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WHITE PAPER

Sybase IQ TPC-H™ Benchmark with Red Hat Enterprise Linux on HP ProLiant Systems

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INTRODUCTION

Sybase®, Red Hat® and HP® are working together to provide a low total cost of ownership Linux solution for Sybase IQ with enterprise-quality performance, robustness, and scalability for business-critical analytics. This paper describes the recent TPC-H performance results for Sybase IQ on an HP ProLiant System running Red Hat Enterprise Linux®. It also provides some background on why Sybase customers and many other IT organizations are moving to Linux and why customers should consider Sybase IQ on Red Hat Enterprise Linux for HP Systems in light of the low cost of ownership and high level of performance.

WHY COMPANIES ARE CONSIDERING LINUX FOR ENTERPRISE INFRASTRUCTURE

The pressure to reduce and contain costs while protecting data processing capabilities and services while planning for expected growth puts tremendous strain on IT budgets and resources. In response to this pressure, IT organizations are constantly evaluating the potential benefits of different approaches for managing their computing infrastructure. Today's challenging and uncertain economy has accelerated the adoption of technologies and architectures that improve price/performance and reduce total cost of ownership.

Using Linux to reduce costs and provide a safe long-term direction

Many IT organizations were early adopters of Linux platforms to address these needs for print servers, mail servers and other parts of their infrastructure. Today, Technology professionals agree that Linux® has developed into a mature platform that handles many of the world's most demanding workloads, and at a much lower cost than traditional, proprietary UNIX® offerings. At the same time, Linux leverages the open source development model, which guarantees a constant stream of technology innovation fueled by a healthy multidimensional community of users and developers.

Linux is both a safe choice, because of the significant investment by many major infrastructure companies, and is also at the center of today's most innovative approaches. Linux-related software growth will continue to lead the industry according to industry experts[1], and Linux is closely aligned with major trends such as virtualization and cloud computing. The convenience of using Linux with virtualization for deploying additional virtual servers has greatly expanded the use of Linux in development, test and production environments. Linux is also a key component of many cloud computing infrastructures, as well as an operating environment for working with these systems. These factors make Linux a highly desirable platform for short-term and long-term future architectures.

Now proven for mission-critical environments

As the use of Linux-platforms has expanded, the balance of workloads has shifted from traditional infrastructure workloads to enterprise-level database and application workloads. IDC quantifies this trend with forecasts for relational database systems for Linux and open source operating environments that are the highest growing sector by far[2]. This means that suppliers will continue to invest strongly in supporting Linux-based systems for enterprise and mission-critical deployments. Sybase, HP, and Red Hat, as well as most major IT technology providers, have consulting practices to help customers deploy and support Linux-based systems in mission-critical environments.

WHY SYBASE, RED HAT AND HP ARE WORKING TOGETHER

Commitment to Linux for enterprise and mission-critical environments

Sybase IQ has been recognized as a leader by industry experts including the Gartner Inc. Magic Quadrant for Data Warehouse (DW) Database Management System (DBMS) report[3]. Sybase customers have received awards for their use of Sybase IQ including Leeds Hospital, Great Britain, by ComputerWorld for Best Practices in Business Intelligence, as well as comScore Networks and Nielsen Media Research for Winter Corporation's TopTen awards[4]. Some of the world's largest data warehouses run on Sybase IQ analytics servers, and customers include leading global organizations such as Taiwan Mobile, ICICI Bank, Nielsen Media Research, European Southern Observatory, Statistics Canada and Samsung Life Insurance, and Sybase IQ customers on Linux include LoanPerformance—a subsidiary of a Fortune 500 company, Agencia Estatal de Administración Tributaria (AEAT)—the Spanish national tax office, Cambridge Astronomical Survey Unit, Metropolitan Health Group and Pick 'n Pay in South Africa.

[1] IDC April 2009, The Opportunity for Linux in a New Economy, #217798

[2] IDC October 2009, Worldwide Database Management Systems 2009-2013 Forecast, #219232E

[3] 2010 Gartner Data Warehouse Database Management System Magic Quadrant, Donald Feinberg and Mark A. Beyer (January 2010)

[4] http://www.wintercorp.com/VLDB/2005_TopTen_survey/2005TopTenWinners.pdf

Sybase has been an innovator on Linux since 1998, when the company released its flagship database, Adaptive Server® Enterprise (ASE), as the first enterprise-class database for the Linux platform. Today, many Sybase products are deployed on Linux, including Sybase Adaptive Server Enterprise, Replication Server®, Sybase IQ, SQL Anywhere® Studio, and Financial Fusion® Tradeforce™. Sybase supports Linux as a core platform, with mission-critical customer support services for Linux, Linux technical competency centers in the United States, Europe and Asia. Consulting and managed services are also available from Sybase Professional Services.

Red Hat is the leader in enterprise Linux and is the most recognized open source brand in the world. Red Hat Enterprise Linux platform is the foundation of the grid and Service-Oriented Architectures (SOA) of many leading financial institutions[5] and is used by the majority of financial institutions on Wall Street, including the NYSE, Merrill Lynch, Credit Suisse UBS Warburg, Morgan Stanley and is used in mission critical systems for organizations such as McKesson, Amazon.com, AOL, DreamWorks, VeriSign, Charles Schwab, FinencoBank, Daiwa Securities, Deutsche Boerse Systems, GE Money Bank, Millennium Global Investments (MGI), NorTel, Verizon Communications, Covad Communications and local, state and federal governments. CIOs have ranked Red Hat as one of the top vendors delivering value in Enterprise Software for five consecutive years in the CIO Insight Magazine Vendor Value survey.

HP certifies more platforms on Red Hat than any other vendor. From versatile HP blade servers to mission critical HP Integrity servers, HP servers set the standard by demonstrating outstanding performance across the industry's most demanding and diverse workloads. Today, there are more HP servers running Linux than any other server—making HP the undisputed platform of choice for Linux distributions (Per the IDC Quarterly Server Tracker Report Q209, HP has sold more than 3.1M servers for Linux since 1998) HP delivers server environments that offer tremendous savings in software licensing, floor space, power and administrative costs. In addition to tremendous cost savings, HP also offers solid partner relationships covering the most popular commercial and enterprise solutions employed by Sun customers.

Working with Red Hat and HP, Sybase provides a low-cost platform with low total cost of ownership that reduces the risk to customers of adopting Linux as a platform for Sybase IQ, and delivers the enterprise-quality performance, robustness, and scalability they expect for business-critical analytics applications.

OVERVIEW OF SYBASE IQ

Sybase IQ is a highly optimized analytics engine used for business intelligence, advanced analytics, predictive modeling, stringent regulatory compliance, and rapid reporting.

Unlike transactional databases that were designed to support business transactions, Sybase IQ was architected for reporting and analysis. Transactional databases require complex, space-consuming indexing and summary tables to perform query-intensive workloads well. These indexes and summary tables actually explode data sizes, often requiring 5 or 10 times more data in the reporting system than in the original operational system.

Transactional databases are also more complex to implement for decision support environments. They require more time to load and refresh, due to labor-intensive steps of creating backups, tables, and indexes. It also takes a lot of tuning to maintain query performance with a traditional database—diagnosing, testing, and tuning queries over and over again.

Sybase IQ's column-based architecture and innovative features deliver high performance to support large numbers of ad hoc and complex queries. Sybase IQ's data compression algorithms cost-effectively support the very largest databases by reducing storage needs up to 90%.

Sybase IQ 15.1 introduces new in-database analytics that deliver performance, scalability and security enhancements. With in-database analytics, data never leaves the database until results are filtered and processed. Further benefits are that the analytics code and models are shareable across organizations and allow ad-hoc analysis. Keeping the data in-database also ensures a higher level of data security.

In addition, Sybase IQ's multi-node architecture helps data aggregators to simultaneously support a large clientele of concurrent users while allowing continuous data feeds into their data warehouses.

Specific capabilities of Sybase IQ that are critical for business analytics include:

- Supports as many queries as possible running in parallel
- Column-based encryption as well as database-level encryption
- In-database analytics capability for greater speed and security
- Multiplex architecture enables readers to be allocated to separate subscribers

[5] Waters, Nov 2006, Networking, The Big One

In summary, the Sybase IQ analytics server delivers faster, more accurate analytics and reporting—to all users, from all information, on their terms. Sybase IQ's column-based core architecture and innovative features provide flexibility and scalability in multiple dimensions, enabling unsurpassed query performance for the most complex analytics tasks, for the rapidly expanding BI user base, on the largest datasets—all within an environment that is both affordable, eco-friendly and manageable at the implementation stage and throughout the information lifecycle. Sybase IQ is deployed by more than 1,500 customers with more than 3,000 projects worldwide.

BACKGROUND AND SIGNIFICANCE OF TPC-H

The TPC-H benchmark tests the performance of analytics servers used by decision support systems by measuring the performance of ad-hoc queries against a data set (called a scale factor) of a specific size while the underlying data is being modified. The objective is to simulate an on-line production database environment with an unpredictable query load that represents a business oriented decision support workload where a DBA must balance query performance and operational requirements such as locking levels and refresh functions. Results are expressed as QphH@Size for performance or $/QphH@Size where "Size" indicates the database size or scale factor used for the testing. TPC-H benchmarking database sizes are currently 1GB, 10GB, 30GB, 100GB, 300GB, 1,000GB, 3,000GB, 10,000GB, 30,000GB, and 100,000GB but the TPC discourages comparing results across different database sizes since database size is a major and obvious factor in performance.[6]

Although any benchmark, including the TPC-H, is unlikely to represent any particular customer's decision support workload or environment, TPC-H is an important test because of the high level of stress it puts on many parts of a decision support system, and is used by virtually all major platform vendors, and many decision support system suppliers to demonstrate the performance attributes of their systems.

SYBASE, HP AND RED HAT EXPERIENCE WITH TPC-H

This was the first joint TPC-H benchmark for these partners, although Sybase, HP and Red Hat all have significant benchmarking experience with TPC-H. Sybase has participated in TPC-H benchmarks with Sybase IQ since 2005 including 5 benchmarks for Sybase 15, and has published results for database sizes from 100GB to 3,000GB[7]. Sybase IQ holds records for performance and price performance including the top performance result for non-clustered systems at 100GB, one of the top two performance results for non-clustered systems at 3,000GB[8], the top two price performance results for non-clustered systems at 3,000 GB, the top three of four price performance results for non-clustered systems at 1,000 GB[9], and three of the top ten price performance results for non-clustered systems at 300GB and 100GB9.

HP has published the most TPC-H benchmarks of any hardware vendor across all categories and dominates almost every scale factor category, with performance leadership in six of the top ten non-clustered systems at 100GB, five of the top ten non-clustered systems at 300GB, seven of the top ten non-clustered systems at 1,000GB, five of the top nine non-clustered systems at 3,000GB, and the only currently published 30,000GB benchmark[10].

LESSONS FROM THE BENCHMARK

Successful TPC benchmarks require close cooperation between performance engineering teams. While some customers may view a particular benchmark as an artificial test, it involves many of the same characteristics as other mission-critical deployments. Servers, storage, operating systems, the analytics server and other system components are stressed to the maximum to provide the best possible, sustainable Sybase IQ performance.

At the beginning of the benchmark planning process, the teams selected a platform configuration and performance target based on their experience in order to demonstrate performance leadership for Linux on an x86 architecture. They decided to use the latest RHEL5 operating system although Sybase certification of 5.3 was still in process. No operating system issues emerged during the benchmark, demonstrating the stability of RHEL 5.3 and compatibility with previous releases. In fact, the benchmark team cited this as one of the shortest benchmark projects in their experience, even though this was their first TPC-H benchmark of Sybase IQ on Linux. The process of tuning the performance of Sybase IQ on Linux was very similar to other platforms, so experience with Sybase IQ is easily leveraged.

[6] TPC Benchmark™ H Standard Specification Revision 2.10.0

[7] Complete TPC-H Results List - Sorted by Database Vendor as of Apr 18, 2010. See http://tpc.org/tpch/results/tpch_results.asp?orderby=dbms for details.

[8] Top Ten Non-Clustered TPC-H by Performance as of Apr 18, 2010. See http://tpc.org/tpch/results/tpch_perf_results.asp?resulttype=noncluster for details.

[9] Top Ten Non-Clustered TPC-H by Price/Performance as of Apr 18, 2010. See http://tpc.org/tpch/results/tpch_price_perf_results.asp?resulttype=noncluster for details.

[10] Top Ten TPC-H by Performance as of Apr 18, 2010. See http://tpc.org/tpch/results/tpch_perf_results.asp for details.

PROLIANT SYSTEM BIOS SETTINGS

The HP and Sybase benchmark team used the following BIOS settings and identified "hp static high performance mode" as a very important performance setting:

ProLiant System BIOS A15

- Enable node Interleaving – disabled
- No-Execute Page-Protection – disabled
- Low Power Halt State (AMD C1 Clock Ramping) – enabled
- AMD Virtualization – disabled
- Processor Core Disable – All Processor Cores Enabled
- DRAM Prefetcher – Enabled
- Hardware Prefetch training on Software Prefetch – Enabled
- hardware Prefetch – Enabled
- power requirements override – disabled
- maximum Memory speed – AUTO
- power regulator for proliant – hp static high performance mode
- ultra low power state – enabled

Typically, there are some differences between platforms however, and in this case, modifying a BIOS setting for the ProLiant server had a very significant impact. Customers using Sybase IQ on ProLiant DL785s are recommended to take advantage of this setting.

The Sybase, HP and Red Hat teams learned important lessons about leveraging their experience with Sybase IQ performance and tuning, and how their respective components can work best together. This translates into greater expertise available to help customers to configure and get the most out of their HP and Red Hat systems running Sybase IQ.

SUMMARY OF THE RESULTS

In February 2010, Sybase, HP and Red Hat announced the submission of this industry-leading TPC-H benchmark for Sybase IQ 15.1. The new TPC-H benchmark of 102,375 queries per hour (QphH) was set using Sybase IQ 15.1 running on an HP ProLiant DL785 server under Red Hat Enterprise Linux 5.3[11]. The benchmark represents the best result among Linux and x86 vendors as of publication and is an important proof of the ability of Sybase IQ 15.1 to deliver maximum performance with cost-effective non-clustered hardware, reducing the cost of ownership for organizations that need high performance business analytics and reporting.

Leadership in 1,000 GB (1TB) non-clustered category

#1 x86 performance record

#1 Linux performance record

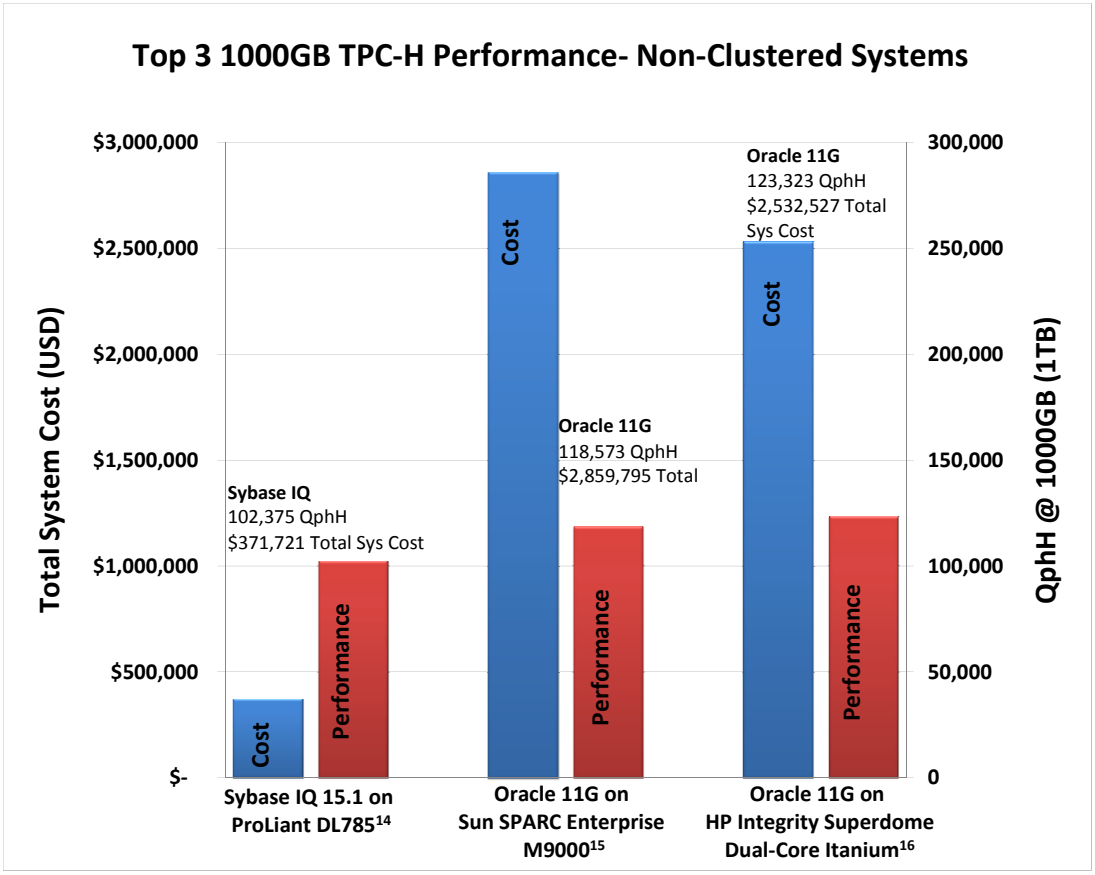
#1 Sybase IQ and HP ProLiant performance record

This marks the third consecutive record-setting Sybase IQ 15.1 TPC-H performance benchmark across the 100GB, 1TB and 3TB scale factors and the first benchmark of Sybase IQ on Linux. This Sybase, HP and Red Hat record is over 25% faster than the previous x86 record[12] (using the same number of cores), and approaches the highest non-clustered performance records for this class of test, while using fewer cores.

[11] HP Proliant DL785 G6; 102,375 QphH@1000GB; 3.63 USD per QphH@1000GB; Available Feb 1, 2010. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=110020101 for details.

[12] HP Proliant DL785 G6; 81,515 QphH@1000GB; 2.90 USD per QphH@1000GB; Available Nov 9, 2009. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=109110901 for details.

The performance of Sybase IQ on HP and Red Hat makes it the third fastest overall non-clustered 1TB TPC-H, at about 1/7th the estimated 3-year total cost of ownership of the top two non-clustered performance records while delivering more than 80% of the query performance at 20% of the cost[13].



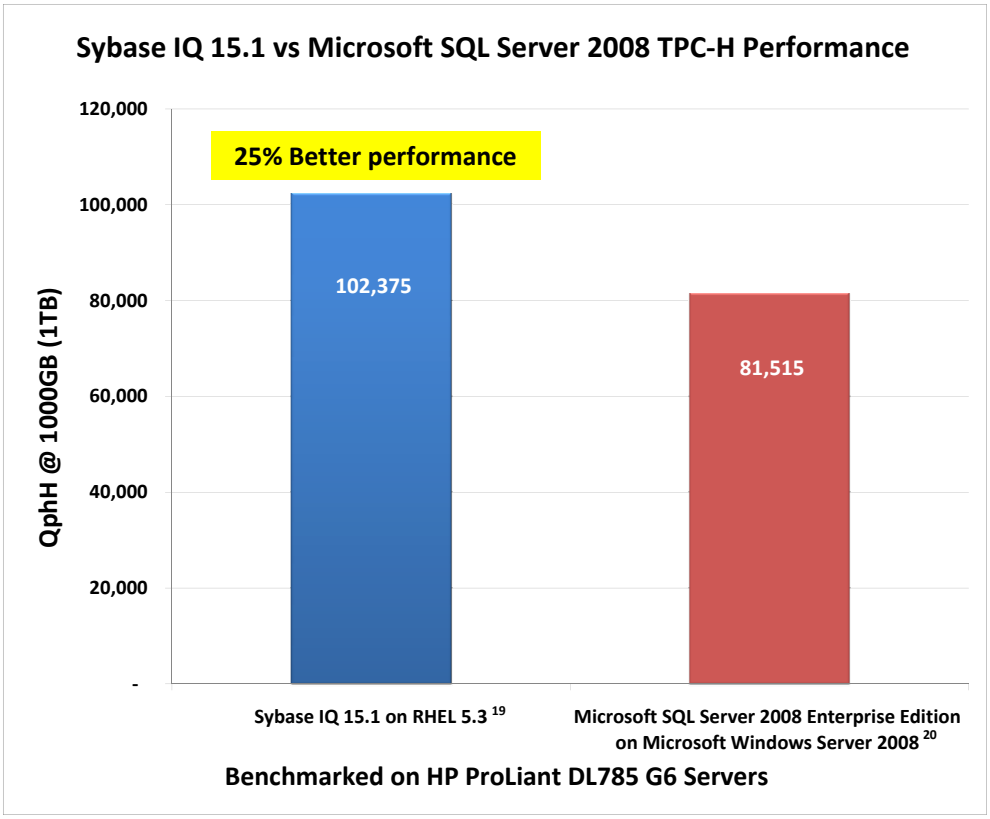
[13] HP Proliant DL785 G6; 102,375 QphH@1000GB; 3.63 USD per QphH@1000GB; Available Feb 1, 2010. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=110020101 for details.
Sun SPARC Enterprise M9000 server; 118,573 QphH@1000GB; 24.12 USD per QphH@1000GB; Available Sep 10, 2008. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=108050501 for details.
HP Integrity Superdome-Dual-Core Itanium; 123,323 QphH@1000GB; 20.54 USD per QphH@1000GB; Available Apr 29, 2009. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=109042901 for details

[14] HP Proliant DL785 G6; 102,375 QphH@1000GB; 3.63 USD per QphH@1000GB; Available Feb 1, 2010. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=110020101 for details

[15] Sun SPARC Enterprise M9000 server; 118,573 QphH@1000GB; 24.12 USD per QphH@1000GB; Available Sep 10, 2008. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=108050501 for details.

[16] HP Integrity Superdome-Dual-Core Itanium; 123,323 QphH@1000GB; 20.54 USD per QphH@1000GB; Available Apr 29, 2009. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=109042901 for details.

Total system costs for benchmark results in this category range from about $236,000 to $6.3M. Of the top ten performance results[17], this benchmark is one of only two with a total system cost less than $400,000. The Sybase IQ result compares favorably to Microsoft[18], with 25% faster performance, also using a ProLiant platform and demonstrates excellent scalability across multiple sockets and cores for this 6 core per socket (48 cores total) architecture. This highlights the ability of Sybase IQ to deliver outstanding results while efficiently using standard platforms.



The HP ProLiant DL785 G6 used in this benchmark of Sybase IQ was configured with 8 Six-Core AMD Opteron™ 8439 2.8-GHz processors (8 processors/48 cores /48 threads), and 384 GB PC2-5300 (48 x 8 GB) main memory. The storage system consisted of eight PCIe Fibre Channel 8 GB dual-port adapters and four HP Modular Storage Array (MSA) 2324 enclosures populated with 96 x 72 GB 15K 2.5" dual-port SAS disks for the database, and 8 internal disks connected to an internal HP Smart Array P400 controller.

CONCLUSION

As the first TPC-H benchmark of Sybase IQ on Linux and the first joint benchmark effort between Sybase, HP and Red Hat, this leading benchmark result is an important proof point for customers interested in Linux as a mission-critical platform for business analytics. It confirms the performance of Sybase IQ on cost-effective HP ProLiant servers, and the robustness of RHEL for these applications. It also demonstrates the scalability of Sybase IQ for multi-socket processor architectures.

The ability of the benchmark team to quickly achieve this performance benchmark also demonstrates that customers familiar with Sybase IQ on other platforms will find it straightforward to work with Sybase IQ on RHEL and meet high service level requirements.

Sybase, Red Hat and HP have proven capabilities for mission-critical environments and offer compelling benefits for reducing total cost of ownership, meeting mission-critical platform requirements such as performance, scalability, and reliability, with enterprise-quality support options. Sybase IQ for Red Hat Enterprise Linux on HP ProLiant systems offers a powerful and low total cost of ownership option for business analytics.

[17] Top Ten TPC-H by Performance as of April 18, 2010. See http://tpc.org/tpch/results/tpch_perf_results.asp for details.

[18] HP Proliant DL785 G6; 102,375 QphH@1000GB; 3.63 USD per QphH@1000GB; Available Feb 1, 2010. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=110020101 for details

HP Proliant DL785 G6; 81,515 QphH@1000GB; 2.90 USD per QphH@1000GB; Available Nov 9, 2009. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=109110901 for details.

[19] HP Proliant DL785 G6; 102,375 QphH@1000GB; 3.63 USD per QphH@1000GB; Available Feb 1, 2010. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=110020101 for details

[20] HP Proliant DL785 G6; 81,515 QphH@1000GB; 2.90 USD per QphH@1000GB; Available Nov 9, 2009. See http://tpc.org/tpch/results/tpch_result_detail.asp?id=109110901 for details.

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