and so on). Similar storage savings can be achieved by using differencing disks in Microsoft Virtual Server; however, as mentioned before, NetApp Snapshot technology is performed at the hardware level on the storage system (negligible performance hit), whereas differencing disks are performed in software on the virtual server host machine (a relatively large performance hit).

Figure 7) Typical disk space consumption before using NetApp Snapshot technology.

Figure 8) Disk space savings by using NetApp Snapshot technology.

Taking Snapshot copies on a NetApp storage system occurs in a matter of seconds. The largest amount of time in creating a new copy of a gold image is spent mounting the new copy to the virtual server machine host. In addition, no matter how large the volume, the time it takes to create the copy remains the same.
Manually copying gold images could take anywhere from 30 minutes to 2 hours, depending on the size of the image and the resources available to copy it (network bandwidth and disk I/O). Figure 9 shows the typical amount of time it would take to set up one machine in an environment. Depending on how many machines an environment consisted of and how many environments needed to be deployed, a typical setup (three machines) could easily take a day.

However, by using NetApp Snapshot technology and automating the process via Avanade applications, as shown in Figure 10, environments can be set up an average of 84% faster. This time savings allows both the infrastructure team and the software development team to focus on other items instead of waiting for machines to be set up and available.

6 CONCLUSION

By incorporating virtualization processes defined by Avanade, NetApp technologies, and Microsoft Virtual Server, custom application development storage requirements can be reduced up to 60%7 and the time to duplicate virtual machines can be reduced up to 84%8. However, the processes outlined are not limited to Microsoft Virtual Server; they can be extended to other virtualization technologies, including VMware, because all of the processes are based around the NetApp storage systems instead of the virtualization software layer.

7 The average total time before Avanade application and process to set up a virtual machine was 2 hours and 25 minutes (145 minutes) (Figure 9). The demonstration with the Avanade application and process reduces the time to 23 minutes. 100% - (23 / 145) = 84% reduction in processing time.

8 Assuming that Figure 7 represents all of the storage space (100%), split between one gold virtual machine and four duplicates, and that by using the Avanade application and process each virtual machine contains only 5% duplicated data (Figure 8), then the gold virtual machine remains the same size (20%) plus the four virtual machine duplicates (4 x 10%). 100% - (20% + (4 * 5%)) = 60% reduction in storage space required.
At ATS Chicago, this virtualization process was designed to be used by the system engineering staff. However, because of the simplicity of creating new environments, there is no reason that developers can't provision their own environments. Avanade has also engineered a Web-based version of their virtualization application. By initially configuring the system and base images and then using the Web application, selected users could be granted rights to set up their own machines, so that the system engineering staff could better serve the developers in other areas instead of constantly setting up environments.

By combining all of these technologies and processes, significant cost savings can be realized with fewer resources needed to manage the set up and maintenance of environments for custom application development.