

Dell delivers 166% better SAP® performance



Dell™ PowerEdge™ R910 server
with Intel® Xeon® Processors X7560

HP ProLiant DL385 G6 server with
AMD Opteron™ processors Model 2435

OUR FINDINGS

Selecting an Intel Xeon Processor X7560-based Dell PowerEdge R910 server over an AMD Opteron processor Model 2435-based HP ProLiant DL385 G6 server can yield significant SAP Enterprise Resource Planning (ERP) performance benefits. In hands-on tests in our labs, the Dell PowerEdge R910 server, running in a dual-socket configuration, delivered 166 percent better SAP performance and supported more than 2.6 times as many users as the HP ProLiant DL385 G6 dual-socket server.

OUR PROCESS

We measured server performance using a representative SAP ERP workload, one that models an end-to-end customer order process, delivery of goods, and subsequent invoicing. This workload shows the servers' capacity to run both the application and the database layers on a single system. We report the results in workload operations per hour. We measured the performance of both the Dell PowerEdge R910 and the HP ProLiant DL385 G6 during the ramp-up, peak load, and ramp-down phases, and we report the results for the peak load phase.



PROJECT OVERVIEW

We tested the SAP ERP performance of the following servers:

- Intel Xeon Processor X7560-powered Dell PowerEdge R910 server running in a dual-socket configuration
- AMD Opteron processor Model 2435-powered HP ProLiant DL385 G6 server

The goal was to determine which server provides better performance running an SAP ERP workload that simulates a customer order scenario in a two-tier configuration, with the database software and SAP ERP layers residing on the same server. In this scenario, we modeled two of the main tasks that an ERP system carries out: sales functionality and order distribution. The capability to process more orders in a limited time window is preferable, and we measure this capability in workload operations per hour. We installed Microsoft® Windows Server® 2008 Enterprise Edition, Microsoft SQL Server® 2008 Enterprise Edition, an SAP ERP 6.0 central system, and multiple SAP ERP 6.0 dialog instances on each server. For each server, our goal was to achieve as much above 90 percent CPU utilization as possible, while still maintaining an acceptable response time; between 0.8 and 1 second. We configured one SAP central system and 11 SAP dialog instances on each system, and adjusted CPU affinity on each platform to provide optimal throughput and response time.

WHAT WE TESTED

We measured server performance using a customer-provided SAP ERP workload that models thousands of users creating customer orders with multiple line items, delivery processing, transfer of goods, and subsequent invoicing. We installed the necessary scripts and services on the workload driver machine as well as on the server under test.

Before running the workload, we iteratively tuned the parameters, such as number of SAP dialog instances, CPU affinity for SAP instances and SQL Server, and number of users per SAP instance, until each server was running with optimal CPU utilization and response time. We then began the workload runs with a single loop execution of the workload to cache the data from the storage subsystem. We then ran the full test three times and took the median run based on workload operations per hour.

We adjusted the length of the high load period, in number of execution loops, based on the number of users per SAP dialog instance. Therefore, the test ran for 9 loops on the HP ProLiant DL385 G6 and for 10 loops on the Dell PowerEdge R910, because the supported user count per instance differed between the two platforms. The workload driver automatically managed the ramp-up and ramp-down phases, and gathered its SAP ERP statistics during the period of high load. We also collected performance statistics, such as CPU

utilization, disk I/O per second, network utilization, and available memory from the Windows® Performance Monitor during each run.

SYSTEM COMPARISON

Figure 1 highlights the key system configuration information for the servers. Appendix A provides detailed configuration information.

Hardware and software specifications	Dell PowerEdge R910 server	HP ProLiant DL385 G6 server
Hardware		
CPU	Intel Xeon X7560	AMD Opteron 2435
CPU speed (GHz)	2.26	2.60
Number of processor packages	2	2
Number of cores per processor package	8	6
Number of hardware threads per core	2	1
Memory type	PC3-8500	PC2-5300
Total memory	256 GB (32 x 8 GB)	128 GB (16 x 8 GB)
Internal storage	Dell PERC H700 storage controller, 512MB cache 8 x 146GB 6Gb SAS 15,000 RPM 2.5" hot-swappable	HP Smart Array P410i storage controller, 512MB cache 2 x 146GB 6Gb SAS 15,000 RPM 2.5" hot-swappable 6 x 72GB 6Gb SAS 15,000 RPM 2.5" hot swappable
Software		
Operating system	Windows Server 2008 Enterprise Edition	Windows Server 2008 Enterprise Edition
Database	SQL Server 2008, Service Pack 1	SQL Server 2008, Service Pack 1
SAP ERP	SAP ERP Central Instance and 11 SAP ERP dialog instances	SAP ERP Central Instance and 11 SAP ERP dialog instances

Figure 1: Key system configuration information for the test servers.

We selected a dual-processor configuration for each server. We tested the HP ProLiant DL385 G6 server with 128 GB of memory, the maximum amount of memory it supports. We took advantage of the Dell PowerEdge R910 server's additional memory capacity and configured it with 256 GB of memory.

WHAT WE FOUND

Figure 2 shows the number of workload operations per hour the test servers achieved during our measurement period of the SAP ERP workload test on the median run. The Dell PowerEdge R910 server, running a dual-socket configuration, achieved a workload-operations-per-hour score of 1,500,339.6 while supporting 4,543 users with

a response time of 0.90 seconds. This SAP ERP performance score is 166 percent better than the score of the HP ProLiant DL385 G6 server, which achieved a workload-operations-per-hour score of 562,290.9 while

supporting 1,691 users with a response time of 0.83 seconds.

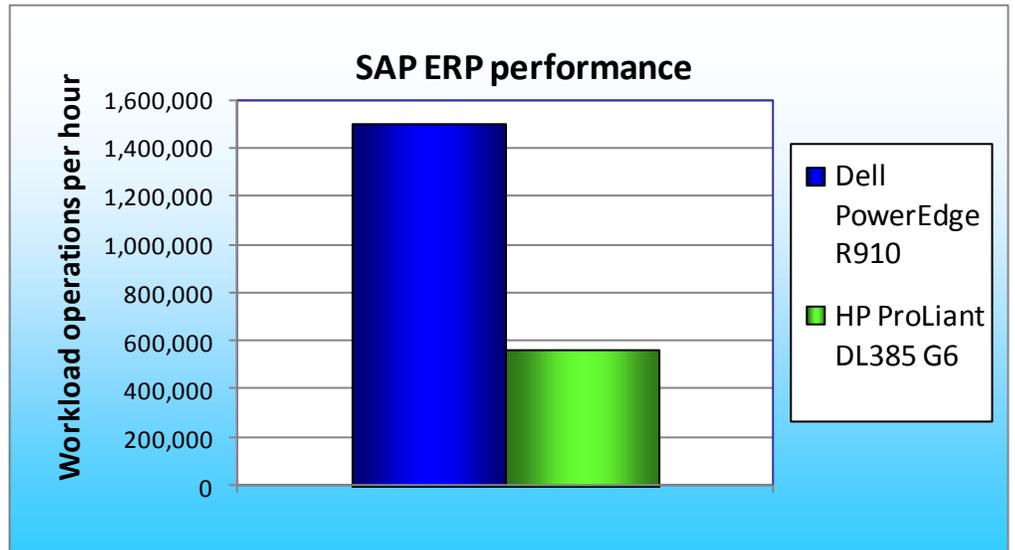


Figure 2: SAP ERP performance results for the two test servers. Higher numbers are better.

HOW WE TESTED

To perform the test, we did the following:

- set up an external storage test environment
- configured the SAP ERP 6.0 system with one central instance and multiple dialog instances
- modified the instance profile parameters to adjust for system hardware, such as number of available cores, buffer sizes, and system RAM amounts
- configured the workload driver system
- installed the workload and iteratively sized the test
- ran the test

The steps involved in creating a formal SAP infrastructure are outside the scope of this report. Such steps would include acquiring the necessary licenses, installing Solution Manager, and configuring an SAP landscape.

Setting up the external storage

We set up an external storage test environment, which included an external storage array and a 10Gb Ethernet switch. We used this environment in tests of both server models. We installed the same model 10Gb

NIC on each server to communicate with the storage array. Figure 3 describes the external storage test environment.

External storage	
External storage array	Dell EqualLogic™ PS6010XV with 16 x 600GB 6Gb SAS 15,000 RPM 3.5” hot swappable
10GB Ethernet switch	10Gb Dell PowerConnect™ 8024 switch
10GB NIC on server (for iSCSI network traffic)	Intel 10 Gigabit AT Server Adapter (EXPX9501AT)

Figure 3: Key external storage test environment configuration information.

Appendix B describes the external storage array in more detail.

Setting up the SAP ERP System and workload driver machine

We attached each server to a Dell EqualLogic PS6010XV tray containing 16 hard drives, configured in RAID 10 mode and configured as a single-member storage group. We connected both 10Gb NICs on the Dell EqualLogic PS6010XV storage array to a 10Gb Dell PowerConnect 8024 switch, and we installed a 10Gb NIC in the server for iSCSI network traffic and attached the server to the Dell PowerConnect 8024 switch. We created a 650GB volume for SQL Server data storage and, by implication, the SAP SQL Server database files, for each server and exposed this volume via the Microsoft iSCSI initiator.

For internal storage, we used the respective RAID configuration utilities on each system to create a two-disk RAID 1 for the operating system, SQL Server software, and SAP software. We then configured a six-disk RAID 10 that contained SQL Server transaction log files and the TEMPDB transaction log files.

Following the operating system installation, we installed all recommended Windows Updates. We then installed SQL Server 2008, SQL Server 2008 Service Pack 1, the SAP ERP Central Instance, multiple SAP ERP dialog instances, and necessary software for the workload.

Configuring the storage for the server

1. Connect the external storage to the Dell PowerConnect 8024 switch.
2. Connect a workstation via serial connection to the Dell EqualLogic PS6010XV, and configure the storage group.
3. Create the volumes on the external storage necessary for SQL Server database files.
4. Install a 10Gb NIC in the server, and connect the NIC to the Dell PowerConnect 8024 switch.
5. On the server, create a two-disk RAID 1 for the operating system, SQL Server software, and SAP software, and a six-disk RAID 10 to contain the SQL Server transaction log files.

Configuring the server and database software

1. Adjust BIOS settings as needed. For our study, we turned off prefetchers and set the power management to maximum performance on each system.
2. Install Windows Server 2008 Enterprise Edition with SP2.

3. Install all recommended Windows updates, rebooting the server as prompted.
4. Disable the Windows firewall, enable the Lock Pages in Memory option, and assign a static IP address to all network interfaces.
5. Add an entry to the C:\Windows\System32\drivers\etc\hosts file to have an entry for all systems involved. An example might be:

```
192.168.1.201 machinename.mynet.local
```

In this example, 192.168.1.201 is the IP address and machinename is the hostname of the system under test.
6. Turn off the User Account Control (UAC) in Windows Server 2008 by following the instructions at [http://technet.microsoft.com/en-us/library/cc709691\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/cc709691(WS.10).aspx)
7. Install SQL Server 2008 according to the instructions in section 4.2.4 of *Installation Guide SAP ERP 6.0 - EHP4 Ready SR1 ABAP on Windows: MS SQL Server*, available from the SAP Service Marketplace. Set SQL Server options as follows:
 - a. Set SQL affinity to restrict it to certain sockets on each configuration. This will vary by system.
 - b. Set SQL I/O affinity to restrict it to certain sockets on each configuration. This will vary by system.
 - c. Set SQL Server minimum and maximum memory settings on each configuration based on system RAM available and SAP needs. This will vary by system.
 - d. Set the SQL Server network packet size to 8192.
 - e. Set the SQL Server priority boost option.
 - f. To remove any potential storage bottleneck, set the Recovery Interval to 32768.
8. Modify SQL Agent properties as specified in *Installation Guide SAP ERP 6.0 - EHP4 Ready SR1 ABAP on Windows: MS SQL Server*.

Installing SAP ERP 6.0

Note – for this section, we followed the guidelines set forth in *Installation Guide SAP ERP 6.0 - EHP4 Ready SR1 ABAP on Windows: MS SQL Server*, available from the SAP Service Marketplace. Please see that guide for details on installing step by step. Here, we provide our high-level methodology.

1. Prepare a shared folder for the SAP Transport host.
2. Install Java™ 1.4.2 JDK, as required by SAP engine (available from http://www.sun.com/software/javaforbusiness/sap_download.jsp).
3. Copy the relevant installation media to the local hard drive of each server for ease of installation. For our installation, we used the following:
 - SAP Installation Master SR1, found on DVD 51036888 titled *Installation Master SR1*
 - Kernel 7.01, found on DVD 51036767 titled *SAP EHP1 FOR SAP NETWEAVER® 7.0 SR1*
 - Installation Export, found on DVD 51036902, titled *SAP ERP 6.0 EHP4 READY*
4. Start SAPinst, and choose to install SAP ERP 6.0 Central System on the Microsoft SQL Server platform.
5. Step through the SAP ERP installation, and provide relevant details for your machine, such as SAPSID, user credentials, file locations, and so on.
6. Finalize the installation parameters, enter the license key from Solution Manager, and continue. The ERP install of the Central System will take approximately 2 to 4 hours.
7. After the SAP ERP installation completes, start the SAP services by using the Microsoft Management Console (MMC) application.

8. Download Java JRE 1.5 release 22 32-bit from www.java.com/en/download/manual.jsp. Install the JRE with default options, and modify the system environment path to use the bin directory of this JRE installation.
9. Install the SAP GUI using the PlatinGUI utility.
10. Modify the Central System profile parameters as required.
11. Install additional dialog instances as necessary.
12. Modify the additional dialog instances' profile parameters as required.

Preparing the system for the workload

1. Download ActivePerl-5.10.1.1007-MSWin32-x64-291969.msi from <http://downloads.activestate.com/ActivePerl/releases/5.10.1.1007/> and install Perl.
2. Create user accounts as needed.
3. Copy workload tools and scripts to the local machine.
4. Setup an FTP server by following the instructions at [http://technet.microsoft.com/en-us/library/dd722761\(ws.10\).aspx](http://technet.microsoft.com/en-us/library/dd722761(ws.10).aspx)
5. Configure the FTP home directory for file transfer.
6. Set up the SAPOSCOL service and service account on the server under test.
7. Install the workload scripts, directories, and services as required.
8. Update the SAP system to add necessary clients and set buffer parameters as necessary.
9. As recommended in *Note 1357244 - High Performance 7.01 Kernel for Windows*, we used the high-performance SAP Kernel. Stop all services, archive the original installation files, and copy the high-performance files to the appropriate exe directories. While this kernel does yield better performance, SAP does not recommend it for all situations.

Configuring the driver system

1. Create a RAID volume for the operating system and workload utilities.
2. Install Windows Server 2008 Enterprise Edition with SP2.
3. Install all recommended Windows updates, rebooting the machine as necessary.
4. Disable the Windows firewall, and assign static IP address to all network interfaces.
5. Download ActivePerl-5.10.1.1007-MSWin32-x64-291969.msi from <http://downloads.activestate.com/ActivePerl/releases/5.10.1.1007/> and install Perl.
6. Create user accounts as needed, and install the workload scripts.
7. Configure connection and access to the ERP system.

APPENDIX A – SERVER CONFIGURATION INFORMATION

Figure 4 provides detailed configuration information about the two test servers.

System	Dell PowerEdge R910	HP ProLiant DL385 G6
Power supplies		
Total number	4	2
Vendor and model number	Dell L1100A-S0	HP 438203-001
Wattage of each (W)	1,100	1,200
Cooling fans		
Total number	6	6
Vendor and model number	Delta Electronics PFC1212DE	Nidec Ultraflo V60E12BS1A7-09A032
Dimensions (h x w) of each (inches)	5-1/4 x 1-3/4	2 x 2-1/2
Volts	12	12
Amps	4.80	2.45
General		
Number of processor packages	2	2
Number of cores per processor	8	6
Number of hardware threads per core	2	1
System power management policy	Windows Balanced Power Policy	Windows Balanced Power Policy
CPU		
Vendor	Intel	AMD
Name	Xeon	Opteron
Model number	X7560	2435
Stepping	D0	D0
Socket type	LGA 1567	Socket Fr6
Core frequency (GHz)	2.26	2.60
Bus frequency	6.4 GT/s	2,400 MHz
L1 cache (KB)	32 + 32 (per core)	64 + 64 (per core)
L2 cache (KB)	256 (per core)	512 (per core)
L3 cache (MB)	24	6
Platform		
Vendor and model number	Dell PowerEdge R910	HP ProLiant DL385 G6
Motherboard model number	OP658H	577426-001
Motherboard chipset	Intel ID3407	ServerWorks® HT-2100 Northbridge and HT-1000 Southbridge Chipset
BIOS name and version	Dell Inc 1.1.7 (5/25/2010)	HP A22 (02/09/2010)

System	Dell PowerEdge R910	HP ProLiant DL385 G6
BIOS settings	Power Management: Maximum Performance Hardware Prefetcher: Disabled Adjacent Cache Line Prefetcher: Disabled	Power Regulator for ProLiant: Static High Performance Mode DRAM Prefetcher: Disabled Hardware Prefetch Training on Software Prefetch: Disabled Hardware Prefetch: Disabled
Memory module(s)		
Total RAM in system (GB)	256	128
Vendor and model number	Samsung M393B1G0DJ1-CF8	Samsung M393T1K66AZA-CE6Q0
Type	DDR3 PC3-8500	DDR2 PC2-5300
Speed (MHz)	1,067	667
Speed running in the system (MHz)	1,067	533
Size (GB)	8	8
Number of RAM module(s)	32	16
Chip organization	Double-sided	Double-sided
Rank	Quad	Dual
Hard disk 1		
Vendor and model number	Dell ST9146852SS	HP EH0146FARWD
Number of disks in system	8	2
Size (GB)	146	146
Buffer size (MB)	16	16
RPM	15,000	15,000
Type	SAS	SAS
Hard disk 2		
Vendor and model number	N/A	HP DH0072FAQRD
Number of disks in system	N/A	6
Size (GB)	N/A	72
Buffer size (MB)	N/A	16
RPM	N/A	15,000
Type	N/A	SAS
Disk controller		
Vendor and model	Dell PERC H700	HP Smart Array P410i
Controller cache (MB)	512	512
Controller driver	DELL 4.17.2.64 (9/28/2009)	Hewlett-Packard Company 6.20.0.64 (2/22/2010)
Controller firmware	12.0.1-0091	3.0
RAID configuration	2 disks: RAID 1 6 disks: RAID 10	2 disks: RAID 1 6 disks: RAID 10
Operating system		

System	Dell PowerEdge R910	HP ProLiant DL385 G6
Name	Windows Server 2008 Enterprise Edition	Windows Server 2008 Enterprise Edition
Build number	6002	6002
Service pack	Service Pack 2	Service Pack 2
File system	NTFS	NTFS
Kernel	ACPI x64-based PC	ACPI x64-based PC
Language	English	English
Graphics		
Vendor and model number	Matrox® G200eW	ATI ES1000
Graphics memory (MB)	8	32
Driver	Microsoft 6.0.6001.18000 (6/20/2006)	ATI Technologies Inc. 8.240.50.5000 (6/23/2009)
Ethernet 1		
Vendor and model number	Broadcom® BCM5709C NetXtreme® II GigE	HP NC382i DP Multifunction Gigabit Server Adapter
Type	Integrated	Integrated
Driver	Broadcom 5.2.14.0 (12/17/2009)	Hewlett-Packard Company 5.2.14.0 (12/17/2009)
Ethernet 2		
Vendor and model number	Intel 10 Gigabit AT Server Adapter (EXPX9501AT)	Intel 10 Gigabit AT Server Adapter (EXPX9501AT)
Type	PCI-Express	PCI-Express
Driver	Intel 2.4.28.0 (4/20/2010)	Intel 2.4.28.0 (4/20/2010)
Optical drive(s)		
Vendor and model number	TEAC DV-28S-W ATA Device	DV-28S HP 461644-932
Type	DVD-ROM	DVD-ROM
USB ports		
Number	4	4
Type	2.0	2.0

Figure 4: Configuration information for the test servers.

APPENDIX B - TEST STORAGE INFORMATION

Figure 5 provides detailed configuration information about the storage array system.

Storage array	Dell EqualLogic SAN
Arrays	One Dell EqualLogic PS6010XV array
Disks	16 x 15,000RPM SAS disks
Active storage cache (GB)	4
Firmware revision	v4.3.5 Patch L1
Switch type/model	One Dell PowerConnect 8024
Disk vendor and model number	Seagate ST3600057SS
Disk size (GB)	600
Disk buffer size (MB)	16

Figure 5: Detailed configuration information for the storage array system.

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