Large Retailer Relies on a Virtual Solution to Deliver Optimal Shopping Experience

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Brad Thompson, Director, Infrastructure Engineering, Target

With its attractive stores offering trendy merchandise at affordable prices, Target changed how consumers think about discount shopping. To help Target deliver on its “Expect More. Pay Less.” brand promise, Target chooses reliable, scalable, and cost-effective technology. That’s why the company is deploying Windows Server 2008 Datacenter and its Hyper-V virtualization technology to retire 8,650 servers and implement a two-servers-per-store policy. By 2012, Target’s entire store server infrastructure will be running on Hyper-V, which will support a total of 15,000 virtual machines running mission-critical applications. Target also deployed Microsoft System Center data center solutions to manage more than 300,000 endpoints across its retail network. With its Microsoft Virtualization solution, the company will save millions of dollars in hardware, electrical, and maintenance costs.

Overview

Country or Region: United States
Industry: Retail

Customer Profile
At U.S.$67 billion in sales, Target is the second largest discount retailer in the United States, serving guests at 1,755 stores in 49 states and at Target.com. Target employs more than 350,000 team members.

Business Situation
Target Technology Services wanted to reduce operational costs by minimizing the physical infrastructure at each store. It needed a virtualization solution for its retail operations that it could trust.

Solution
Target deployed Windows Server 2008 Datacenter and Hyper-V at all of its stores and used Microsoft System Center data center solutions to manage more than 300,000 store-based endpoints.

Benefits
• Reduced costs
• Increased the IT team’s ability to support the business
• Improved infrastructure management
• Increased system availability

“Expect More. Pay Less.”
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Amy Reilly, Spokesperson, Target

Situation
The first Target store opened in 1962 in the Minneapolis suburb of Roseville, Minnesota, with a focus on convenient shopping at competitive discount prices. Today, Target remains committed to providing guests with the right merchandise mix—from everyday commodities and grocery offerings to trend-right home and apparel lines—at outstanding value. Target continually reinvents its stores, including layout, presentation, and merchandise assortment, to create an engaging shopping experience.

To continue offering merchandise at appealing prices, Target looks for ways to control its operating costs. Consequently, the company’s IT department, called Target Technology Services, chooses technology that’s cost-effective and delivers real business value. “Target Technology Services is considered a strategic enabler for just about everything we do in retail strategy,” says Brad Thompson, Director of Infrastructure Engineering at Target. “That said, we are still a cost center, and so we are always looking to drive down costs where possible, as long as we meet the requirements of our guests, our application development teams, and our business partners.”

Amy Reilly, Spokesperson for Target, points out that technology also underlies the customer experience at each Target store: “When our guests come into our stores, they have a certain expectation of their experience. They expect clean, wide aisles and to find what they need and check out quickly because they lead busy lives. So reliability in our technology, including our POS [point-of-sale] and replenishment applications, is very important to helping us deliver on our ‘Expect More. Pay Less.’ brand promise.”

Distributed IT Infrastructure
Target has a highly distributed IT infrastructure with more than 300,000 endpoints, including servers, computers, POS registers, kiosks, and mobile devices dispersed among its 1,755 retail stores. Except for centralized authentication, domain name resolution, and endpoint monitoring services, each retail store functions as an autonomous unit. “Every one of our stores has its own control room, with its own network and compute capacity inside the store,” says Thompson. “So if you think of our infrastructure across all those stores, we have to get very creative with how we build, scale, and manage that environment.”

Until recently, each store had seven servers that housed a suite of mission-critical applications. These include a POS solution that runs an average of 30 registers per store, security applications, inventory-management and stock-replenishment applications, pharmacy applications for those stores with a Target Pharmacy on-site, and database, infrastructure, and asset-protection applications.

IT Management Challenges
“With Target’s growth, the proliferation of servers, and the increasing portfolio of applications that we manage, it was time for a new approach to our IT infrastructure,” says Fritz DeBrine, Senior Group Manager of Server Technology and Enterprise Storage at Target. “We used to work in a model where if you were developing an application for a store, you’d have to buy a server for that application. Over time, that’s amounted to a lot of money. We wanted to reduce the number of physical servers that we need to run our applications at each store.”

Target does not have any of its own IT team members working at its stores.
Instead, the company has a contract with a third-party IT services provider that has technicians trained in Target store procedures and who perform wall-to-wall hardware maintenance. “To keep our management costs down, it’s in our best interests to have a streamlined IT infrastructure at each store,” continues DeBrine. “And because of the scale and number of endpoints that we have, it’s crucial that we can automate the deployment of software to our stores and quickly gather information about our retail environments.”

When Target Technology Services team members at headquarters need to deploy new software, application upgrades, or security updates, they face significant challenges to get the job done before doors open for business in the morning. “There are only a few hours at night when we can do deployments without disturbing scheduled processes, such as POS system maintenance and sales and inventory transactions,” says Thompson. “The control room has to be up and running by 7 a.m. because we can’t do anything that puts opening the doors at risk.”

Server sprawl and the accompanying rise in hardware and electricity costs, plus a rapidly growing, highly distributed infrastructure with hundreds of thousands of endpoints to manage, were challenges that suggested a virtualization solution. However, it was a specific business need that arose in 2004 that became the catalyst for the company’s first virtualization solution. Target needed to replace the aging servers that hosted the company’s pharmacy application running on the IBM AIX operating system for those stores with a Target pharmacy.

“The hardware we had been using for the pharmacy solution was no longer available,” says Thompson. “At the same time, we didn’t want to replace a lot of hardware that would cost us millions of dollars. By this point, virtualization had become a viable alternative to simply deploying more servers. It also would allow us to make better use of existing server capacity and reduce infrastructure management. We just needed to find the right virtualization solution for Target.”

Solution
In 2004, Target joined the Microsoft Technology Adoption Program (TAP) for virtualization and found the solution it was looking for. During the TAP, the Microsoft team worked closely with Target Technology Services team members to virtualize the Linux-based pharmacy solution and run it successfully in a Microsoft Virtual Server 2005 environment. “Microsoft was pretty creative about developing a virtual machine edition for SUSE Linux for us,” says DeBrine. “So the first virtual instance in our stores was actually a Linux virtual machine, and it worked great. We deployed that solution to approximately 1,500 stores.”

Target’s participation in the TAP program absolved the company from having to buy new hardware for its pharmacy applications and was the catalyst for Target choosing a Microsoft Virtualization solution for every one of its retail stores in the United States. However, Target Technology Services did due diligence in investigating alternative solutions. “We looked at VMware ESX Server in 2005, and part of the conversation was around the price of deployment,” says DeBrine. “Instead, Microsoft gave us everything we needed in a virtualization solution at lower cost. Given the pharmacy server experience, we knew Microsoft would be there for us, so we chose a Microsoft Virtualization solution as a key...”

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cost-optimization strategy for Target moving forward."

Over the next three years, Target increased its Microsoft Virtualization footprint in all the stores by virtualizing three additional workloads on Virtual Server 2005. These new virtual machines housed Microsoft SQL Server 2005 data management software and Microsoft System Center Configuration Manager 2007. By the time Microsoft released the Windows Server 2008 operating system with Hyper-V virtualization technology in February 2008, the only remaining workloads running on their own physical servers were the POS and asset-protection solutions.

**Bottleneck Solved**

Target is very focused on continuously improving store productivity and the inventory replenishment process is a large part of that focus. In 2009, Target noticed reduced performance on the replenishment application at the stores. When unloading merchandise trailers at night, team members use the replenishment application on mobile devices that have barcode scanners to transmit inventory data to the SQL Server database in the store’s control room.

“We focused on the response time between SQL Server and the devices and noticed the normal subsecond response was now taking up to a minute,” says DeBrine. “As a result, our typical unload time for a trailer went up dramatically. We were approaching peak holiday season when our high-volume stores usually receive additional trailers each night. We needed to do something to fix the SQL Server bottleneck.”

Further investigation revealed that the single CPU limitation in Microsoft Virtual Server 2005 was responsible for performance issues with SQL Server. However, now that Target could take advantage of the performance improvements with Hyper-V, the company had a ready-made solution to its problem. Target deployed Windows Server 2008 Datacenter and Hyper-V to gain access to the new multicore capability in Hyper-V that gives each virtual machine access to as many as four logical processors.

“In the fall of 2009, we partnered again with Microsoft and simulated a store in a lab to see if Hyper-V would solve the problem with SQL Server by giving us access to multiple CPUs. It worked perfectly,” says DeBrine. “We just needed to expedite deployment to all our stores in time for the busy holiday season building up to December 2009.”

The scale of the migration posed a significant challenge, made even more complicated by the small window of opportunity that Target Technology Services team members have to administer the mission-critical applications at each store. Target worked with Microsoft to come up with a solution. “We scripted the entire conversion so we could migrate the applications remotely,” explains Keith Narr, Technical Architect Consultant at Target. “Microsoft helped us make this happen in a creative way. We upgraded from Windows 2003 to 2008, and then converted the virtual hard disk files that were running the virtual machines. So it was an in-place upgrade done hands-off with no IT personnel required at the store.”

By the end of September 2009, prior to the peak shopping season, Target had migrated all the virtual machines at every store from Virtual Server 2005 to Hyper-V. However, the POS system and the asset-protection solution still ran on physical servers.
Next Steps for Virtualization

With the SQL Server bottleneck solved and Hyper-V running problem-free through the holidays in December 2009, Target Technology Services turned its attention to fulfilling its long-term goal for a Microsoft Virtualization solution—migrating all the applications at every store to Hyper-V.

“For this last phase in our virtualization roadmap, the motivation came down to cost,” says Thompson. “Ultimately, we were looking at collapsing seven servers down to two. With that many servers in each of 1,755 stores, the cost to power, maintain, and refresh those servers adds up to a hefty amount of money each year.”

In early 2010, Target started with a pilot project, migrating its existing virtual workloads, the POS system, and the asset-protection solution to Hyper-V in 10 high-volume stores. “It was really important for us to have total confidence that we can process transactions during our fourth-quarter holiday season when transaction volumes go way up,” says Thompson. “So the high-volume stores were a great testing ground for this last phase of our virtualization strategy at the stores.”

This time, Target purchased new Dell R710 servers for the hosts running Hyper-V and Dell MD1000 storage units. “We ran several pilots and ultimately chose Dell because they had a hardware platform that scales to meet our needs,” says DeBrine.

“We found that Hyper-V and Dell offered a platform that proved we could run our mission-critical store applications in our highest-volume stores from a transaction perspective,” adds Thompson.

Target is presently rolling out its two-servers-per-store model with Hyper-V to all stores. For each store, the migration process for all the applications takes only two nights. “We modified the script that we used for our previous migrations, completing the actual conversion using custom scripts and another zero-touch migration,” says Narr.

In 2010, Target completed this process at 350 stores. It has more than 1,300 stores scheduled for the migration in 2011. “By the second quarter of 2012, we’ll be complete, with more than 15,000 virtual guests running on more than 3,600 Hyper-V hosts across our entire store network,” says Thompson.

Powerful Infrastructure Management Tools

Part of the decision to choose a Microsoft Virtualization solution came down to the powerful suite of server and desktop management tools from Microsoft that work with both virtual and physical environments. “We felt that Microsoft Virtualization technologies met the requirements we had in our stores at the most attractive price point,” says Thompson. “But we also liked where Microsoft was going with its System Center data center products for infrastructure management. Today, we use System Center products heavily to streamline how we manage and update more than 300,000 endpoints across our network: servers, virtual machines, mobile devices, PCs, and POS registers.”

At each store, System Center Configuration Manager 2007 acts as a distribution point for security updates and application upgrades for approximately 172 devices. Target has been using Microsoft Operations Manager (now Microsoft System Center Operations Manager 2007 R2) since its release in 2000 as a centralized solution for event monitoring and endpoint management. Adds Narr, “Each of our server endpoints and each of our 5,400...”
POS registers has a System Center Operations Manager agent installed. That way, we can ensure the checkout experience for our guests remains fast and efficient.”

Benefits
Beginning with one pharmaceutical program in 2004, Target is steadily expanding its Microsoft Virtualization solution to the point where host servers with Hyper-V will support all the programs necessary for every store’s retail operations. Along the way, the company solved immediate business issues and built up a cost-effective, easily managed IT infrastructure. “Our Microsoft Virtualization solution is an essential part of Target’s strategies for consolidating and economizing IT services at our stores,” says DeBrine. “We have been running Microsoft technology for a long time with very stable environments and I’m sure that a lot of that is attributable to the software.”

Since deploying its Microsoft Virtualization solution, Target has reduced costs, increased the IT team’s ability to support the business, and improved infrastructure management and business continuity.

Reduced Costs
Using virtualization to consolidate thousands of servers means that Target is spending less time and money on its physical infrastructure. Now the company can devote more resources to driving its competitive advantage through a superior guest experience. “A Microsoft Virtualization solution runs our stores on two servers instead of seven, reducing costs by millions of dollars a year through power savings, maintenance savings, and avoided hardware costs,” says Thompson.

Also, Target will be spending less on its monthly maintenance contract. “With fewer physical machines to manage, we’ll be paying less for maintenance every month,” says Thompson. “Additionally, fewer servers reduces our power consumption. At Target, we take environmental sustainability very seriously, with goals to reduce our environmental footprint integrated throughout our business.”

The money that Target saves on physical infrastructure and daily server and application maintenance can be reinvested into the business through improved IT services to team members and by further differentiating the shopping experience it offers guests. “We want to free up money for investments in business process automation and in deploying new applications that are directly visible to our guests and to our team members,” says DeBrine. “Hyper-V is an important enabler in this goal because we are spending less on infrastructure.”

Increased the IT Team’s Ability to Support the Business
Initially, Target used a Microsoft Virtualization solution to quickly solve an immediate problem with aging servers that ran a mission-critical pharmacy application. A few years later, virtualization offered a solution to another technical issue that reduced efficiency unloading merchandise at the stores. On both occasions, a Microsoft Virtualization solution became a significant tool that Target Technology Services used to solve an IT issue before it negatively affected guests’ experience at Target stores.

“With the bottleneck issue with SQL Server, we were up against a deadline with our busy holiday season approaching,” recalls DeBrine. “The flexibility of the virtualized environment and the combined efforts of Microsoft and Target Technology Services provided a fast solution to the problem—it
took only two and one-half hours per store to migrate to Hyper-V, and we were done with all stores in 45 days. This would have taken months to solve if we had had to deploy new servers. Instead, our Microsoft Virtualization solution helped to ensure that our guests continued to enjoy the choice of merchandise they expect at Target.”

**Improved Infrastructure Management**

Today, Target is using Microsoft System Center data center solutions to quickly deploy additional workloads, application upgrades, and security updates to the stores, a real boon considering the small window of time available each night to make changes to the stores’ IT environments.

“There aren’t a lot of distributed enterprises of our scale,” says DeBrine. “With 1,755 stores with no IT personnel on-site, it’s really important to be able to manage those environments remotely. So we use Microsoft technologies to create a management infrastructure to update our stores overnight and make sure that when guests arrive in the morning, they will find the right products in the right places and a fast, friendly check-out experience. We’ve had situations when we needed to deploy important security patches to more than 300,000 endpoints in our stores within a 24-hour period, and Microsoft lets us do that.”

**Increased System Availability**

A Microsoft Virtualization solution also makes it easier for Target Technology Services to adhere to the service level agreements it has with the business. “After deploying Hyper-V, we have fewer physical boxes, which means fewer points of failure,” says Thompson. “Now that we have virtualized our POS application, we can build redundancy by replicating the application on both Hyper-V host servers. It’s capabilities like this that give us the confidence to run our business-critical applications in the stores on Hyper-V. It’s not hyperbole to suggest that most of our guest shopping experiences are affected by our Microsoft Virtualization solution. That’s a good thing for Target, and it’s a good thing for our guests.”
Microsoft Virtualization

Microsoft virtualization is an end-to-end strategy that can profoundly affect nearly every aspect of the IT infrastructure management lifecycle. It can drive greater efficiencies, flexibility, and cost effectiveness throughout your organization. From accelerating application deployments; to ensuring systems, applications, and data are always available; to taking the hassle out of rebuilding and shutting down servers and desktops for testing and development; to reducing risk, slashing costs, and improving the agility of your entire environment—virtualization has the power to transform your infrastructure, from the data center to the desktop.

For more information about Microsoft virtualization solutions, go to: www.microsoft.com/virtualization

Software and Services

- Microsoft Server Product Portfolio
  - Windows Server 2008 R2 Datacenter
  - Microsoft System Center Configuration Manager 2007 R2
  - Microsoft System Center Operations Manager 2007 R2
- Microsoft System Center Virtual Machine Manager 2008 R2
  - Technologies
    - Hyper-V
- Hardware
  - Servers: Dell R710
  - Storage: Dell MD1000

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