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**The Home Depot moves towards
continuous availability with
IBM System z**

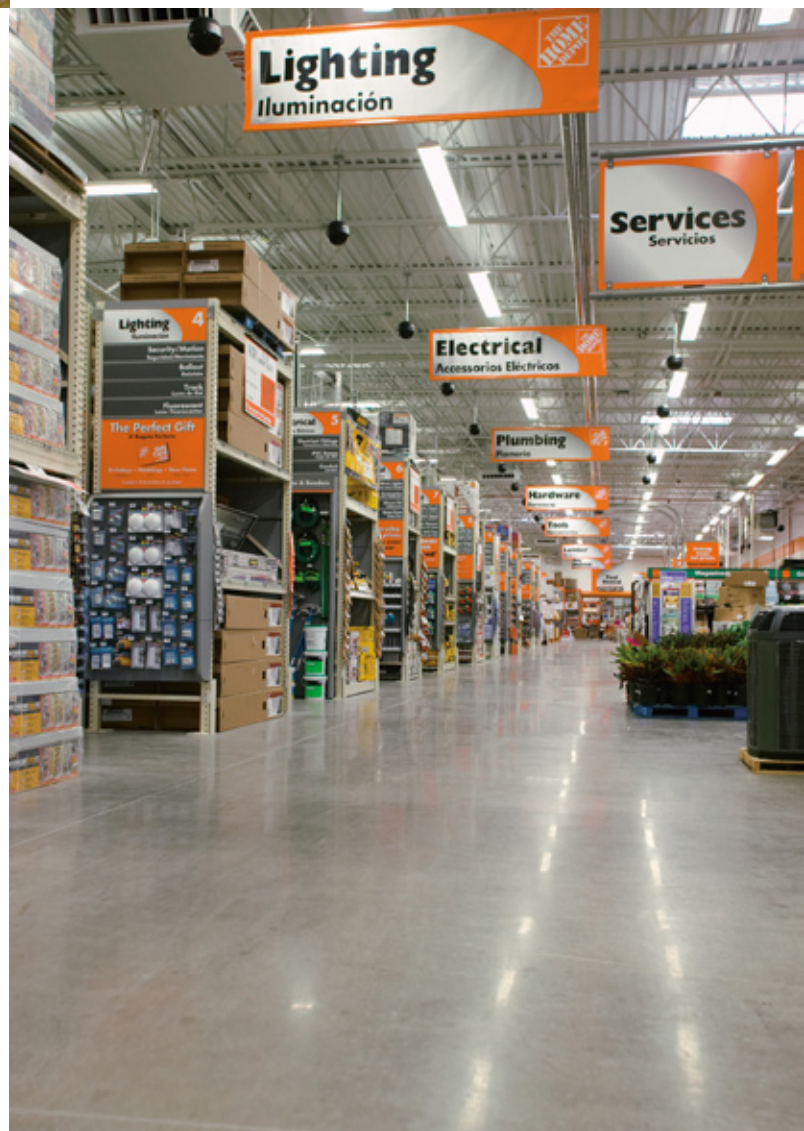


“Continuous availability and manageability are the design principles of our IT architecture. We’re proud of our ability to failover without data loss in a very short period of time. The improved availability and disaster recovery capabilities delivered by running the SAP applications on Linux for System z provide an extra layer of insurance against potentially damaging and expensive outages.”

Clifford W. Gum
SAP Technical Architect
The Home Depot

“Our customers expect the best price and an exceptional service. Both are supported by our SAP on System z landscape. System z provides excellent TCO such as savings in storage costs by virtue of DB2 hardware compression. The high availability architecture of our SAP landscape provides access to our business critical order systems at all times.”

Jim Fisher
VP Information Technology
The Home Depot



The Home Depot moves towards continuous availability with IBM System z

About this paper

This paper describes the technical architecture deployed to support The Home Depot's business-critical SAP® for Retail and SAP ERP 6.0 environments, including IBM® z/OS® and Novell® SUSE® Linux environments running on IBM System z®, and IBM AIX® on IBM Power Systems™ servers. It describes the historical background, the current hardware and software landscape, and future project plans.

Customer Objectives

- *Improve the quality of service and support to The Home Depot's store associates and customers*
- *Provide continuous availability of SAP for Retail applications for 173 stores and warehouses across five time zones*
- *Ensure that all SAP systems can be fully recovered within 48 hours in case of disaster*
- *Create an infrastructure capable of processing more than four million line items per hour in SAP for Retail applications*
- *Reduce the cost of the IT infrastructure supporting the SAP applications*
- *Accelerate the provisioning of new servers for the SAP environment.*

IBM Solution

- *Four IBM System z9 EC 2094 and one z10 EC 2097 servers deployed at two data centers, one in Atlanta, GA and the other in Austin, TX, with failover capability and EMC storage mirrored asynchronously across a distance of over 1,500 miles*
- *The Home Depot runs 72 IBM DB2® for z/OS version 8 databases for their SAP applications, some of them in active-active data-sharing mode*
- *SAP application servers:*
 - *IBM AIX 5.3 on IBM Power Systems servers*
 - *SUSE Linux Enterprise Server 10 SP1 and z/VM® 5.3 on IFL processors in the System z environment*
- *To improve performance in its business intelligence*

environment, The Home Depot has also deployed SAP NetWeaver Business Warehouse Accelerator.

- *In total, The Home Depot is leveraging 86 IBM System z Central Processors, 27 IBM System z Integrated Information Processors (zIIPs), and 58 IBM Integrated Facility for Linux (IFL) engines.*

Customer benefits

- *System z technology provides continuous availability for DB2 databases*
- *System z platform has been proven capable of processing more than five million line items per hour in SAP for Retail applications – providing significant capacity for business growth*
- *Power Systems architecture provides high levels of performance and reliability for production SAP application servers*
- *Fast provisioning of servers with z/VM eliminates the need to source, deploy and configure new physical hardware*
- *Hardware data compression on System z reduces storage needs by more than 50 percent, saving millions in storage hardware costs*
- *Easy manageability of the infrastructure has allowed IT staffing levels to remain constant, despite rapid growth in the SAP environment.*
- *By using System z hardware data compression to reduce the size of its DB2 databases for SAP, The Home Depot has been able to buy, operate and maintain 60 to 80 percent less storage hardware than would have been required with a traditional solution.*

Background, starting point and objectives

The Home Depot is the world's largest home improvement specialty retailer, with 331,000 employees working at more than 2,200 retail stores in the United States, Canada, Mexico and China. The company is listed on the New York Stock Exchange (NYSE: HD), and is included in the Dow Jones industrial average and Standard & Poor's 500 index.

With so many stores distributed across the globe, The Home Depot has to manage a highly complex supply chain. To support its store network, the company operates 78 warehouses and distribution centers, 17 import distribution centers, 7 carton goods facilities, 30 lumber distribution centers, 6 transit facilities, 14 specialty distribution centers and 6 global sourcing offices.

It is critical for the company to be able to stock the right products in the right stores to meet consumer demand – so its ERP systems must be kept online at all times to ensure that stock levels, forecasting and replenishment are managed effectively.

More specifically, the company uses the SAP for Retail solution portfolio to manage its in-store operations. If this environment were to experience downtime, special order and inventory management for in store associates and customers would be delayed – with potentially significant negative impact on customer satisfaction and loyalty.

The company wanted to create a technical architecture capable of ensuring that its SAP applications in general – and the SAP for Retail environment in particular – would be able to provide both continuous availability and rapid recovery without data loss (Recovery Point Objective at last committed transaction / RPO = 0) in case of disaster.

Detailed description of IT architecture

1. Data centers

The Home Depot's IT infrastructure is distributed between two main data centers – the first located at the company's headquarters in Atlanta, Georgia, and the second in Austin, Texas. A high-speed connection traverses the 1,500 miles between the two sites, enabling rapid data exchange (see Figure 1).

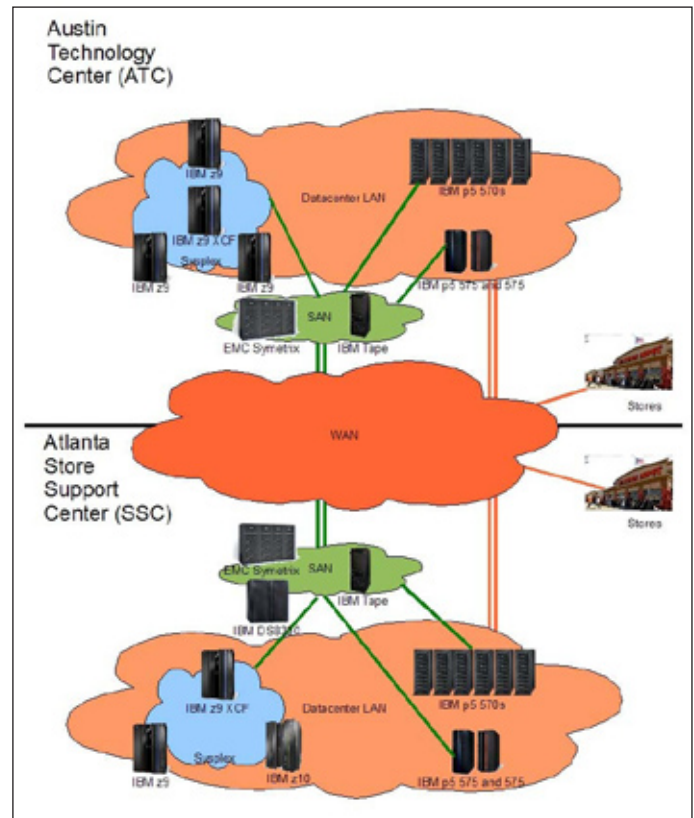


Figure 1: Home Depot data centers

2. Database servers

The four IBM DB2 8.1 database members that support the SAP for Retail application environment run on an IBM System z9 EC 2094 server and an IBM System z10 EC 2097 server, both located at the Atlanta data center. The ERP databases run under IBM z/OS 1.9 in active-active data-sharing configuration, so workload is shared evenly between all four members. In the event of one member failing, workload is immediately reallocated to the other three members, providing high availability without impacting ongoing operational activities or significantly compromising performance.

For other SAP applications, The Home Depot runs twelve IBM DB2 8.1 databases in active-standby mode under z/OS 1.9. These instances can also fail over without impacting ongoing operational activities. The Home Depot also runs another fifty-four non-production SAP instances (unique SID's) on the System z database platform. The z/OS environment for DB2 leverages 27 specialized IBM System z Integrated Information Processors (zIIPs), providing high performance for database workload at a substantially lower licensing cost than standard System z engines.

3. Data compression

The company has used the IBM System z hardware-assisted data compression feature to reduce the size of the DB2 databases, achieving average compression rates of 60 to 80 percent. The compressed volume is around 15TB for SAP production systems, and more than 30TB for non-production. The consequent saving on storage costs was estimated at millions during the original implementation. Since then, the SAP environment at The Home Depot has grown significantly.

In the near future, The Home Depot plans to upgrade DB2, to take advantage of new features like index compression. This could potentially reduce storage volumes further.

4. Shared file system

SAP systems require shared NFS access to specific files that contain common SAP information.

zFS, the native z/OS file system, is being used as a shared file system in the System z Parallel Sysplex and is accessible via NFS by all remote application servers. The zFS solution provides all the advantages of the System z platform in terms of reliability and availability, and leverages the considerable z/OS expertise of the in-house IT team.

5. Storage hardware, backups and automation

The data is stored on EMC storage hardware, and is mirrored asynchronously between sites using EMC SRDF asynchronous replication. To achieve the fastest possible recovery for non-disaster failures, The Home Depot uses EMC Business Continuance Volumes (BCVs). These BCVs are snapshots of the entire database (similar to IBM FlashCopy images), and can be used for point-in-time restores. For daily backups, the company uses three BCVs, each containing eight hours of data. In a recovery scenario these are then processed in parallel, enabling the whole recovery to be completed within a four-hour window.

The company also uses CA-OPS/MVS® Event Management and Automation from CA, Inc. for automating the disaster recovery processes and end-to-end automation.

6. Application servers

AIX on Power Systems

The Home Depot uses AIX as the primary environment for SAP application servers – two SAP ERP instances for finance and global trade, SAP CRM and SAP SCM environments, SAP NetWeaver Portal, SAP NetWeaver Process Integration, and a SAP NetWeaver Business Warehouse system for reporting.

The majority of The Home Depot's SAP application servers run in an AIX 5.3 environment on a large number of IBM Power Systems servers. Most of these servers contain 16 IBM POWER5 or POWER5+ processors, although there are also some larger and some smaller models. The application servers run in virtualized logical partitions (LPARs) to improve flexibility.

SUSE Linux on System z

As part of a consolidation strategy, The Home Depot conducted a pilot project which demonstrated that it would be possible to replace 78 POWER processors with 12 Integrated Facility for Linux (IFL) processors on the System z platform, freeing up 16 Power Systems servers for production applications.

Based on this evidence, the company plans to move approximately 25 to 40 percent of its production SAP application servers and most of its non-production application servers into virtualized SUSE Linux Enterprise Server 10 SP1 environments, running under z/VM 5.3 on the System z servers. These systems leverage 58 IFLs, distributed across the System z servers.

The majority of the application servers running on System z fall into one of two categories:

1. Non-production systems, especially SAP test and development servers, are planned to run in the virtualized Linux environment because they will be able to be provisioned very rapidly, with no need to source, install and configure a new physical server for each new environment. As a result, a provisioning process that might previously have taken several weeks will be able to be completed in less than an hour.
2. A percentage of the production application servers in the SAP for Retail environment (SAP ERP, SAP POS Data Mart, SAP SCM, SAP NetWeaver Business Warehouse and SAP NetWeaver Process Integration) will also be virtualized on the System z platform to accelerate recovery in the event of a disaster (see below for a detailed explanation).

SAP Central Services for ABAP and for Java

For high availability setups, SAP has separated the singular central service entities from the application server and grouped them together as SAP Central Services (SCS):

- Enqueue server
- Message server
- SAP gateway.

For each SAP system, a SCS exists each for ABAP and Java. Although it is possible to place the SAP Central Services on all supported Application Server types, for example on Linux for System z or on AIX, The Home Depot has placed the central services on z/OS. This allows the Home Depot to manage all critical components together, in one place.

7. SAP NetWeaver Business Warehouse Accelerator

To deliver rapid analysis of business data in the SAP for Retail environment, The Home Depot uses the SAP NetWeaver Business Warehouse Accelerator solution. This SAP solution boosts the query performance of SAP NetWeaver Business Warehouse (BW) by an integrated HW/SW extension. During query preparation phase, the BW system uses the DB2 for z/OS BW database to create indexed BW Infocubes and loads

them into the accelerator's private storage. When running BW queries, the accelerator processes these with greatly accelerated response – even without further specific tuning and optimization.

The BW data repository remains on DB2 for z/OS to manage the warehouse, collect further information and perform all other BW tasks.

IBM solution

- Four IBM System z9 EC 2094 and one z10 EC 2097 servers have been deployed at two data centers, one in Atlanta, GA, and the other in Austin, TX, with EMC storage mirrored asynchronously across a distance of over 1,500 miles. Production workload is split across the data centers, with failover capability to run in the opposite datacenter.
- The Home Depot runs 72 IBM DB2 for z/OS databases for their SAP applications:
 - For the SAP for Retail environment, The Home Depot is running four IBM DB2 for z/OS Version 8 databases in active-active data-sharing mode on two of the System z servers.
 - For other SAP applications, The Home Depot runs twelve IBM DB2 for z/OS Version 8 databases in active-standby mode.
 - The Home Depot runs another fifty-four non-production DB2 databases for SAP test, QA and development on the System z platform.
- In total, The Home Depot is leveraging 86 IBM System z Central Processors, 27 IBM System z Integrated Information Processors (zIIPs), and 58 IBM Integrated Facility for Linux (IFL) engines.
- The Home Depot runs the majority of its SAP application servers under IBM AIX on IBM Power Systems servers. It also runs additional application servers (including production SAP for Retail applications and many non-production systems) under SUSE Linux Enterprise Server 10 SP1 and z/VM 5.3 on IFL processors in the System z environment.
- The Home Depot intends to run about 40 percent of its production retail application servers, all its non-production application servers, and to run 100 percent of its batch workload on System z IFLs. The remaining application servers (including production SAP ERP applications to support corporate financial accounting and global trade, SAP CRM and SAP NetWeaver Business Warehouse systems) will continue to run under AIX on IBM Power Systems servers with IBM POWER processors.
- Consolidation of non-production application servers onto z/VM IFL engines aims to free up previously under-utilized Power Systems servers for redeployment as production application servers.
- To improve performance in its business intelligence environment, The Home Depot has also deployed SAP NetWeaver Business Warehouse Accelerator.

Project achievements

Performance

When The Home Depot first deployed the SAP for Retail solution, there were major concerns over its scalability. The largest SAP for Retail environment previously deployed was capable of processing 1.25 million line items (i.e. single item purchase transactions, passed from SAP POS Data Mart into SAP ERP) per hour – but The Home Depot needed to be able to handle at least 4 million line items.

IBM helped the company run a proof-of-concept using the proposed Power Systems and System z architecture, which demonstrated an ability to process more than 5 million line items per hour – meeting the company's planned needs and providing considerable headroom for growth.

Continuous availability and disaster recovery

By running its SAP systems on DB2 Data Sharing for System z, The Home Depot has eliminated single points of failure in its SAP environment. The active-active data sharing setup is particularly helping to maintain the availability of in-store and back-end systems at all times, and easily achieving service level obligations. DB2 data sharing allows, in addition to DB2 maintenance, even major DB2 release upgrades without shutting down the system. This integrates neatly into System z capability of allowing z/OS and hardware maintenance in the running system, reducing the need for system shutdown during planned system maintenance to an absolute minimum.

By running the SAP for Retail application servers under Linux on System z, the company has also greatly improved its ability to recover in case of disaster. EMC SRDF asynchronous replication technology (similar to IBM Global Mirror) ensures that even if all systems fail at one data center, all data is preserved on the storage systems at the secondary site. All database servers, the SAP Central Services in z/OS, and all application servers running under Linux on System z can be recovered together, allowing for simultaneous recovery of the business.

After the recovery, the SAP for Retail applications are started again on the System z at the other site, utilizing IBM Capacity on Demand to activate backup processors and provide sufficient capacity. All these applications then connect to the failover DB2 instances, and normal service is resumed. This failover can be completed within a short time, preventing outages from having any significant effect on consumers' shopping experience.

Less-critical production application servers, which run on the outlying Power Systems servers (for example, the corporate SAP NetWeaver Business Warehouse system), are then restored over a period of time. The entire SAP landscape can be brought back online within the agreed period of 48 hours.

Cost savings

By using System z hardware data compression to reduce the size of its DB2 databases for SAP, The Home Depot has been able to buy, operate and maintain 60 to 80 percent less storage hardware than would have been required with a traditional solution.

Using IFL and zIIP specialty engines to handle Linux and database workloads has significantly reduced the company's processor licensing fees and software fees. In addition, consolidating application servers from Power Systems servers to Linux on System z will save operating system costs and is expected to allow many Power Systems test and development servers to be re-purposed as production servers.

Moreover, even though The Home Depot has dramatically extended its SAP environment, with three major new projects taking place over the last 16 months, the manageability of the environment has meant that the company has not needed to hire any additional staff.

Finally, and most importantly, the improved availability and disaster recovery capabilities delivered by running the SAP applications on System z provide an extra layer of insurance against potentially damaging and expensive outages. By ensuring that customer service levels will be maintained even in the event of a serious infrastructure problem, the company retains consumer loyalty and protects its market share.

Project summary

Implementing SAP on a combination of System z and Power Systems servers has enabled The Home Depot to operate its ERP environment in an efficient and cost-effective manner, while providing business continuity and resilience against disaster.

In the future, The Home Depot is planning to move more of its application servers onto the System z platform, which will improve recovery time further and reduce overall infrastructure maintenance costs.

Customer Benefits

- Highly reliable System z technology provides continuous availability for DB2 databases.
- In the event of a disaster, core SAP for Retail applications running on System z can be failed over to the secondary data center within minutes – preserving availability of customer-facing systems.
- Non-disaster failover is performed within the same data center with zero downtime to the end users. The business continues without interruption.
- System z platform has been proven capable of processing more than five million line items per hour in SAP for Retail applications – providing significant capacity for business growth.
- Power Systems architecture provides high levels of performance and reliability for production SAP application servers.
- Virtualization with z/VM enables test and development servers to be provisioned in less than an hour, eliminating the need to source, deploy and configure new physical hardware.
- Hardware data compression on System z reduces storage needs by more than 50 percent, saving millions in storage hardware costs.
- System z zIIP and IFL specialty engines deliver excellent price performance for SAP workloads.
- Easy manageability of the infrastructure has allowed IT staffing levels to remain constant, despite rapid growth in the SAP environment.



For more information

To learn more about the solutions from IBM and SAP, visit: **ibm-sap.com**

To learn more about The Home Depot, visit:

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