Sun microsystems

THE NETWORK IS THE COMPUTER™

TPC Benchmark™ H
Full Disclosure Report

Sun Microsystems Sun Fire™ X4500 Server
Using Sybase IQ 12.6 Single Application Server

Submitted for Review
Report Date: Oct 15, 2007

TPC Benchmark H Full Disclosure Report

First Printing

© 2006 Sun Microsystems, Inc.

901 San Antonio Road, Palo Alto, California 94303 U.S.A.

All rights reserved. This product and related documentation are protected by copyright and distributed under licenses restricting its use, copying, distribution, and decompilation. No part of this product or related documentation may be reproduced in any form by any means without prior written authorization of Sun and its licensors, if any.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the United States Government is subject to the restrictions set forth in DFARS 252.227-7013 (c)(1)(ii) and FAR 52.227-19, Rights in Technical Data and Computer Software (October 1988).

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

TRADEMARKS

Sun, Sun Microsystems, the Sun logo, Sun Fire V440 Server, SMCC, the SMCC logo, SunSoft, the SunSoft logo, Solaris, SunOS, OpenWindows, DeskSet, ONC, and NFS are trademarks or registered trademarks of Sun Microsystems, Inc. All other product names mentioned herein are the trademarks of their respective owners.

All SPARC trademarks, including the SCD Compliant Logo, are trademarks or registered trademarks of SPARC International, Inc. SPARCstation, SPARCserver, SPARCengine, SPARCworks, and SPARCompiler are licensed exclusively to Sun Microsystems, Inc. Products bearing SPARC trademarks are based upon an architecture developed by Sun Microsystems, Inc.

The OPEN LOOK™ and Sun™ Graphical User Interfaces were developed by Sun Microsystems, Inc. for its users and licensees. Sun acknowledges the pioneering efforts of Xerox in researching and developing the concept of visual or graphical user interfaces for the computer industry. Sun holds a non-exclusive license from Xerox to the Xerox Graphical User Interface, which license also covers Sun's licensees who implement OPEN LOOK GUIs and otherwise comply with Sun's written license agreements.

TPC-H Benchmark™ is a trademark of the Transaction Processing Performance Council.

Sybase IQ are registered trademarks of Sybase Inc.

THIS PUBLICATION IS PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT.

THIS PUBLICATION COULD INCLUDE TECHNICAL INACCURACIES OR TYPOGRAPHICAL ERRORS. CHANGES ARE PERIODICALLY ADDED TO THE INFORMATION HEREIN; THESE CHANGES WILL BE INCORPORATED IN NEW EDITIONS OF THE PUBLICATION. SUN MICROSYSTEMS, INC. MAY MAKE IMPROVEMENTS AND/OR CHANGES IN THE PRODUCT(S) AND/OR THE PROGRAM(S) DESCRIBED IN THIS PUBLICATION AT ANY TIME.

Sun Microsystems, Inc., believes that the information in this document is accurate as of its publication date. The information in this document is subject to change without notice. Sun Microsystems, Inc., assumes no responsibility for any errors that may appear in this document.

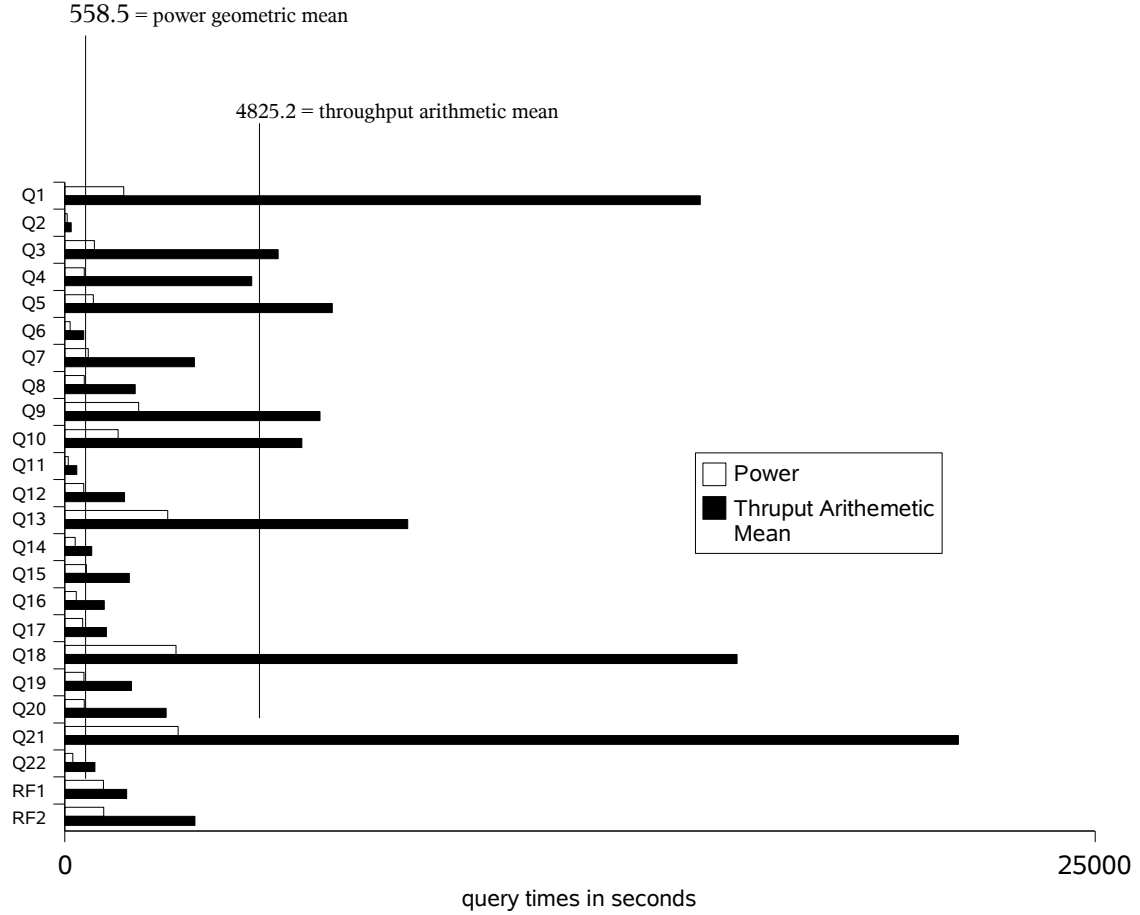
The pricing information in this document is believed to accurately reflect prices in effect on Report Date: Oct 15, 2007. However, Sun Microsystems and Sybase Corporation provide no warranty on the pricing information in this document.

The performance information in this document is for guidance only. System performance is highly dependent on many factors including system hardware, system and user software, and user application characteristics. Customer applications must be carefully evaluated before estimating performance. Sun Microsystems, Inc., does not warrant or represent that a user can or will achieve a similar performance. No warranty on system performance or price/performance is expressed or implied in this document.

Sun microsystems / SYBASE	Sun Fire™ X4500 Server with Sybase IQ 12.6 Single Application Server	TPC-H Rev. 2.6.1 Report Date: Oct 15, 2007

Total System Cost	Composite Query per Hour Metric	Price/Performance
$45,439.50	**5604.9** QphH@1000GB	**$8.11** per QphH@1000GB

Database Size	Database Manager	Operating System	Other Software	Availability Date
1000GB	**Sybase IQ 12.6 Single Application Server**	**Solaris 10**	**Solaris Volume Manager**	**Oct 15, 2007**



Database Load Time = 10:05:33 Load Includes Backup: N Total Storage/Database Size=11.18

RAID (Base tables): RAID 1 RAID (Base tables and auxiliary data structures): RAID 1 RAID (All): N

System Configuration

```
Processors/Cores/Threads      :     2/4/4 2.8GHz Dual Core AMD 290
                Memory        :     16GB memory
          Internal Disks      :     48 x 250GB 10k rpm SATA disks
```

Total Disk Storage : 11175 GB
(in this calculation 1 GB is defined as 1024 * 1024 * 1024)

Sun Fire™ X4500 Server with Sybase IQ 12.6 Single Application Server

TPC-H Rev. 2.6.1

Report Date: Oct 15, 2007

Description	Part Number	Source	Unit Price	Qty	Ext. Price	3 Yr. maint.
Server Hardware						
Sun Fire X4500 x64, 2xAMD Opteron Dual core 290 (2.8GHz/1MB) processor, 16GB PC3200 DDR1/400 (8x2GB) memory, 48 SATA 3.5 250GB 7200 RPM HDD	A76-PPZ2-16G-GMH	1	23,995.00	1	23,995.00	
Sun Fire X4500 Server upgrade to 3 year Gold support	W9D-A76-3G	1	7,236.00	1		7,236.00
Server discount		1		1	-2,399.50	.00
Server HardwareSubtotal					21,595.50	7,236.00
External Storage						
No external storage required						
Server Software						
Sybase IQ-M Single App Svr, per cpu core	12841	2	2,595.00	4	10,380.00	
Sybase IQ 3 Years Extended Support 24 x 7	98480	2	1,557.00	4		6,228.00
Server Software Subtotal					10,380.00	6,228.00
			Total		31,975.50	13,464.00
			3 Yr. Cost		45,439.50	
			QphH@ 100GB		5,604.90	
			$/QphH@ 100GB		$8.11	

Service for all Sun products is from Sun Microsystems, Inc.

Service for Sybase products is from Sybase Inc.

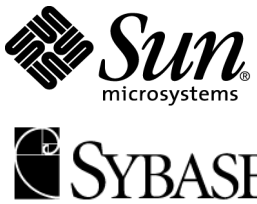
Notes (Source):

1. Innovative Systems Design
2. Sybase Inc.

PriceQuotes provided in Appendix G

Audited by: Brad Askins, InfoSizing, Inc. (www.sizing.com)

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the standard components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchase are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections of the TPC benchmark specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.



Sun Fire™ X4500 Server with Sybase IQ 12.6 Single Application Server

TPC-H Rev. 2.6.1

Report Date: Oct 15, 2007

Numerical Quantities

Measurement Results:

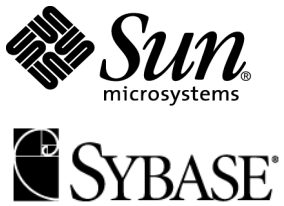
Database Scale Factor	= 1000GB
Total Data Storage / Database Size	= 11.18
Start of database load time	= 2007-08-29 18:35:40
End of database load time	= 2007-08-30 04:41:13
Database Load Time	= 10:05:33
Query Streams for Throughput Test	= 7
TPC-H Power	= 6446.1
TPC-H Throughput	= 4873.5
TPC-H Composite Query-per-Hour Rating (QphH@1000GB)	= 5604.9
Total System Price Over 3 Years	= $45,439.50
TPC-H Price/Performance Metric ($/QphH@1000GB)	= $8.11

Measurement Intervals:

Measurement Interval in Throughput Test (Ts)	= 113,757 seconds

Duration of Stream Execution:

Stream ID	Seed	Start Date	Start Time	End Date	End Time	Duration
Stream 0	830044113	2007-08-30	04:42:31	2007-08-30	10:27:16	5hrs:44mins:45secs
Stream 1	830044114	2007-08-30	10:27:18	2007-08-31	14:33:25	1day:4hrs:6mins:7secs
Stream 2	830044115	2007-08-30	10:27:18	2007-08-31	14:55:32	1day:4hrs:28mins:14secs
Stream 3	830044116	2007-08-30	10:27:18	2007-08-31	18:03:15	1day:7hrs:35mins:57secs
Stream 4	830044117	2007-08-30	10:27:18	2007-08-31	15:58:18	1day:5hrs:31mins
Stream 5	830044118	2007-08-30	10:27:18	2007-08-31	16:43:16	1day:6hrs:15mins:58secs
Stream 6	830044119	2007-08-30	10:27:18	2007-08-31	15:33:19	1day:5hrs:6mins:1min
Stream 7	830044120	2007-08-30	10:27:18	2007-08-31	15:48:52	1day:5hrs:21mins:34secs



Sun Fire™ X4500 Server with Sybase IQ 12.6 Single Application Server

TPC-H Rev. 2.6.1

Report Date: Oct 15, 2007

TPC-H Timing Intervals (in seconds)

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
Stream 00	1429.4	64.1	717.5	477.6	696	128.7	573.8	476.3	1795.3	1296	86.9	460.4
Stream 01	13746.8	105.7	10219.5	5266.4	2187.7	349.8	1473.7	1064.8	5843.1	3005.7	298.2	1442.1
Stream 02	14622.5	245.2	2375.8	3678.2	3825.4	598.6	2241.8	1954.8	7390.4	10417.7	276.5	1730.3
Stream 03	17590	175.6	742.7	5733.9	26126.6	562.8	5921.6	3309.2	5790.9	4025.4	258.5	525
Stream 04	17209.4	131.4	1988.3	4722.1	6172.2	489.4	1452.3	1221.3	8349.7	4794.9	358.6	2809.9
Stream 05	19721.7	144.1	6367.2	3785.8	2137.3	594.7	3448.2	1197.3	2201.6	2836.4	294.5	1323.5
Stream 06	12899.2	166.8	12732.8	3826.9	2690	446.9	3032.5	1945.1	7628.8	11412	326.3	1476.5
Stream 07	12158.1	118.4	1835.8	4770.6	2283.1	205.9	4440.1	1291	6169.5	3816.9	260.9	872.8
Minimum	12158.1	105.7	742.7	3678.2	2137.3	205.9	1452.3	1064.8	2201.6	2836.4	258.5	525.0
Average	15421.1	155.3	5180.3	4540.6	6488.9	464.0	3144.3	1711.9	6196.3	5758.4	296.2	1454.3
Maximum	19721.7	245.2	12732.8	5733.9	26126.6	598.6	5921.6	3309.2	8349.7	11412.0	358.6	2809.9

	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	RF1	Rf2
Stream 00	2501.2	253.4	525.6	282.6	438.8	2699.8	469.2	472.8	2754.9	194.8	940	948.9
Stream 01	7060	507.3	1652.6	632.1	942.7	12614.5	1735.8	1191.3	29028.8	796.5	1986.1	13598
Stream 02	11574.7	968	1493.8	1829.8	1885.3	16516.5	2317.8	2362.7	13508.6	677.9	1435.5	1343.2
Stream 03	2551.8	661.2	1797.2	278.9	881.8	15101.9	602.7	2236.8	18058.7	823.2	1428.1	1389.9
Stream 04	10830.5	653.6	1488.6	864.7	816	12283.8	1746.8	780.6	26654.6	440.3	1320.2	1391.4
Stream 05	7332.8	812.4	1829.1	1780.9	1005.8	16634.3	1840	775.7	31993.5	899.9	1387.2	1502.8
Stream 06	11231.6	536.4	1717.4	836.2	591.9	13904.2	1632.4	973.7	14107.9	643.5	1522.8	1405.6
Stream 07	7699	449.4	988.7	511.7	949.7	27165.6	1482.2	8903.1	18459.8	860.7	1425.9	1476.3
Minimum	2551.8	449.4	988.7	278.9	591.9	12283.8	602.7	775.7	13508.6	440.3	1320.2	1343.2
Average	8325.8	655.5	1566.8	962.0	1010.5	16317.3	1622.5	2460.6	21687.4	734.6	1500.8	3158.2
Maximum	11574.7	968.0	1829.1	1829.8	1885.3	27165.6	2317.8	8903.1	31993.5	899.9	1986.1	13598.0

Table of Contents

1. General Items 12
   1.1 Benchmark Sponsor 12
   1.2 Parameter Settings 12
   1.3 Configuration Diagram 13
2. Clause 1 Logical Database Design 14
   2.1 Database Definition Statements 14
   2.2 Physical Organization 14
   2.3 Horizontal Partitioning 14
   2.4 Replication 14
3. Clause 2 Queries and Refresh Functions 15
   3.1 Query Language 15
   3.2 Verifying Method for Random Number Generation 15
   3.3 Generating Values for Substitution Parameters 15
   3.4 Query Text and Output Data from Qualification Database 15
   3.5 Query Substitution Parameters and Seeds Used 15
   3.6 Query Isolation Level 16
   3.7 Source Code of Refresh Functions 16
4. Clause 3 Database System Properties 17
   4.1 ACID Properties 17
   4.2 Atomicity 17
      4.2.1 Completed Transaction 17
      4.2.2 Aborted Transaction 17
   4.3 Consistency 17
      4.3.1 Consistency Test 18
   4.4 Isolation 18
      4.4.1 Read-Write Conflict with Commit 18
      4.4.2 Read-Write Conflict with Rollback 18
      4.4.3 Write-Write Conflict with Commit 18
      4.4.4 Write-Write Conflict with Rollback 19
      4.4.5 Concurrent Progress of Read and Write Transactions 19
      4.4.6 Read-Only Query Conflict with Update Transaction 19
   4.5 Durability 19
      4.5.1 Failure of a Durable Medium 20
      4.5.2 System Crash 20
      4.5.3 Memory Failure 20
5. Clause 4 Scaling and Database Population 21
   5.1 Ending Cardinality of Tables 21
   5.2 Distribution of Tables and Logs Across Media 21
   5.3 Database partition/replication mapping 22
   5.4 RAID Feature 23
   5.5 Modifications to the DBGEN 23
   5.6 Database Load Time 23
   5.7 Data Storage Ratio 23
   5.8 Database Load Mechanism Details and Illustration 24
   5.9 Qualification Database Configuration 24

6. Clause 5 Performance Metrics and Execution Rules..... 25
6.1 System Activity Between Load and Performance Tests..... 25
6.2 Steps in the Power Test..... 25
6.3 Timing Intervals for Each Query and Refresh Functions..... 25
6.4 Number of Streams for the Throughput Test..... 25
6.5 Start and End Date/Times for Each Query Stream..... 25
6.6 Total Elapsed Time of the Measurement Interval..... 25
6.7 Refresh Function Start Date/Time and Finish Date/Time..... 26
6.8 Timing Intervals for Each Query and Each Refresh Function for Each Stream..... 26
6.9 Performance Metrics..... 26
6.10 The Performance Metric and Numerical Quantities from Both Runs..... 26
6.11 System Activity Between Performance Tests..... 27
7. Clause 6 SUT and Driver Implementation..... 28
7.1 Driver..... 28
7.2 Implementation-Specific Layer..... 28
7.3 Profile-Directed Optimization..... 28
8. Clause 7 Pricing..... 29
8.1 Hardware and Software Used..... 29
8.2 Total Three Year Price..... 29
8.3 Availability Date..... 29
9. Auditor's Information and Attestation Letter..... 30
Appendix A. Solaris 10 and Sybase IQ 12.6 Parameters..... 31
Appendix B. Programs and Scripts..... 32
Appendix C. Query Text and Query Output..... 48
Appendix E. Implementation-Specific Layer/Driver Code..... 57
Appendix F. Misc database scripts..... 59
Appendix G. Pricing information..... 61

INFOSIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

Benchmark Sponsors:

Brad Carlile
Director, Enterprise Benchmarking
Sun Microsystems, Inc.
8305 S. W. Creekside Place
Beaverton, OR 97008

Sumit Kundu
Director of Product Management
and Marketing
Sybase, Inc.
1 Sybase Drive
Dublin, CA 94568

October 13, 2007

I verified the TPC Benchmark™ H performance of the following configuration:

Platform: **Sun Fire X4500 Server**

Database Manager: **Sybase IQ 12.6 Single Application Server**

Operating System: **Solaris 10**

The results were:

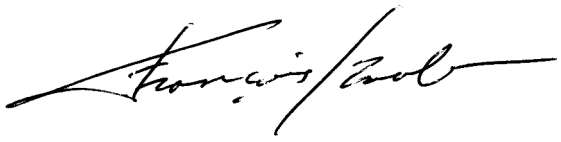
CPU (Speed)	Memory	Disks	QphH@1000GB
One (1) Sun Fire X4500			
2 x AMD 290 (2.8 Ghz)	16 GB Main	48 x 250 GB (int.)	**5604.9**

In my opinion, this performance result was produced in compliance with the TPC's requirements for the benchmark. The following verification items were given special attention:

- The database records were defined with the proper layout and size
- The database population was generated using DBGEN
- The database was properly scaled to 1000GB and populated accordingly
- The compliance of the database auxiliary data structures was verified
- The database load time was correctly measured and reported
- The required ACID properties were verified and met

- The query input variables were generated by QGEN
- The query text was produced using minor modifications
- The execution of the queries against the SF1 database produced compliant answers
- A compliant implementation specific layer was used to drive the tests
- The throughput tests involved 7 query streams
- The ratio between the longest and the shortest query was such that no query timing was adjusted
- The execution times for queries and refresh functions were correctly measured and reported
- The repeatability of the measured results was verified
- The required amount of database log was configured
- The system pricing was verified for major components and maintenance
- The major pages from the FDR were verified for accuracy

Respectfully Yours,



François Raab, President

Bradley J. Askins, Auditor

1373 North Franklin Street • Colorado Springs, CO 80903-2527 • Office: 719/473-7555 • Fax: 719/473-7554

INFOSIZING

TPC TRANSACTION PROCESSING PERFORMANCE COUNCIL CERTIFIED AUDITOR

TPC Benchmark H Overview

The TPC BenchmarkTM H (TPC-H) is a Decision Support benchmark. It is a suite of business-oriented ad-hoc queries and concurrent modifications. The queries and the data populating the database have been chosen to have broad industry-wide relevance while maintaining a sufficient degree of ease of implementation. This benchmark illustrates Decision Support systems that:

- Examine large volumes of data
- Execute queries with a high degree of complexity
- Give answers to critical business questions

TPC-H evaluates the performance of various Decision Support systems by the execution of sets of queries against a standard database under controlled conditions. The TPC-H queries:

- Give answers to real-world business questions
- Simulate generated ad-hoc queries
- Are far more complex than most OLTP transactions
- Include a rich breadth of operators and selectivity constraints
- Generate intensive activity on the part of the database server component of the system under test
- Are executed against a database complying to specific population and scaling requirements
- Are implemented with constraints derived from staying closely synchronized with an on-line production database

1373 North Franklin Street • Colorado Springs, CO 80903-2527 • Office: 719/473-7555 • Fax: 719/473-7554

1. General Items

1.1 Benchmark Sponsor

A statement identifying the benchmark sponsor(s) and other participating companies must be provided.

Sun Microsystems, Inc. and Sybase Inc. are the sponsors of this TPC-H benchmark.

1.2 Parameter Settings

Settings must be provided for all customer-tunable parameters and options that have been changed from the defaults found in actual products, including but not limited to:

- *Database Tuning Options*
- *Optimizer/Query execution options*
- *Query processing tool/language configuration parameters*
- *Recovery/commit options*
- *Consistency/locking options*
- *Operating system and configuration parameters*
- *Configuration parameters and options for any other software component incorporated into the pricing structure*
- *Compiler optimization options*

Appendix A contains the Solaris and Sybase IQ parameters used in this benchmark.

1.3 Configuration Diagram

Provide diagrams of both the measured and priced configurations, accompanied by a description of the differences.

The priced and measured configurations were identical.

Priced Configuration

SUN Fire X4500 Server

2 x 2.8 GHz AMD Opteron dual-core processors

16 GB Memory

48 x 250 GB internal SATA disks

2. Clause 1 Logical Database Design

2.1 Database Definition Statements

Listings must be provided for all table definition statements and all other statements used to set up the test and qualification databases.

Appendix B contains the programs and scripts that create and analyze the tables and indexes for the TPC-H database.

2.2 Physical Organization

The physical organization of tables and indices within the test and qualification databases must be disclosed. If the column ordering of any table is different from that specified in Clause 1.4, it must be noted.

No record clustering or index clustering was used. Column ordering was changed for some tables. Refer to the table create statements in Appendix B for further details.

2.3 Horizontal Partitioning

Horizontal partitioning of tables and rows in the test and qualification databases (see Clause 1.5.4) must be disclosed.

Horizontal partitioning was not used for any of the tables.

2.4 Replication

Any replication of physical objects must be disclosed and must conform to the requirements of Clause 1.5.6.

No replication was used.

3. Clause 2 Queries and Refresh Functions

3.1 Query Language

The query language used to implement the queries must be identified.

SQL was the query language used to implement all queries.

3.2 Verifying Method for Random Number Generation

The method of verification for the random number generation must be described unless the supplied DBGEN and QGEN were used.

TPC supplied versions 2.6.0 of DBGEN and QGEN were used for this TPC-H benchmark.

3.3 Generating Values for Substitution Parameters

The method used to generate values for substitution parameters must be disclosed. If QGEN is not used for this purpose, then the source code of any non-commercial tool used must be disclosed. If QGEN is used, the version number, release number, modification number, and patch level of QGEN must be disclosed.

The supplied QGEN version 2.6.0 was used to generate the substitution parameters.

3.4 Query Text and Output Data from Qualification Database

The executable query text used for query validation must be disclosed along with the corresponding output data generated during the execution of the query text against the qualification database. If minor modifications (see Clause 2.2.3) have been applied to any functional query definitions or approved variants in order to obtain executable query text, these modifications must be disclosed and justified. The justification for a particular minor query modification can apply collectively to all queries for which it has been used. The output data for the power and throughput tests must be made available electronically upon request.

Appendix C contains the query text and query output. The standard queries were used throughout with the following modifications:

- In Q1, Q4, Q5, Q6, Q10, Q12, Q14, Q15 and Q20, the "dateadd" function is used to perform date arithmetic.
- In Q7, Q8 and Q9, the "datepart" function is used to extract part of a date (e.g., "year").
- In Q2, Q3, Q10, Q18 and Q21, the "top" function is used to restrict the number of output rows.
- The semicolon (;) is used as a command delimiter.

3.5 Query Substitution Parameters and Seeds Used

The query substitution parameters used for all performance tests must be disclosed in tabular format, along with the seeds used to generate these parameters.

Appendix D contains the seed and query substitution parameters.

3.6 Query Isolation Level

The isolation level used to run the queries must be disclosed. If the isolation level does not map closely to the levels defined in Clause 3.4, additional descriptive detail must be provided.

The queries and transactions were run with isolation level 3 (repeatable read).

3.7 Source Code of Refresh Functions

The details of how the refresh functions were implemented must be disclosed (including source code of any non-commercial program used).

Appendix B contains the source code for the refresh functions.

4. Clause 3 Database System Properties

4.1 ACID Properties

The ACID (Atomicity, Consistency, Isolation and Durability) properties of transaction processing systems must be supported by the system under test during the timed portion of this benchmark. Since TPC-H is not a transaction processing benchmark, the ACID properties must be evaluated outside the timed portion of the test.

Source code for the ACID test is included in Appendix B.

4.2 Atomicity

The system under test must guarantee that transactions are atomic; the system will either perform all individual operations on the data, or will assure that no partially-completed operations leave any effects on the data.

4.2.1 Completed Transaction

Perform the ACID Transaction for a randomly selected set of input data and verify that the appropriate rows have been changed in the ORDERS, LINEITEM, and HISTORY tables

1. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. The ACID Transaction was performed using the order key from step 1.
3. The ACID Transaction committed.
4. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for the same order key. It was verified that the appropriate rows had been changed.

4.2.2 Aborted Transaction

Perform the ACID Transaction for a randomly selected set of input data, substituting a ROLLBACK of the transaction for the COMMIT of the transaction. Verify that the appropriate rows have not been changed in the ORDERS, LINEITEM, and HISTORY tables.

1. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for a randomly selected order key.
2. The ACID Transaction was performed using the order key from step 1. The transaction was stopped prior to the commit.
3. The ACID Transaction was ROLLED BACK.
4. The total price from the ORDERS table and the extended price from the LINEITEM table were retrieved for the same order key. It was verified that the appropriate rows had not been changed.

4.3 Consistency

Consistency is the property of the application that requires any execution of transactions to take the database from one consistent state to another.

4.3.1 Consistency Test

Verify that ORDERS and LINEITEM tables are initially consistent, submit the prescribed number of ACID Transactions with randomly selected input parameters, and re-verify the consistency of the ORDERS and LINEITEM.

1. The consistency of the ORDERS and LINEITEM tables was verified based on a sample of order keys.
2. 100 ACID Transactions were submitted by each of six execution streams.
3. The consistency of the ORDERS and LINEITEM tables was re-verified.

4.4 Isolation

Operations of concurrent transactions must yield results which are indistinguishable from the results which would be obtained by forcing each transaction to be serially executed to completion in the proper order.

4.4.1 Read-Write Conflict with Commit

Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is committed.

1. An ACID Transaction was started for a randomly selected O_KEY, L_KEY, and DELTA. The ACID Transaction was suspended prior to COMMIT.
2. An ACID Query was started for the same O_KEY used in step 1.
3. The ACID Transaction was resumed and COMMITTED.
4. The ACID Query completed. It returned the data as committed by the ACID Transaction.

4.4.2 Read-Write Conflict with Rollback

Demonstrate isolation for the read-write conflict of a read-write transaction and a read-only transaction when the read-write transaction is rolled back.

1. An ACID Transaction was started for a randomly selected O_KEY, L_KEY, and DELTA. The ACID Transaction was suspended prior to ROLLBACK.
2. An ACID Query was started for the same O_KEY used in step 1. The ACID Query did not see the uncommitted changes made by the ACID Transaction.
3. The ACID Transaction was ROLLED BACK.
4. The ACID Query completed.

4.4.3 Write-Write Conflict with Commit

Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is committed.

1. An ACID Transaction, T1, was started for a randomly selected O_KEY, L_KEY, and DELTA. T1 was suspended prior to COMMIT.
2. Another ACID Transaction, T2, was started using the same O_KEY and L_KEY and a randomly selected DELTA.
3. T2 waited.
4. T1 was allowed to COMMIT and T2 completed.

5. It was verified that T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE + (DELTA1*(T1.L_EXTENDEDPRICE/T1.L_QUANTITY))

4.4.4 Write-Write Conflict with Rollback

Demonstrate isolation for the write-write conflict of two update transactions when the first transaction is rolled back.

1. An ACID Transaction, T1, was started for a randomly selected O_KEY, L_KEY, and DELTA. T1 was suspended prior to ROLLBACK.
2. Another ACID Transaction, T2, was started using the same O_KEY and L_KEY and a randomly selected DELTA.
3. T2 waited.
4. T1 was allowed to ROLLBACK and T2 completed.
5. It was verified that T2.L_EXTENDEDPRICE = T1.L_EXTENDEDPRICE.

4.4.5 Concurrent Progress of Read and Write Transactions

Demonstrate the ability of read and write transactions affecting different database tables to make progress concurrently.

1. An ACID Transaction, T1, was started for a randomly selected O_KEY, L_KEY, and DELTA. T1 was suspended prior to ROLLBACK.
2. Another Transaction, T2, was started which did the following:

   For random values of PS_PARTKEY and PS_SUPPKEY, all columns of the PARTSUPP table for which PS_PARTKEY and PS_SUPPKEY are equal, are returned.
3. T2 completed.
4. T1 was allowed to COMMIT.
5. It was verified that appropriate rows in ORDERS, LINEITEM and HISTORY tables were changed.

4.4.6 Read-Only Query Conflict with Update Transaction

Demonstrate that the continuous submission of arbitrary (read-only) queries against one or more tables of the database does not indefinitely delay update transactions affecting those tables from making progress.

1. A Transaction, T1, executing Q1 against the qualification database, was started using a randomly selected DELTA.
2. An ACID Transaction T2, was started for a randomly selected O_KEY, L_KEY and DELTA.
3. T2 completed and appropriate rows in the ORDERS, LINEITEM and HISTORY tables had been changed.
4. Transaction T1 completed executing Q1.

4.5 Durability

The SUT must guarantee durability: the ability to preserve the effects of committed transactions and insure database consistency after recovery from any one of the failures listed in Clause 3.5.3.

4.5.1 Failure of a Durable Medium

Guarantee the database and committed updates are preserved across a permanent irrecoverable failure of any single durable medium containing TPC-H database tables or recovery log tables.

All disks containing TPC-H tables, TPC-H indexes, the Sybase IQ utility db file and the Sybase IQ log file are housed on RAID1 volumes. A permanent irrecoverable failure of one of these disks was simulated by removing it from the X4500 Server. Shortly after this was done, the SybaseIQ server died because a TEMP db segment housed on the removed disk was no longer accessible to IQ. After an interval of about 60 seconds, power to the X4500 Server was cut off. The outcome is described in section 4.5.2.

4.5.2 System Crash

Guarantee the database and committed updates are preserved across an instantaneous interruption (system crash/system hang) in processing which requires the system to reboot to recover.

A system crash was produced by cutting off power to the X4500 Server. When power was restored, the system automatically rebooted and the database was restarted. The durability success file and the HISTORY table were compared successfully.

4.5.3 Memory Failure

Guarantee the database and committed updates are preserved across failure of all or part of memory (loss of contents).

A memory failure was simulated by cutting off power to the X4500 Server. The outcome is described in section 4.5.2.

5. Clause 4 Scaling and Database Population

5.1 Ending Cardinality of Tables

The cardinality (i.e., the number of rows) of each table of the test database, as it existed at the completion of the database load (see clause 4.2.5) must be disclosed.

Table	***Rows***
Lineitem	*5,999,989,709*
orders	*1,500,000,000*
Partsupp	*800,000,000*
Part	*200,000,000*
Customer	*150,000,000*
Supplier	*10,000,000*
Nation	*25*
Region	*5*

5.2 Distribution of Tables and Logs Across Media

The distribution of tables and logs across all media must be explicitly described.

- All tables and indexes were stored on 23 RAID 1 volumes. Each volume was constructed from two raw partitions using the Solaris Volume Manager.
- The Temp database for Sybase IQ was configured using one raw partition per disk on 46 internal disks. The Temp databases were not mirrored.

The following table shows all the disk slices used for all the non-RAID1 devices.

Partition	**Use**	**Size (in GB)**
c5t0d0s0	root partition	5.86
c5t0d0s6	swap	18.35
c0t0d0s0	tempdb [via symbolic link /sybase2/T01]	10
c0t1d0s0	tempdb [via symbolic link /sybase2/T02]	10
c0t2d0s0	tempdb [via symbolic link /sybase2/T03]	10
c0t3d0s0	tempdb [via symbolic link /sybase2/T04]	10
c0t4d0s0	tempdb [via symbolic link /sybase2/T05]	10
c0t5d0s0	tempdb [via symbolic link /sybase2/T06]	10
c0t6d0s0	tempdb [via symbolic link /sybase2/T07]	10
c0t7d0s0	tempdb [via symbolic link /sybase2/T08]	10
c1t0d0s0	tempdb [via symbolic link /sybase2/T09]	10
c1t1d0s0	tempdb [via symbolic link /sybase2/T10]	10
c1t2d0s0	tempdb [via symbolic link /sybase2/T11]	10
c1t3d0s0	tempdb [via symbolic link /sybase2/T12]	10
c1t4d0s0	tempdb [via symbolic link /sybase2/T13]	10
c1t5d0s0	tempdb [via symbolic link /sybase2/T14]	10
c1t6d0s0	tempdb [via symbolic link /sybase2/T15]	10

Partition	Use	Size (in GB)
c1t7d0s0	tempdb [via symbolic link /sybase2/T16]	10
c4t1d0s0	tempdb [via symbolic link /sybase2/T17]	10
c4t2d0s0	tempdb [via symbolic link /sybase2/T18]	10
c4t3d0s0	tempdb [via symbolic link /sybase2/T19]	10
c4t4d0s0	tempdb [via symbolic link /sybase2/T20]	10
c4t5d0s0	tempdb [via symbolic link /sybase2/T21]	10
c4t6d0s0	tempdb [via symbolic link /sybase2/T22]	10
c4t7d0s0	tempdb [via symbolic link /sybase2/T23]	10
c5t1d0s0	tempdb [via symbolic link /sybase2/T24]	10
c5t2d0s0	tempdb [via symbolic link /sybase2/T25]	10
c5t3d0s0	tempdb [via symbolic link /sybase2/T26]	10
c5t4d0s0	tempdb [via symbolic link /sybase2/T27]	10
c5t5d0s0	tempdb [via symbolic link /sybase2/T28]	10
c5t6d0s0	tempdb [via symbolic link /sybase2/T29]	10
c5t7d0s0	tempdb [via symbolic link /sybase2/T30]	10
c6t0d0s0	tempdb [via symbolic link /sybase2/T31]	10
c6t1d0s0	tempdb [via symbolic link /sybase2/T32]	10
c6t2d0s0	tempdb [via symbolic link /sybase2/T33]	10
c6t3d0s0	tempdb [via symbolic link /sybase2/T34]	10
c6t4d0s0	tempdb [via symbolic link /sybase2/T35]	10
c6t5d0s0	tempdb [via symbolic link /sybase2/T36]	10
c6t6d0s0	tempdb [via symbolic link /sybase2/T37]	10
c6t7d0s0	tempdb [via symbolic link /sybase2/T38]	10
c7t0d0s0	tempdb [via symbolic link /sybase2/T39]	10
c7t1d0s0	tempdb [via symbolic link /sybase2/T40]	10
c7t2d0s0	tempdb [via symbolic link /sybase2/T41]	10
c7t3d0s0	tempdb [via symbolic link /sybase2/T42]	10
c7t4d0s0	tempdb [via symbolic link /sybase2/T43]	10
c7t5d0s0	tempdb [via symbolic link /sybase2/T44]	10
c7t6d0s0	tempdb [via symbolic link /sybase2/T45]	10
c7t7d0s0	tempdb [via symbolic link /sybase2/T46]	10
c5t0d0s7	SVM state replica	0.3
c5t1d0s7	SVM state replica	0.7

The next table shows the disk slices used for the SVM RAID1 devices. The /sybase2 file system is used to store the IQ catalog file and IQ log file.

SVM Device Details:

Raw Partition Name	SVM Device Name	SVM Contained Device	Symbolic Link	Database Usage	Database Device Size GB	RAID
c4t0d0s4	d1	d2	none	/sybase2	1.7	RAID 1
C5t0d0s1	d1	d3	none	/sybase2	1.7	RAID 1
c0t1d0s1	d15	d10	/sybase2/M01	IQ Main	171	RAID 1
c0t2d0s1	d15	d11	/sybase2/M01	IQ Main	171	RAID 1
c0t3d0s1	d25	d20	/sybase2/M02	IQ Main	171	RAID 1
c0t4d0s1	d25	d21	/sybase2/M02	IQ Main	171	RAID 1

Raw Partition Name	SVM Device Name	SVM Contained Device	Symbolic Link	Database Usage	Database Device Size GB	RAID
c0t5d0s1	d35	d30	/sybase2/M03	IQ Main	171	RAID 1
c0t6d0s1	d35	d31	/sybase2/M03	IQ Main	171	RAID 1
c0t7d0s1	d45	d40	/sybase2/M04	IQ Main	171	RAID 1
c1t1d0s1	d45	d41	/sybase2/M04	IQ Main	171	RAID 1
c1t2d0s1	d55	d50	/sybase2/M05	IQ Main	171	RAID 1
c1t3d0s1	d55	d51	/sybase2/M05	IQ Main	171	RAID 1
c1t4d0s1	d65	d60	/sybase2/M06	IQ Main	171	RAID 1
c1t5d0s1	d65	d61	/sybase2/M06	IQ Main	171	RAID 1
c1t6d0s1	d75	d70	/sybase2/M07	IQ Main	171	RAID 1
c1t7d0s1	d75	d71	/sybase2/M07	IQ Main	171	RAID 1
c4t0d0s1	d85	d80	/sybase2/M08	IQ Main	171	RAID 1
c4t1d0s1	d85	d81	/sybase2/M08	IQ Main	171	RAID 1
c4t2d0s1	d95	d90	/sybase2/M09	IQ Main	171	RAID 1
c4t3d0s1	d95	d91	/sybase2/M09	IQ Main	171	RAID 1
c4t4d0s1	d105	d100	/sybase2/M10	IQ Main	171	RAID 1
c4t5d0s1	d105	d101	/sybase2/M10	IQ Main	171	RAID 1
c4t6d0s1	d115	d110	/sybase2/M11	IQ Main	171	RAID 1
c4t7d0s1	d115	d111	/sybase2/M11	IQ Main	171	RAID 1
c5t2d0s1	d125	d120	/sybase2/M12	IQ Main	171	RAID 1
c5t3d0s1	d125	d121	/sybase2/M12	IQ Main	171	RAID 1
c5t4d0s1	d135	d130	/sybase2/M13	IQ Main	171	RAID 1
c5t5d0s1	d135	d131	/sybase2/M13	IQ Main	171	RAID 1
c5t6d0s1	d145	d140	/sybase2/M14	IQ Main	171	RAID 1
c5t7d0s1	d145	d141	/sybase2/M14	IQ Main	171	RAID 1
c6t0d0s1	d155	d150	/sybase2/M15	IQ Main	171	RAID 1
c6t1d0s1	d155	d151	/sybase2/M15	IQ Main	171	RAID 1
c6t2d0s1	d165	d160	/sybase2/M16	IQ Main	171	RAID 1
c6t3d0s1	d165	d161	/sybase2/M16	IQ Main	171	RAID 1
c6t4d0s1	d175	d170	/sybase2/M17	IQ Main	171	RAID 1
c6t5d0s1	d175	d171	/sybase2/M17	IQ Main	171	RAID 1
c6t6d0s1	d185	d180	/sybase2/M18	IQ Main	171	RAID 1
c6t7d0s1	d185	d181	/sybase2/M18	IQ Main	171	RAID 1
c7t0d0s1	d195	d190	/sybase2/M19	IQ Main	171	RAID 1
c7t1d0s1	d195	d191	/sybase2/M19	IQ Main	171	RAID 1
c7t2d0s1	d205	d200	/sybase2/M20	IQ Main	171	RAID 1
c7t3d0s1	d205	d201	/sybase2/M20	IQ Main	171	RAID 1
c7t4d0s1	d215	d210	/sybase2/M21	IQ Main	171	RAID 1
c7t5d0s1	d215	d211	/sybase2/M21	IQ Main	171	RAID 1
c7t6d0s1	d225	d220	/sybase2/M22	IQ Main	171	RAID 1
c7t7d0s1	d225	d221	/sybase2/M22	IQ Main	171	RAID 1
c0t0d0s1	d235	d230	/sybase2/M23	IQ Main	171	RAID 1
c1t0d0s1	d235	d231	/sybase2/M23	IQ Main	171	RAID 1

Additional details can be found in the disk configuration section in Appendix B.

5.3 Database partition/replication mapping

The mapping of database partitions/replications must be explicitly described.

Database partitioning/replication was not used.

5.4 RAID Feature

Implementations may use some form of RAID to ensure high availability. If used for data, auxiliary storage (e.g. indexes) or temporary space, the level of RAID must be disclosed for each device.

RAID 1 was used for all base tables and auxiliary data structures. In addition, the Sybase IQ utility db file and log file also resided on a RAID 1 devices.

5.5 Modifications to the DBGEN

Any modifications to the DBGEN (see Clause 4.2.1) source code must be disclosed. In the event that a program other than DBGEN was used to populate the database, it must be disclosed in its entirety.

The supplied DBGEN version 2.6.0 was used to generate the database population for this benchmark.

5.6 Database Load Time

The database load time for the test database (see clause 4.3) must be disclosed.

The database load time was =10:05:33

5.7 Data Storage Ratio

The data storage ratio must be disclosed. It is computed as the ratio between the total amount of priced disk space, and the chosen test database size as defined in Clause 4.1.3.

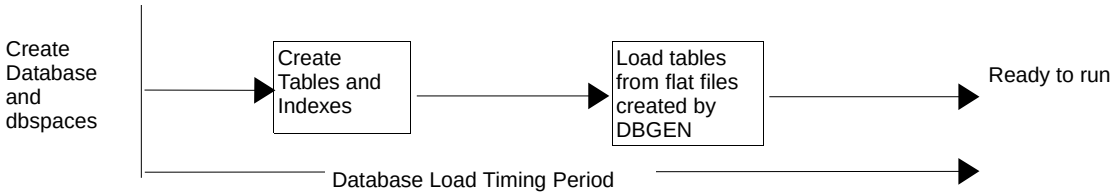
The data storage ratio is computed from the following information:

Disk Type	# of Disks	GB* per disk	Total Disk Space in GB**
Internal	48	250	11175.87
		Total Space	11175.87
		Data Storage Ratio	11.18

** Disk manufacturer definition of one GB is 10^9 bytes*
***In this calculation one GB is defined as 2^30 bytes*

5.8 Database Load Mechanism Details and Illustration

The details of the database load must be described, including a block diagram illustrating the overall process.



The test database was loaded using flat files. All load scripts are included in Appendix B.

5.9 Qualification Database Configuration

Any differences between the configuration of the qualification database and the test database must be disclosed.

The qualification database used identical scripts to create and load the data with only the necessary adjustments for size differences.

6. Clause 5 Performance Metrics and Execution Rules

6.1 System Activity Between Load and Performance Tests

Any system activity on the SUT that takes place between the conclusion of the load test and the beginning of the performance test must be fully disclosed.

1. Auditor requested queries were run against the database to verify the correctness of the load

All scripts and queries used are included in Appendix F

6.2 Steps in the Power Test

The details of the steps followed to implement the power test (.e.g., system boot, database restart, etc.) must be disclosed.

The following steps were used to implement the power test:

1. RF1 Refresh Transaction
2. Stream 00 Execution
3. RF2 Refresh Transaction

6.3 Timing Intervals for Each Query and Refresh Functions

The timing intervals for each query and for both refresh functions must be reported for the power test.

The timing intervals for each query and both update functions are reported on the page titled "Numerical Quantities", contained in the beginning of this document and replicated in the Executive Summary document.

6.4 Number of Streams for the Throughput Test

The number of execution streams used for the throughput test must be disclosed.

7 streams were used for the throughput test.

6.5 Start and End Date/Times for Each Query Stream

The start time and finish time for each query stream must be reported for the throughput test.

The start times and finish times for each query stream in the throughput test are reported on the page titled "Numerical Quantities", contained in the beginning of this document and replicated in the Executive Summary document.

6.6 Total Elapsed Time of the Measurement Interval

The total elapsed time of the measurement interval must be reported for the throughput test.

The total elapsed time of the throughput test is reported on the page titled "Numerical Quantities", contained in the beginning of this document and replicated in the Executive Summary document.

6.7 Refresh Function Start Date/Time and Finish Date/Time

Start and finish time for each refresh function in the refresh stream must be reported for the throughput test.

The start and finish times for each refresh function:

Stream ID	Refresh Function	Start Date	Start Time	End Date	End Time
stream01	RF1	2007-08-30	10:27:18	2007-08-30	11:00:24
stream01	RF2	2007-08-30	11:00:24	2007-08-30	14:47:02
stream02	RF1	2007-08-30	14:47:02	2007-08-30	15:10:58
stream02	RF2	2007-08-30	15:10:58	2007-08-30	15:33:21
stream03	RF1	2007-08-30	15:33:21	2007-08-30	15:57:09
stream03	RF2	2007-08-30	15:57:09	2007-08-30	16:20:19
stream04	RF1	2007-08-30	16:20:19	2007-08-30	16:42:20
stream04	RF2	2007-08-30	16:42:20	2007-08-30	17:05:31
stream05	RF1	2007-08-30	17:05:31	2007-08-30	17:28:38
stream05	RF2	2007-08-30	17:28:38	2007-08-30	17:53:41
Stream06	RF1	2007-08-30	17:53:42	2007-08-30	18:19:04
Stream06	RF2	2007-08-30	18:19:04	2007-08-30	18:42:30
Stream07	RF1	2007-08-30	18:42:30	2007-08-30	19:06:16

6.8 Timing Intervals for Each Query and Each Refresh Function for Each Stream

The timing intervals for each query of each stream and each refresh function must be reported for the throughput test.

The timing intervals for each query and each refresh function for the throughput test are reported on the page titled "Numerical Quantities", contained in the beginning of this document and replicated in the Executive Summary document.

6.9 Performance Metrics

The computed performance metric, related numerical quantities and price performance metric must be reported.

The performance metrics, and the numbers on which they are based, are reported on the page titled "Numerical Quantities", contained in the beginning of this document and replicated in the Executive Summary document.

6.10 The Performance Metric and Numerical Quantities from Both Runs

The performance metric and numerical quantities from both runs must be disclosed.

Performance results from the first two executions of the TPC-H benchmark indicated the following percent difference for the three metrics:

Run ID	QppH@1000GB	QthH@1000GB	QphH@1000GB
Run 1	6446.1	4873.5	5604.9
Run 2	6310.3	5140.9	5695.7
% Difference	-2.15%	5.20%	1.59%

6.11 System Activity Between Performance Tests

Any activity on the SUT that takes place between the conclusion of Run1 and the beginning of Run2 must be disclosed.

No activity occurred between Run 1 and Run 2. Moreover Sybase IQ was not restarted after the database load or between the two runs.

7. Clause 6 SUT and Driver Implementation

7.1 Driver

A detailed description of how the driver performs its functions must be supplied, including any related source code or scripts. This description should allow an independent reconstruction of the driver.

The entire test is run by executing the ntest shellscript.

The text of ntest is reproduced in Appendix E and the texts of the subscripts invoked by ntest are reproduced in Appendix B.

The scripts that perform the query streams within the power and throughput tests are generated by the gen_streams_new .ksh script (which in turn invokes QGEN to generate the actual query stream files).

The Power Test is performed when ntest executes update_power.sql, which in turn runs the refresh functions and the power stream queries.

The Throughput Test is performed when ntest concurrently executes the 7 query stream scripts, stream[1-7].sql, together with the script update_throughput7.sql. The latter executes the refresh functions in parallel with the query streams according to the rules set out in the TPC-H specification document.

7.2 Implementation-Specific Layer

If an implementation-specific layer is used, then a detailed description of how it performs its functions must be supplied, including any related source code or scripts. This description should allow an independent reconstruction of the implementation-specific layer.

All database configuration was done through scripts disclosed in Appendix B.

The performance tests are performed using dbisqlc. dbisqlc is a Sybase-provided utility that allows SQL statements to be executed against an Sybase IQ database. The dbisqlc utility is invoked from the command-line on the SUT. It reads input from files containing SQL statements and sends results to stdout. dbisqlc uses information in the .odbc.ini file to connect to the database. The performance test scripts utilizing dbisqlc can be found in Appendix E.

The ACID tests are performed using dbtest. dbtest is a Sybase-provided utility, similar to dbisqlc, but providing additional scripting capabilities. It is invoked from the command-line on the SUT and uses information in the .odbc.ini file to connect to the database. All the ACID test scripts are reproduced in Appendix B.

7.3 Profile-Directed Optimization

If profile-directed optimization as described in Clause 5.2.9 is used, such use must be disclosed.

Profile-directed optimization was not used.

8. Clause 7 Pricing

8.1 Hardware and Software Used

A detailed list of hardware and software used in the priced system must be reported. Each item must have vendor part number, description, and release/revision level, and either general availability status or committed delivery date. If package-pricing is used, contents of the package must be disclosed. Pricing source(s) and effective date(s) of price(s) must also be reported.

Refer to the Executive Summary for the pricing spreadsheet and Appendix G for the actual price quotes used to create the spreadsheet.

8.2 Total Three Year Price

The total 3-year price of the entire configuration must be reported, including hardware, software, and maintenance charges. Separate component pricing is recommended. The basis of all discounts used must be disclosed.

The total 3-year price of the configuration is $45,439.50. For details of pricing, see the second page of the Executive Summary.

Discounts were taken from actual price quotes,available to any buyer with like conditions, provided by Sun Microsystems Inc. and Sybase Inc. The respective price quotes are included in Appendix G of this document.

8.3 Availability Date

The committed delivery date for general availability of products used in the price calculations must be reported. When the priced system includes products with different availability dates, the reported availability date for the priced system must be the date at which all components are committed to be available.

All hardware and software components used in the measured configuration are generally available as of Oct 15, 2007.

9. Auditor's Information and Attestation Letter

The auditor's agency name, address, phone number, and Attestation letter with a brief audit summary report indicating compliance must be included in the full disclosure report. A statement should be included specifying who to contact in order to obtain further information regarding the audit process.

The auditor's attestation letter follows the table of contents.

Appendix A. Solaris 10 and Sybase IQ 12.6 Parameters

This Appendix contains Solaris kernel parameters and environment variables and Sybase IQ system parameters.

==========

Sybase IQ Server Configuration Parameters

==========

utility.cfg

```
#
# these are the default suggested startup parameters
for the asiq
#
# note that you will still need to provide the
# server with the server name on startup "-n", and
# possibly a different system port number
#
-n util_thmp
-c  32m
-gd all
-gl all
-gm 15
-gp 4096
-ti 4400
-tl 300
-iqtc 128
-iqmc 128
```

tpch.cfg

```
# note the port number here must matche the one in
# .odbc.ini
-c  12m
-gd all
-gl all
-gm 30
-gp 4096
-ti 4400
-tl 300
-iqmc 9500
-iqtc 4000
-iqmt   800
-iqgovern 12
-iqpartition 2
-x tcpip{port=3002}
-n tpch_thmp
```

==========

Sybase IQ Database Options

(altered from default)

==========

options.sql

```
==========
SET OPTION PUBLIC.Allow_Nulls_By_Default='Off';
SET OPTION PUBLIC.Flatten_Subqueries = 'On';
SET OPTION PUBLIC.Force_No_Scroll_Cursors='On';
SET OPTION PUBLIC.Load_Memory_Mb=0;
SET OPTION PUBLIC.Minimize_Storage='On';
SET OPTION PUBLIC.Notify_Modulus=10000000;
SET OPTION PUBLIC.Query_Temp_Space_Limit=0;
SET OPTION PUBLIC.Row_Counts='On';
SET OPTION PUBLIC.Query_Plan='off';
SET OPTION PUBLIC.Hash_Thrashing_Percent=100;
SET OPTION PUBLIC.Main_Reserved_DBSpace_MB=300;
SET OPTION
PUBLIC.SignificantDigitsForDoubleEquality=15;
SET OPTION PUBLIC.Sort_Phase1_Helpers=2;

SET OPTION PUBLIC.Max_IQ_Threads_Per_Connection=100;
SET OPTION PUBLIC.Append_Load='On';
SET OPTION PUBLIC.Default_Having_Selectivity = 1;
SET OPTION PUBLIC.Default_Like_Range_Selectivity = 1;
SET OPTION PUBLIC.Garray_Fill_Factor_Percent=3;

SET OPTION PUBLIC.Max_Hash_Rows = 25000000;
SET OPTION PUBLIC.Prefetch_Threads_Percent=15;
SET OPTION PUBLIC.Sweeper_Threads_Percent=10 ;
SET OPTION PUBLIC.Wash_Area_Buffers_Percent = '18';

==========

==========
```

Sybase IQ Environment Variables

==========

```
SYBASE="/export/home/sybase"
export SYBASE
SYBASE_OCS="OCS-12_5"
export SYBASE_OCS
ASDIR="${SYBASE}/ASIQ-12_6"
export ASDIR
PATH="${ASDIR}/bin:${SYBASE}/${SYBASE_OCS}/bin:${PATH}
:/etc:."
export PATH
IQLIB="${ASDIR}/usrlib:${ASDIR}/lib:${SYBASE}/${SYBASE
_OCS}/lib"
LD_LIBRARY_PATH_64="${IQLIB}:$LD_LIBRARY_PATH_64"
export LD_LIBRARY_PATH_64
LD_LIBRARY_PATH="${IQLIB}:$LD_LIBRARY_PATH"
export LD_LIBRARY_PATH
unset IQLIB
```

==========

.odbc.ini

```
==========
[ODBC Data Sources]
tpch=ASIQ Driver
utility_db=ASIQ Driver

[tpch]
Driver=/export/home/sybase/asiq12/lib/dbodbc7_r.so.1
EngineName=tpch_gal1
CommLinks=tcpip{host=129.148.109.183;Port=3002}
DatabaseName=tpch
UserID=DBA
Password=SQL
DBG=yes
LOG=/tmp/tpch_odbc.log

[utility_db]
Driver=/export/home/sybase/asiq12/lib/dbodbc7_r.so.1
EngineName=util_gal1
CommLinks=tcpip{host=129.148.109.183;Port=2638}
DatabaseName=utility_db
UserID=DBA
Password=SQL
DBG=yes
LOG=/tmp/utility_db_odbc.log
```

Solaris Parameters

(altered from default)

==========

/etc/system

==========

```
set tune_t_fsflushr=600
set autoup=36000000
set lotsfree = 4096
set bufhwm = 10000
```

Appendix B. Programs and Scripts

==========

check_query1.bash

==========

```
#!/bin/bash
#
# First remove the rf1.lock so that the Query Stream
will start
#
rm -f /export/home/sybase/run/scripts/rf1.lock
#
# Sleep while the rf2.lock file exists
# when the query stream completes it will remove the
rf2.lock
#
while [ -f /export/home/sybase/run/scripts/rf2.lock ]
do
 # Wait for the Query Steam to complete
 # check every 10 seconds
 # echo "Lock File Exists"
 sleep 10
done
# Return Control to the RF stream
```

==========

create_database.sql

```
CREATE DATABASE '/sybase2/tpch.db'
TRANSACTION LOG ON
COLLATION 'ISO_BINENG'
CASE RESPECT
PAGE SIZE 4096
BLANK PADDING ON
JAVA ON
JCONNECT ON
IQ PATH '/sybase2/M01'
IQ PAGE SIZE 524288
TEMPORARY PATH '/sybase2/T01'
```

==========

create_dbspaces.sql

==========

```
set temporary option on_error='continue';
create dbspace main2     as '/sybase2/M02' iq store;
create dbspace main3     as '/sybase2/M03' iq store;
create dbspace main4     as '/sybase2/M04' iq store;
create dbspace main5     as '/sybase2/M05' iq store;
create dbspace main6     as '/sybase2/M06' iq store;
create dbspace main7     as '/sybase2/M07' iq store;
create dbspace main8     as '/sybase2/M08' iq store;
create dbspace main9     as '/sybase2/M09' iq store;
create dbspace main10    as '/sybase2/M10' iq store;
create dbspace main11    as '/sybase2/M11' iq store;
create dbspace main12    as '/sybase2/M12' iq store;
create dbspace main13    as '/sybase2/M13' iq store;
create dbspace main14    as '/sybase2/M14' iq store;
create dbspace main15    as '/sybase2/M15' iq store;
create dbspace main16    as '/sybase2/M16' iq store;
create dbspace main17    as '/sybase2/M17' iq store;
create dbspace main18    as '/sybase2/M18' iq store;
create dbspace main19    as '/sybase2/M19' iq store;
create dbspace main20    as '/sybase2/M20' iq store;
create dbspace main21    as '/sybase2/M21' iq store;
create dbspace main22    as '/sybase2/M22' iq store;
create dbspace main23    as '/sybase2/M23' iq store;

create dbspace iqtemp2   as '/sybase2/T02' iq
temporary store;
create dbspace iqtemp3   as '/sybase2/T03' iq
temporary store;
create dbspace iqtemp4   as '/sybase2/T04' iq
temporary store;
create dbspace iqtemp5   as '/sybase2/T05' iq
temporary store;
create dbspace iqtemp6   as '/sybase2/T06' iq
temporary store;
create dbspace iqtemp7   as '/sybase2/T07' iq
temporary store;
create dbspace iqtemp8   as '/sybase2/T08' iq
temporary store;
create dbspace iqtemp9   as '/sybase2/T09' iq
temporary store;
create dbspace iqtemp10  as '/sybase2/T10' iq
temporary store;
create dbspace iqtemp11  as '/sybase2/T11' iq
temporary store;
create dbspace iqtemp12  as '/sybase2/T12' iq
temporary store;
create dbspace iqtemp13  as '/sybase2/T13' iq
temporary store;
create dbspace iqtemp14  as '/sybase2/T14' iq
temporary store;
create dbspace iqtemp15  as '/sybase2/T15' iq
temporary store;
create dbspace iqtemp16  as '/sybase2/T16' iq
temporary store;
create dbspace iqtemp17  as '/sybase2/T17' iq
temporary store;
create dbspace iqtemp18  as '/sybase2/T18' iq
temporary store;
create dbspace iqtemp19  as '/sybase2/T19' iq
temporary store;
create dbspace iqtemp20  as '/sybase2/T20' iq
temporary store;
create dbspace iqtemp21  as '/sybase2/T21' iq
temporary store;
create dbspace iqtemp22  as '/sybase2/T22' iq
temporary store;
create dbspace iqtemp23  as '/sybase2/T23' iq
temporary store;
create dbspace iqtemp24  as '/sybase2/T24' iq
temporary store;
create dbspace iqtemp25  as '/sybase2/T25' iq
temporary store;
create dbspace iqtemp26  as '/sybase2/T26' iq
temporary store;
create dbspace iqtemp27  as '/sybase2/T27' iq
temporary store;
create dbspace iqtemp28  as '/sybase2/T28' iq
temporary store;
create dbspace iqtemp29  as '/sybase2/T29' iq
temporary store;
create dbspace iqtemp30  as '/sybase2/T30' iq
temporary store;
create dbspace iqtemp31  as '/sybase2/T31' iq
temporary store;
create dbspace iqtemp32  as '/sybase2/T32' iq
temporary store;
create dbspace iqtemp33  as '/sybase2/T33' iq
temporary store;
create dbspace iqtemp34  as '/sybase2/T34' iq
temporary store;
create dbspace iqtemp35  as '/sybase2/T35' iq
temporary store;
create dbspace iqtemp36  as '/sybase2/T36' iq
temporary store;
create dbspace iqtemp37  as '/sybase2/T37' iq
temporary store;
create dbspace iqtemp38  as '/sybase2/T38' iq
temporary store;
create dbspace iqtemp39  as '/sybase2/T39' iq
temporary store;
create dbspace iqtemp40  as '/sybase2/T40' iq
temporary store;
create dbspace iqtemp41  as '/sybase2/T41' iq
temporary store;
create dbspace iqtemp42  as '/sybase2/T42' iq
temporary store;
create dbspace iqtemp43  as '/sybase2/T43' iq
temporary store;
```

```
create dbspace iqtemp44  as '/sybase2/T44' iq
temporary store;
create dbspace iqtemp45  as '/sybase2/T45' iq
temporary store;
create dbspace iqtemp46  as '/sybase2/T46' iq
temporary store;
```

==========

==========

create_tables.sql

==========

```
CREATE TABLE region
  (
    r_regionkey            unsigned int,
    r_name                 char(25),
    r_comment              varchar(152),
    PRIMARY KEY (r_regionkey)
  );


CREATE TABLE nation
  (
    n_nationkey            unsigned int,
    n_name                 char(25),
    n_regionkey            unsigned int,
    n_comment              varchar(152),
    PRIMARY KEY (n_nationkey)
  );
CREATE HG INDEX n_regionkey_hg ON nation(n_regionkey)
;


CREATE TABLE supplier
  (
    s_suppkey              unsigned int,
    s_name                 char(25),
    s_address              varchar(40),
    s_nationkey            unsigned int,
    s_phone                char(15),
    s_acctbal              double precision,
    s_comment              varchar(101),
    PRIMARY KEY (s_suppkey)
  );
CREATE HG INDEX s_nationkey_hg ON
supplier(s_nationkey) ;


CREATE TABLE part
  (
    p_partkey              unsigned int,
    p_name                 varchar(55),
    p_mfgr                 char(25),
    p_brand                char(10),
    p_type                 varchar(25),
    p_size                 int,
    p_container            char(10),
    p_retailprice          double precision,
    p_comment              varchar(23),
    PRIMARY KEY(p_partkey)
  );

CREATE TABLE partsupp
  (
    ps_partkey             unsigned int,
    ps_suppkey             unsigned int,
    ps_availqty            integer,
    ps_supplycost          double precision,
    ps_comment             varchar(199),
    PRIMARY KEY (ps_partkey, ps_suppkey)
  );
CREATE HG INDEX ps_partkey_hg ON partsupp(ps_partkey)
;
CREATE HG INDEX ps_suppkey_hg ON partsupp(ps_suppkey)
;


CREATE TABLE customer
  (
    c_custkey              unsigned int,
    c_name                 varchar(25),
    c_address              varchar(40),
    c_nationkey            unsigned int,
    c_phone                char(15),
    c_acctbal              double precision,
    c_mktsegment           char(10),
    c_comment              varchar(117),
    PRIMARY KEY(c_custkey)
  );
CREATE HG INDEX c_nationkey_hg ON
customer(c_nationkey) ;


CREATE TABLE orders
  (
    o_orderkey             unsigned int,
    o_custkey              unsigned int,
    o_orderstatus          char(1),
    o_totalprice           double precision,
    o_orderdate            date,
    o_orderpriority        char(15),
    o_clerk                char(15),
    o_shippriority         int,
    o_comment              varchar(79),
    PRIMARY KEY (o_orderkey)
  );
CREATE HG INDEX o_custkey_hg ON orders(o_custkey) ;
CREATE DATE INDEX o_orderdate_date ON
orders(o_orderdate) ;


CREATE TABLE lineitem
  (
    l_orderkey             unsigned int,
    l_partkey              unsigned int,
    l_suppkey              unsigned int,
    l_linenumber           int,
    l_quantity             double precision,
    l_extendedprice        double precision,
    l_discount             double precision,
    l_tax                  double precision,
    l_returnflag           char(1),
    l_linestatus           char(1),
    l_shipdate             date,
    l_commitdate           date,
    l_receiptdate          date,
    l_shipinstruct         char(25),
    l_shipmode             char(10),
    l_comment              varchar(44)
  );

CREATE HG INDEX l_partsupp_hg ON
lineitem(l_partkey,l_suppkey) ;
CREATE HG INDEX l_orderkey_hg ON lineitem(l_orderkey)
;
CREATE HG INDEX l_partkey_hg ON lineitem(l_partkey) ;
CREATE HG INDEX l_suppkey_hg ON lineitem(l_suppkey) ;
CREATE DATE INDEX l_shipdate_date ON
lineitem(l_shipdate) ;
CREATE DATE INDEX l_receiptdate_date ON
lineitem(l_receiptdate);
```

==========

tpch_rf.sql

==========

```
create table refresh_control ( rf1_data_set int not
null, rf2_data_set int not null);
insert into refresh_control values (0,0);
```

```
commit;
CREATE PROCEDURE DBA.tpch_rf1 (IN c_directory
varchar(128),
                               IN c_stream varchar(3))
ON EXCEPTION RESUME
BEGIN
  DECLARE delim_asci integer;
  DECLARE c_data_set varchar(3);
  DECLARE i_data_set integer;
  DECLARE c_cmd long varchar;
  DECLARE outfilename varchar(128); -- Debug
  DECLARE outfilename2 varchar(128); -- Debug
  DECLARE c_lf varchar(2);
  DECLARE t_qstart timestamp;
  DECLARE t_qstop timestamp;
  DECLARE n_seconds numeric(12,5);
  DECLARE c_sqlstate CHAR(5);
  SET t_qstart = now(*);
  SET c_lf=char(10);
  SELECT rf1_data_set INTO i_data_set FROM
refresh_control;
  SET c_data_set=CAST(i_data_set+1 AS varchar(3));
  SET c_cmd='load table orders ( '+c_lf;
  SET c_cmd=c_cmd+' o_orderkey
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' o_custkey
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' o_orderstatus
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' o_totalprice
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' o_orderdate date('+char(39)+'YYYY-
MM-DD'+char(39)+'), filler(1), '+c_lf;
  SET c_cmd=c_cmd+' o_orderpriority
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' o_clerk '+char(39)+'|'+char(39)+',
'+c_lf;
  SET c_cmd=c_cmd+' o_shippriority
'+char(39)+'|'+char(39)+','+c_lf;
  SET c_cmd=c_cmd+' o_comment
'+char(39)+'|'+char(39)+' ) '+c_lf;
  SET c_cmd=c_cmd+'from
'+char(39)+c_directory+'orders.tbl.u'+c_data_set+char(
39)+c_lf;
  SET c_cmd=c_cmd+'row delimited by
'+char(39)+'\\x0a'+char(39)+' quotes off escapes off
preview on;';
  EXECUTE IMMEDIATE c_cmd;
  SELECT SQLSTATE INTO c_sqlstate;
  IF c_sqlstate != '00000' THEN
    ROLLBACK;
    RAISERROR 23002 'RF1 failed at Step 1 with
SQLSTATE: ', c_sqlstate;
    RETURN(1);
  END IF;
  SET c_cmd='load table lineitem ( '+c_lf;
  SET c_cmd=c_cmd+' l_orderkey
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_partkey
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_suppkey
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_linenumber
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_quantity
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_extendedprice
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_discount
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_tax '+char(39)+'|'+char(39)+',
'+c_lf;
  SET c_cmd=c_cmd+' l_returnflag
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_linestatus
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_shipdate date('+char(39)+'YYYY-
MM-DD'+char(39)+'), filler(1), '+c_lf;
  SET c_cmd=c_cmd+' l_commitdate
date('+char(39)+'YYYY-MM-DD'+char(39)+'), filler(1),
'+c_lf;
  SET c_cmd=c_cmd+' l_receiptdate
date('+char(39)+'YYYY-MM-DD'+char(39)+'), filler(1),
'+c_lf;
  SET c_cmd=c_cmd+' l_shipinstruct
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_shipmode
'+char(39)+'|'+char(39)+', '+c_lf;
  SET c_cmd=c_cmd+' l_comment
'+char(39)+'|'+char(39)+' )'+c_lf;
  SET c_cmd=c_cmd+'from
'+char(39)+c_directory+'lineitem.tbl.u'+c_data_set+cha
r(39)+c_lf;
  SET c_cmd=c_cmd+'row delimited by
'+char(39)+'\\x0a'+char(39)+c_lf+'quotes off escapes
off preview on;';
  EXECUTE IMMEDIATE c_cmd;
  SELECT SQLSTATE INTO c_sqlstate;
  IF c_sqlstate != '00000' THEN
    rollback;
    RAISERROR 23002 'RF1 failed at Step 2 with
SQLSTATE: ', c_sqlstate;
    RETURN(1);
  END IF;
  UPDATE refresh_control SET
rf1_data_set=cast(c_data_set AS integer);
  COMMIT;
  SET t_qstop = now(*);
  SET
n_seconds=cast(datediff(millisecond,t_qstart,t_qstop)
AS numeric(12,5))/1000;
  SET c_cmd='Stream updates Update
update_'+c_stream+'_RF1 LENGTH -- '+cast(n_seconds AS
varchar(20))+ ' seconds' ;
  SELECT c_cmd;
  RETURN(0);
END;
CREATE PROCEDURE DBA.tpch_rf2 (in c_directory
varchar(128),
                                  in c_stream varchar(3))
ON exception resume
BEGIN
  DECLARE delim_asci integer;
  DECLARE c_data_set varchar(3);
  DECLARE i_data_set integer;
  DECLARE c_cmd long varchar;
  DECLARE outfilename varchar(128); -- Debug
  DECLARE c_lf varchar(2);
  DECLARE t_qstart timestamp;
  DECLARE t_qstop timestamp;
  DECLARE n_seconds numeric(12,5);
  DECLARE c_sqlstate CHAR(5);
  SET t_qstart = now(*);
  SET c_lf=char(10);
  SELECT rf2_data_set INTO i_data_set FROM
refresh_control;
  SET c_data_set=CAST(i_data_set+1 AS varchar(3));
  CREATE TABLE #delete_table ( d_orderkey UNSIGNED
INT, PRIMARY KEY (d_orderkey) );
  SET c_cmd='load table #delete_table  (d_orderkey
'+char(39)+'\\x0a'+char(39)+') '+c_lf;
  SET c_cmd=c_cmd+'from
'+char(39)+c_directory+'delete.'+c_data_set+char(39)+c
_lf;
  SET c_cmd=c_cmd+'quotes off '+c_lf;
  SET c_cmd=c_cmd+'escapes off; '+c_lf;
  EXECUTE IMMEDIATE c_cmd;
  SELECT SQLSTATE INTO c_sqlstate;
  IF c_sqlstate != '00000' THEN
    ROLLBACK;
    SET c_cmd='RF2 failed at Step 1 with SQLSTATE:
'+c_sqlstate;
    RAISERROR 23002 c_cmd;
    RETURN(1);
  END IF;
  DELETE lineitem FROM lineitem, #delete_table WHERE
```

```
l_orderkey = d_orderkey;
  SELECT SQLSTATE INTO c_sqlstate;
  IF c_sqlstate != '00000' THEN
    ROLLBACK;
    SET c_cmd='RF2 failed at Step 2 with SQLSTATE:
'+c_sqlstate;
    RAISERROR 23002 c_cmd;
    RETURN(1);
  END IF;
  DELETE orders FROM orders, #delete_table WHERE
o_orderkey = d_orderkey;
  SELECT SQLSTATE INTO c_sqlstate;
  IF c_sqlstate != '00000' THEN
    ROLLBACK;
    SET c_cmd='RF2 failed at Step 3 with SQLSTATE:
'+c_sqlstate;
    RAISERROR 23002 c_cmd;
    RETURN(1);
  END IF;
  UPDATE refresh_control SET
rf2_data_set=CAST(c_data_set AS integer);
  COMMIT;
  DROP TABLE #delete_table;
  SET t_qstop = now(*);
  SET
n_seconds=cast(datediff(millisecond,t_qstart,t_qstop)
as numeric(12,5))/1000;
  SET c_cmd='Stream updates Update
update_'+c_stream+'_RF2 LENGTH -- '+cast(n_seconds as
varchar(20))+ ' seconds' ;
  SELECT c_cmd;
  RETURN(0);
END;
```

==========

load_region.sql

==========

```
LOAD TABLE REGION (
R_REGIONKEY                                '|',
R_NAME                                     '|',
R_COMMENT                                  '|'
)
FROM '/sybase_stage/region.tbl'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_nation.sql

==========

```
LOAD TABLE NATION (
N_NATIONKEY                                '|',
N_NAME                                     '|',
N_REGIONKEY                                '|',
N_COMMENT                                  '|'
)
FROM '/sybase_stage/nation.tbl'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_customer.sql

==========

```
LOAD TABLE CUSTOMER (
C_CUSTKEY                                  '|',
C_NAME                                     '|',
C_ADDRESS                                  '|',
C_NATIONKEY                                '|',
C_PHONE                                    '|',
C_ACCTBAL                                  '|',
C_MKTSEGMENT                               '|',
C_COMMENT                                  '|'
)
FROM '/sybase_stage/customer.tbl'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_part.sql

==========

```
LOAD TABLE PART (
P_PARTKEY                                  '|',
P_NAME                                     '|',
P_MFGR                                     '|',
P_BRAND                                    '|',
P_TYPE                                     '|',
P_SIZE                                     '|',
P_CONTAINER                                '|',
P_RETAILPRICE                              '|',
P_COMMENT                                  '|'
)
FROM '/sybase_stage/part.tbl'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_supplier.sql

==========

```
LOAD TABLE SUPPLIER (
S_SUPPKEY                                  '|',
S_NAME                                     '|',
S_ADDRESS                                  '|',
S_NATIONKEY                                '|',
S_PHONE                                    '|',
S_ACCTBAL                                  '|',
S_COMMENT                                  '|'
)
FROM '/sybase_stage/supplier.tbl'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_partsupp.sql

==========

```
LOAD TABLE PARTSUPP (
PS_PARTKEY                                 '|',
PS_SUPPKEY                                 '|',
PS_AVAILQTY                                '|',
PS_SUPPLYCOST                              '|',
PS_COMMENT                                 '|'
)
FROM '/sybase_stage/partsupp.tbl'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_orders.sql

==========

```
LOAD TABLE ORDERS (
O_ORDERKEY                                              '|',
O_CUSTKEY                                               '|',
O_ORDERSTATUS                                           '|',
O_TOTALPRICE                                            '|',
O_ORDERDATE                                             '|',
O_ORDERPRIORITY                                         '|',
O_CLERK                                                 '|',
O_SHIPPRIORITY                                          '|',
O_COMMENT                                               '|'
)
FROM
'/sybase_stage/orders.tbl.1',
'/sybase_stage/orders.tbl.2',
'/sybase_stage/orders.tbl.3',
'/sybase_stage/orders.tbl.4',
'/sybase_stage/orders.tbl.5',
'/sybase_stage/orders.tbl.6',
'/sybase_stage/orders.tbl.7',
'/sybase_stage/orders.tbl.8'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
```

==========

load_lineitem.sql

==========

```
LOAD TABLE LINEITEM (
L_ORDERKEY                                      '|',
L_PARTKEY                                       '|',
L_SUPPKEY                                       '|',
L_LINENUMBER                                    '|',
L_QUANTITY                                      '|',
L_EXTENDEDPRICE                                 '|',
L_DISCOUNT                                      '|',
L_TAX                                           '|',
L_RETURNFLAG                                    '|',
L_LINESTATUS                                    '|',
L_SHIPDATE                                      '|',
L_COMMITDATE                                    '|',
L_RECEIPTDATE                                   '|',
L_SHIPINSTRUCT                                  '|',
L_SHIPMODE                                      '|',
L_COMMENT                                       '|'
)
FROM
     '/sybase_stage/lineitem.tbl.1',
     '/sybase_stage/lineitem.tbl.2',
     '/sybase_stage/lineitem.tbl.3',
     '/sybase_stage/lineitem.tbl.4',
     '/sybase_stage/lineitem.tbl.5',
     '/sybase_stage/lineitem.tbl.6',
     '/sybase_stage/lineitem.tbl.7',
     '/sybase_stage/lineitem.tbl.8'
escapes off
quotes off
row delimited by '\x0a'
WITH CHECKPOINT ON;
commit;
checkpoint;
commit;
```

==========

update_power.sql

==========

```
create variable qstart timestamp;
create variable qstop timestamp;
create variable c_sqlstate CHAR(5);
create variable c_path varchar(128);
set c_path='/sybase_stage/';
set qstart=now(*);
select 'Stream 0 RF1 START -- ', qstart ;
call tpch_rf1 (c_path,'0');
set qstop=now(*);
select 'Stream 0 Update RF1 LENGTH --
',cast(datediff(millisecond,qstart,qstop) as
numeric)/1000, ' seconds';
select 'Stream 0 RF1 FINISH -- ', qstop ;
-- Sleep Until the query stream completes
set qstart = now(*);
select 'Stream 0 RF WAITING -- ', qstart;
xp_cmdshell('/export/home/sybase/run/scripts/check_que
ry1.bash');
set qstart = now(*);
select 'Stream 0 RF CONTINUING -- ', qstart;
set qstart = now(*);
select 'Stream 0 RF2 START -- ', qstart ;
call tpch_rf2 (c_path,'0');
set qstop=now(*);
select 'Stream 0 Update RF2 LENGTH --
',cast(datediff(millisecond,qstart,qstop) as
numeric)/1000, ' seconds';
select 'Stream 0 RF2 FINISH -- ', qstop ;
```

==========

update_throughput7.sql

```
create variable qstart timestamp;
create variable qstop timestamp;
create variable c_sqlstate CHAR(5);
create variable c_path varchar(128);
set qstart = now(*);
set c_path='dbgen_files/';
select 'Stream updates START -- ', qstart ;
select @@servername, db_name();
call tpch_rf1 (c_path,'1');
commit;
tpch_wait;
call tpch_rf2 (c_path,'1');
commit;
tpch_wait;
call tpch_rf1 (c_path,'2');
commit;
tpch_wait;
call tpch_rf2 (c_path,'2');
commit;
tpch_wait;
call tpch_rf1 (c_path,'3');
commit;
tpch_wait;
call tpch_rf2 (c_path,'3');
commit;
tpch_wait;
call tpch_rf1 (c_path,'4');
commit;
tpch_wait;
call tpch_rf2 (c_path,'4');
commit;
tpch_wait;
call tpch_rf1 (c_path,'5');
commit;
tpch_wait;
call tpch_rf2 (c_path,'5');
commit;
tpch_wait;
call tpch_rf2 (c_path,'6');
commit;
tpch_wait;
call tpch_rf2 (c_path,'6');
commit;
tpch_wait;
call tpch_rf2 (c_path,'7');
commit;
tpch_wait;
call tpch_rf2 (c_path,'7');
commit;
tpch_wait;
```

```
set qstop = now(*);
select 'Stream updates STOP -- ', qstop ;
```

==========

gen_streams_new.ksh

==========

```
#!/bin/ksh

if (( $# < 3 ))
then
     echo "usage:  $0  seed  scale_factor
num_streams"
     exit
fi


PATH=/export/home/sybase/ASIQ-
12_5/bin:/export/home/sybase/OCS-
12_5/bin:/usr/openwin/bin:/bin:.:/usr/dist/pkgs/forte_
dev/SUNWspro/bin:/usr/ccs/bin:/usr/dt/bin:/usr/dist/pk
gs/devpro,v4.0/5.x-
sparc/bin:/usr/dist/local/exe:/usr/dist/exe:/usr/ucb:/
usr/sbin:/net/josie/export/home18/rgostan/bin:/export/
home/sybase/run/scripts:/etc:.:/export/home/sybase/run
/tpch/appendix/dbgen
export PATH
export DSS_PATH=/export/home/sybase/run/scripts;
export
DSS_CONFIG=/export/home/sybase/run/tpch/appendix/dbgen
;
export DSS_DIST=dists.dss;
export
DSS_QUERY=/export/home/sybase/run/tpch/appendix/templa
tes/queries;
#export
DSS_QUERY=/export/home/sybase/run/tpch/appendix/templa
tes/queries.debug;

seed=$1
sf=$2
ns=$3

i=0

while ((i<=ns))
do

    qgen -c -p 0 -l qparm${i}.txt -i
$DSS_QUERY/init.sql -t $DSS_QUERY/complete.sql -r
$seed -s $sf \
    1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
21 22 > stream${i}.sql
    ((seed=seed+1))
    ((i=i+1))0
done

echo $seed
```

==========

ACID Test Execution Code

==========

==========

atomicity test

==========

```
dbtest acid_atomic_main.tst > acid_atomic_main.out
```

==========

consistency test

==========

```
dbtest acid_consistency_main.tst >
acid_consistency_main.out
```

==========

isolation tests

==========

```
dbtest acid_isolation_main1.tst >
acid_isolation_main1.out
dbtest acid_isolation_main2.tst >
acid_isolation_main2.out
dbtest acid_isolation_main3.tst >
acid_isolation_main3.out
dbtest acid_isolation_main4.tst >
acid_isolation_main4.out
dbtest acid_isolation_main5.tst >
acid_isolation_main5.out
dbtest acid_isolation_main6.tst >
acid_isolation_main6.out
```

==========

durability test

==========

```
dbtest acid_durability_main.tst >
acid_durability_main.out
```

==========

ACID Test Source Code

==========

==========

acid_atomic_main.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print 'Atomicity test start = ', times
print ' '

include 'acid_functions.tst'
commit

%
% Atomicity test with rollback
%
print ' '
print 'Starting atomicity test with rollback'
print ' '

run test 'acid_atomic_setup.tst'

stringconnect "dsn=tpch;"
let counter=0

LOOP {
open cur2 {select ordr, line, delta from aa_whattodo
where seqnum=^}
       substitute counter
print 'counter = ',counter
fetch cur2 into ordr, line, delta
if ROWSTATUS != FOUND then { BREAK LOOP } endif
print 'Acid transaction for: o_key-',ordr,'  l_key-',
line,'  delta-',delta

execute {select o_totalprice, l_quantity,
l_extendedprice
       from orders, lineitem
       where o_orderkey = l_orderkey and o_orderkey
=^ and l_linenumber = ^}
       substitute ordr, line
       into o_total, l_quan, l_price
print  'o_totalprice = ',o_total,'   l_quantity =
',l_quan,
       '       l_extendedprice = ',l_price
```

```
execute {call acid_transaction(^, ^,  ^, rprice,
quantity,
                               tax, disc, extprice,
ototal)
        } substitute ordr, line, delta
close cur2
let counter = counter+1

rollback
execute {select now(*)} into times
print 'rollback : ', times

execute {select o_totalprice, l_quantity,
l_extendedprice
        from orders, lineitem
        where o_orderkey = l_orderkey and o_orderkey
=^ and l_linenumber = ^}
        substitute ordr, line
        into o_total, l_quan, l_price
print   'o_totalprice = ',o_total,'   l_quantity =
',l_quan,
        '       l_extendedprice = ',l_price
print ' '

} ENDLOOP

commit

%
% Atomicity test with commit
%
stringconnect "dsn=tpch;"
print ' '
print 'Starting atomicity test with commit '
print ' '
run test 'acid_atomic_setup.tst'

stringconnect "dsn=tpch;"

open cur1 {select ordr, line, delta from aa_whattodo}
LOOP {
fetch cur1 into ordr, line, delta
if ROWSTATUS != FOUND then { BREAK LOOP } endif
print 'Acid transaction for: o_key-',ordr,'  l_key-',
line,'  delta-',delta
execute {select o_totalprice, l_quantity,
l_extendedprice
        from orders, lineitem
        where o_orderkey = l_orderkey and o_orderkey
=^ and l_linenumber = ^}
        substitute ordr, line
        into o_total, l_quan, l_price
print   'o_totalprice = ',o_total,'   l_quantity =
',l_quan,
        '       l_extendedprice = ',l_price

execute {call acid_transaction(^, ^,  ^, rprice,
quantity,
                               tax, disc, extprice,
ototal)
        } substitute ordr, line, delta
commit
execute {select now(*)} into times
print 'commit : ', times

execute {select o_totalprice, l_quantity,
l_extendedprice
        from orders, lineitem
        where o_orderkey = l_orderkey and o_orderkey
=^ and l_linenumber = ^}
        substitute ordr, line
        into o_total, l_quan, l_price
print   'o_totalprice = ',o_total,'   l_quantity =
',l_quan,
        '       l_extendedprice = ',l_price
print ' '

} ENDLOOP

close cur1
commit

execute {select now(*)} into times
print 'Atomicity test end = ', times

End Test
```

==========

acid_atomic_setup.tst

==========

```
stringconnect "dsn=tpch;"

allow error -141
execute { commit }
execute { drop table aa_whattodo }
allow no error

execute {
create table aa_whattodo (
                seqnum       int      not null,
                ordr         int        not null,
                line         int        null,
                delta        int         null)
}

print 'aa_whattodo CREATED!!'
execute {select now(*)} into times
print 'time = ', times

fetch {select count(*) from aa_whattodo } into ROWS
assert ROWS = 0

print 'Number of rows before load: ',ROWS

LOOP ({let counter = 0}; {counter < 5}; {let counter =
counter + 1})
{
        execute {call generate_acid_values()}
                into orderkey, linenumber,delta
        execute {insert into aa_whattodo values ( ^ ,
^ , ^ , ^ ) }
                substitute counter, orderkey,
linenumber, delta
 print  counter, ' ',orderkey, ' ',linenumber,' ',
delta
}
ENDLOOP

commit

fetch {select count(*) from aa_whattodo } into ROWS
assert ROWS = 5

print 'Number of rows after load: ',ROWS

disconnect

End Test
```

==========

acid_consistency_main.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print 'Consistency test start = ', times
print ' '

include 'acid_functions.tst'

run test 'acid_consistency_setup.tst'
```

```
execute {select now(*)} into times
print 'Consistency test time = ', times
print ' '

run test '-o' 'acid_consistency_q1.ot'
'acid_consistency_query.tst'
disconnect

start test '-o' 'acid_consist_user1.ot' 'stream=1'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user2.ot' 'stream=2'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user3.ot' 'stream=3'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user4.ot' 'stream=4'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user5.ot' 'stream=5'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user6.ot' 'stream=6'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user7.ot' 'stream=7'
'acid_consistency_txn.tst'
sleep 1000
start test '-o' 'acid_consist_user8.ot' 'stream=8'
'acid_consistency_txn.tst'

% let the log flush...
sleep 1500000

stringconnect "dsn=tpch;"
run test '-o' 'acid_consistency_q2.ot'
'acid_consistency_query.tst'

execute {select now(*)} into times
print 'Consistency test end = ', times
print ' '

End Test
```

acid_consistency_query.tst

```
stringconnect "dsn=tpch;"

open cur1 {select stream, seqnum, ordr, line, delta
from acid_table
              where seqnum > 10 order by seqnum}
print ' '

let n=1
LOOP {
   fetch cur1 into str, seq, ord, lin, delta

   fetch {select round(cast(o_totalprice as
numeric(26,16)),2)
              from orders where o_orderkey=^ }
        substitute ord into o_price

   if ROWSTATUS != FOUND then { BREAK LOOP } endif
   if n > 25 then { BREAK LOOP } endif

   fetch { call acid_single_query (^) } substitute ord
into l_total

   fetch {select cast(^ as numeric(12,2)) } substitute
o_price into o_price
   fetch {select cast(^ as numeric(12,2)) } substitute
l_total into l_total

   print 'orderkey = ', ord, '       o_totalprice =
', o_price,
         '       acid query = ' , l_total

   ASSERT (o_price = l_total)
       then { print 'Did not compare correctly' }
ENDASSERT
   let n=n+1
 } ENDLOOP

disconnect

END Test
```

acid_consistency_setup.tst

```
stringconnect "dsn=tpch;"

execute { set option public.isolation_level=3 }
execute {set option public.query_plan='off'}
execute {set temporary option chained='on'}
execute {set option public.auto_commit=off}

% Drop Table if found
allow error -141
execute { drop table acid_table }
execute {drop table latest}
allow no error

execute {
create table acid_table (
               stream  int    null,
                seqnum  int   null,
                ordr    int   null,
                line    int   null,
                delta   int   null)
on SYSTEM
}

execute {checkpoint}

fetch {select count(*) from acid_table } into ROWS
assert ROWS = 0
print 'Number of rows before load: ',ROWS
commit

print 'acid_table created'

execute {create table latest(stream int ,last int
null) on SYSTEM }
LOOP ({let j = 1}; {j <= 8}; {let j = j + 1})
    {
       execute { insert into latest(stream,last)
values (^,0) }
                substitute j
    } endloop
commit

print 'latest created'

LOOP ({let i = 1}; {i <= 8}; { let i = i + 1})
{
  LOOP ({let j = 1}; {j <= 100}; {let j = j + 1})
    {
       execute { call generate_acid_values()} into
ordr, line, delta
       execute { insert into acid_table values
(^,^,^,^,^) }
                substitute i,j,ordr,line,delta
    } endloop
  print (j-1)*i
} endloop

commit
```

```
fetch {select count(*) from acid_table } into ROWS
assert ROWS = 800
print 'Number of rows after load: ',ROWS

End Test
```

==========

acid_consistency_txn.tst

==========

```
stringconnect "dsn=tpch;"

execute {set temporary option chained='on'}

execute {select now(*)} into times
print 'Consistancy test start = ', times
print ' '

commit

LOOP ({let i = 1}; {i <= 100}; { let i = i + 1})
{
 fetch {select ordr, line, delta from acid_table
                where stream=^ and seqnum=^ }
        substitute stream, i
 commit
 if ROWSTATUS != FOUND then { print 'not enough rows'
                BREAK LOOP }
 endif

 print 'User=',stream,' Acid Txn=',i,
        '   o_key=', ordr , '  l_key=', line , '
delta=' ,delta

 execute {call acid_transaction( ^, ^,  ^, rprice,
quantity,
                               tax, disc, extprice,
ototal)
        } substitute ordr, line, delta

 commit
 execute { update latest set last=^ where stream=^ }
substitute i,stream
 commit
 execute { set temporary option isolation_level=1 }
 execute { select max(last) from latest } into biggest
 execute { select min(last) from latest } into
smallest
 commit
 execute { set temporary option isolation_level=3 }

 let num=1200*(i-smallest)
 if i+4>=biggest
 then {let num=num+8000}
 endif
 sleep 14000
}
ENDLOOP

disconnect

End Test
```

==========

acid_durability_main.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print 'Durability test start = ', times
print ' '

include 'acid_functions.tst'
run test 'acid_durability_setup.tst'

execute {select now(*)} into times
print 'Durability test time = ', times
print ' '

run test  '-o' 'acid_durability_q1.ot'
'acid_durability_query.tst'

start test '-o' 'acid_dura_user1.ot' 'stream=1'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user2.ot' 'stream=2'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user3.ot' 'stream=3'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user4.ot' 'stream=4'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user5.ot' 'stream=5'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user6.ot' 'stream=6'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user7.ot' 'stream=7'
'acid_durability_txn.tst'
sleep 1000
start test '-o' 'acid_dura_user8.ot' 'stream=8'
'acid_durability_txn.tst'

synchronize 10

execute {select now(*)} into times
print 'Durability test time = ', times
print ' '


run test  '-o' 'acid_durability_q2.ot'
'acid_durability_query.tst'

execute {select now(*)} into times
print 'Durability test end = ', times
print ' '

End Test
```

==========

acid_durability_query.tst

==========

```
Test 'tpcd_acid_query'
Description 'perform the acid query.'

stringconnect "dsn=tpch;"

open cur1 {select stream, seqnum, ordr, line, delta
from acid_table
               where seqnum > 5 order by seqnum}
print ' '

let n=1
LOOP {
   fetch cur1 into str, seq, ord, lin, delta

   fetch {select round(cast(o_totalprice as
numeric(26,16)),2)
               from orders where o_orderkey=^ }
         substitute ord into o_price

   if ROWSTATUS != FOUND then { BREAK LOOP } endif
   if n > 50 then { BREAK LOOP } endif

   fetch { call acid_single_query (^) } substitute ord
into l_total
```

```
   fetch {select cast(^ as numeric(12,2)) } substitute
o_price into o_price
   fetch {select cast(^ as numeric(12,2)) } substitute
l_total into l_total

   print 'orderkey = ', ord, '       o_totalprice =
', o_price,
         '       acid query = ' , l_total

   ASSERT (o_price = l_total)
       then { print 'Did not compare correctly' }
ENDASSERT
   let n=n+1

 } ENDLOOP

disconnect

END Test
```

==========

acid_durability_setup.tst

==========

```
stringconnect "dsn=tpch;"

% Drop Table if found
allow error -141
execute { drop table acid_table }
allow no error

execute {
create table acid_table (
               stream  int     not null,
                seqnum  int    not null,
                ordr    int    not null,
                line    int    null,
                delta   int    null)
}

execute {checkpoint}

print 'acid_table CREATED!!'

fetch {select count(*) from acid_table } into ROWS
assert ROWS = 0
print 'Number of rows before load: ',ROWS
commit

LOOP ({let i = 1}; {i <= 8}; { let i = i + 1})
{
  LOOP ({let j = 1}; {j <= 200}; { let j = j + 1})
    {
       execute { call generate_acid_values()} into
ordr, line, delta
       execute { insert into acid_table values
(^,^,^,^,^) }
               substitute i,j,ordr,line,delta
    } endloop
  print (j-1)*i
} endloop

commit
execute {checkpoint}

fetch {select count(*) from acid_table } into ROWS

print 'Number of rows after load: ',ROWS

End Test
```

==========

acid_durability_txn.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print 'Durability test start = ', times
print ' '
print 'stream  trans.  o_key   l_key   p_key   s_key
delta   date_t '

LOOP ({let i = 1}; {i <= 200}; { let i = i + 1})
{
 fetch {select ordr, line, delta from acid_table
        where stream=^ and seqnum=^ }
        substitute stream, i

 if ROWSTATUS != FOUND then { print 'not enough rows'
BREAK LOOP }
 endif

 execute {select l_partkey, l_suppkey from lineitem
               where l_orderkey=^ and l_linenumber=^}
        substitute ordr, line
        into p_key, s_key

 execute {call acid_transaction( ^, ^,  ^)
         } substitute ordr, line, delta
        into  rprice, quantity, tax, disc, extprice,
ototal

 assert SQLCODE=0 then { DIE } endassert
 commit

 execute {select now(*)} into times
 print  stream,'       ',
        'txn ',i, '    ',
         ordr,  '      ',
         line,  '      ',
         p_key, '      ',
         s_key, '      ',
         delta, '      ',
         times, '      '

 sleep 1000
}
ENDLOOP

synchronize 10

End Test
```

==========

acid_functions.tst

==========

```
print 'creating the sleep procedure'

allow error -265
execute { DROP PROCEDURE dbo.sleep}
allow no error

execute{ create procedure dbo.sleep(in sleep_time
integer default null)
begin
  declare command varchar(255);
  select 'xp_cmdshell ''sleep '+str(sleep_time)+''''
into command;
  execute immediate command
end;
}

print 'creating the Acid Transaction'

allow error -265
execute { DROP PROCEDURE acid_transaction }
allow no error

execute{ CREATE PROCEDURE acid_transaction(
                IN  o_key      INT,
```

```
               IN  l_key      INT,
               IN  delta      INT,
               OUT rprice     Numeric(18,8),
               OUT quantity   INT,
               OUT tax        Numeric(18,8),
               OUT disc       Numeric(18,8),
               OUT extprice   Numeric(18,8),
               OUT ototal     Numeric(18,8)
               )
ON EXCEPTION RESUME
BEGIN
 DECLARE pkey           INT ;
 DECLARE skey           INT ;
 DECLARE cost           NUMERIC(18,8) ;
 DECLARE new_extprice   NUMERIC(18,8) ;
 DECLARE new_ototal     NUMERIC(18,8) ;
 DECLARE new_quantity   INT ;
 DECLARE c_sqlstate     char(5);
 LOOP1: LOOP
   rollback;
   call dbo.sleep(1);
    COMMIT;
    SELECT o_totalprice
      INTO ototal
      FROM orders
     WHERE o_orderkey = o_key ;
    SELECT l_quantity,
           l_extendedprice,
           l_partkey,
           l_suppkey,
           l_tax,
           l_discount
      INTO quantity,
           extprice,
           pkey,
           skey,
           tax,
           disc
      FROM lineitem
     WHERE l_orderkey   = o_key
       AND l_linenumber = l_key;
    -- CLEAN UP IMPRECICE NUMBERS
    SET ototal = ototal -
"TRUNCATE"("truncate"(extprice*(1-disc),2)*(1+tax),2);
    SET rprice = "TRUNCATE"((extprice  / quantity),2);
    SET cost = "TRUNCATE"((rprice * delta),2);
    SET new_extprice = extprice + cost;
    SET new_ototal = "TRUNCATE"(new_extprice * (1.0 -
disc),2);
    SET new_ototal = "TRUNCATE"(new_ototal * (1.0 +
tax),2);
    SET new_ototal = ototal + new_ototal ;
    SET new_quantity = quantity + delta ;
    --
    -- Update LineItem
    --
    UPDATE lineitem
       SET l_quantity      = new_quantity,
           l_extendedprice = new_extprice
     WHERE l_orderkey=o_key
       AND l_linenumber=l_key;
    SELECT SQLSTATE INTO c_sqlstate;
    IF c_sqlstate = '00000' THEN
        --
        -- Update Orders
        --
        UPDATE orders
           SET o_totalprice = new_ototal
         WHERE o_orderkey = o_key;
        SELECT SQLSTATE INTO c_sqlstate;
        IF c_sqlstate = '00000'  THEN
            INSERT INTO history VALUES ( pkey, skey,
o_key, l_key, delta, now(*)) ;
            SELECT SQLSTATE INTO c_sqlstate;
            IF c_sqlstate = '00000'  THEN
                LEAVE LOOP1;
            END IF;
        END IF;
    END IF;
 END LOOP LOOP1;
 RETURN(0);
END;
}

print 'Acid transaction created'
print ' '

print 'Creating Acid query'

allow error -265
execute { DROP PROCEDURE acid_single_query }
allow no error

execute{
CREATE PROCEDURE acid_single_query( IN o_key INT, OUT
o_total NUMERIC(26,16) )
BEGIN
    SELECT o_total =
        sum ("truncate" ("truncate"(
                          round(cast(l_extendedprice as
numeric(26,16)),2) *
                          (1 - round(cast(l_discount as
numeric(26,16)),2)),2)
                    * (1 + round(cast(l_tax as
numeric(26,16)),2)) , 2))
    FROM lineitem WHERE l_orderkey = o_key;
 END
}

print 'Acid query created'
print ' '

print 'Creating Generate_acid_values function'

allow error -265
execute { DROP PROCEDURE generate_acid_values }
allow no error

execute{
create procedure generate_acid_values(
out orderkey   int,
out linenumber int,
out delta      int)

BEGIN

 declare seed          bigint;
 declare rand_dbl      double precision;
 declare rand_int      int;
 declare out_key       int;

 declare times cursor for select
datediff(millisecond,convert(char(10),getdate(),
116),now(*));
 declare random1 cursor for select rand(seed);
 declare random cursor for select rand();
 declare get_order cursor for
       select o_orderkey from orders where o_orderkey
= rand_int;
 declare get_linenumber cursor for
       select max(l_linenumber) from lineitem
       where l_orderkey = orderkey;

 open times;
 fetch next times into seed;
 open random1;
 fetch next random1 into rand_dbl;

 set out_key = 0;
 loop1:
 while out_key = 0 LOOP
       open random;
       open get_order;

       fetch next random into rand_dbl;
       set rand_int = rand_dbl * 6001215 +1;
```

```
       fetch next get_order into out_key;

       close random;
       close get_order;
 end loop loop1;

 set orderkey = out_key;

 open get_linenumber;
 fetch next get_linenumber into linenumber;
 close get_linenumber;

 open random;
 fetch next random into rand_dbl;
 set delta = rand_dbl * 100 + 1;
 close random;

END
}
commit
execute {checkpoint}
print 'Generate_acid_values function created'
print ' '

print 'Creating Generate_Ps_Values function'

allow error -265
execute { DROP PROCEDURE generate_ps_values }
allow no error

execute{
create procedure generate_ps_values(
out partkey    int,
out suppkey    int)

BEGIN

 declare seed          bigint;
 declare rand_dbl      double precision;
 declare rand_int      int;
 declare out_key       int;
 declare counter       int;

 declare times cursor for select
datediff(millisecond,convert(char(10),getdate(),
116),now(*));
 declare random1 cursor for select rand(seed);
 declare random cursor for select rand();
 declare get_supp cursor for
       select ps_suppkey from partsupp
       where ps_suppkey = rand_int;
 declare get_part cursor for
       select ps_partkey from partsupp
       where ps_suppkey = suppkey;

 open times;
 fetch next times into seed;
 open random1;
 fetch next random1 into rand_dbl;
 close random1;

 set out_key = 0;
 while out_key = 0 LOOP
       open random;
       open get_supp ;

       fetch next random into rand_dbl;
       set rand_int = rand_dbl * 10000 +1;
       fetch next get_supp into out_key;

       close random;
       close get_supp ;
 end loop;
 set suppkey = out_key;

 set out_key = 0;
 set counter  = 0;
 open random;
 open get_part;
 fetch next random into rand_dbl;
 set rand_int = rand_dbl * 10 +1;

 loop1:
 while counter < rand_int LOOP
       set counter = counter+1;
       fetch next get_part into out_key;
 end loop loop1;

 set partkey = out_key;
 close random;
 close get_part;

END
}
commit
execute {checkpoint}
print 'Generate_Ps_Values function created'
print ' '

print 'Creating history table'

allow error -141
execute { drop table history }
allow no error

execute {
create table history (
   h_p_key    unsigned INT NOT NULL ,
   h_s_key    unsigned INT NOT NULL ,
   h_o_key    unsigned INT NOT NULL ,
   h_l_key    INT NOT NULL,
   h_delta    INT NOT NULL,
   h_date_t   TIMESTAMP NOT NULL)
}

commit
execute {checkpoint}
print 'history table created'
print ' '
```

==========

acid_isolation_main1.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print ' '
print ' '
print 'Isolation test 1'
print 'start = ', times
print ' '

include 'acid_functions.tst'
include 'acid_isolation_setup.tst'

start test  'acid_isolation_test1.tst'
start test  'acid_isolation_test1_query.tst'

End Test
```

==========

acid_isolation_main2.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print ' '
print ' '
print 'Isolation test 2'
print 'start = ', times
print ' '
```

```
include 'acid_functions.tst'
include 'acid_isolation_setup.tst'

start test  'acid_isolation_test2.tst'
start test  'acid_isolation_test2_query.tst'

End Test
```

==========

acid_isolation_main3.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print ' '
print ' '
print 'Isolation test 3'
print 'start = ', times
print ' '
print 'Isolation test start = ', times

include "acid_functions.tst"
include 'acid_isolation_setup.tst'

start test  'acid_isolation_test3_transaction1.tst'
start test  'acid_isolation_test3_transaction2.tst'

End Test
```

==========

acid_isolation_main4.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print ' '
print ' '
print 'Isolation test 4'
print 'start = ', times
print ' '
print 'Isolation test start = ', times

include 'acid_functions.tst'
include 'acid_isolation_setup.tst'

start test  'acid_isolation_test4_transaction1.tst'
start test  'acid_isolation_test4_transaction2.tst'

End Test
```

==========

acid_isolation_main5.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print ' '
print ' '
print 'Isolation test 5'
print 'start = ', times
print ' '

include 'acid_functions.tst'
include 'acid_isolation_setup.tst'

start test 'acid_isolation_test5_transaction1.tst'
start test 'acid_isolation_test5_query.tst'

End Test
```

==========

acid_isolation_main6.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print ' '
print ' '
print 'Isolation test 6'
print 'start = ', times
print ' '

include 'acid_functions.tst'
include 'acid_isolation_setup.tst'

start test '-u' 'acid_isolation_test6_query.tst'
start test  'acid_isolation_test6_transaction1.tst'

End Test
```

==========

acid_isolation_setup.tst

==========

```
stringconnect "dsn=tpch;"

% Drop Table if found

allow error -141
execute { commit }
execute { drop table acid_isolation_table }
allow no error

execute {
create table acid_isolation_table (
                ordr         int    not null,
                line         int    null,
                delta        int    null)
}

execute {checkpoint}

print 'acid_isolation_table CREATED!!'
execute {select now(*)} into times
print 'time = ', times

fetch {select count(*) from acid_isolation_table }
into ROWS
assert ROWS = 0

print 'Number of rows before load: ',ROWS

execute {call generate_acid_values()} into orderkey,
linenumber,delta
execute {insert into acid_isolation_table values ( ^ ,
^ , ^ ) }
                substitute orderkey, linenumber, delta
print  orderkey, ' ',linenumber,' ', delta

commit

fetch {select count(*) from acid_isolation_table }
into ROWS
assert ROWS = 1

print 'Number of rows after load: ',ROWS

disconnect

End Test
```

==========

acid_isolation_test1.tst

==========

```
stringconnect "dsn=tpch;"
```

```
execute {select ordr, line, delta from
acid_isolation_table}
        into ordr, line, delta

 print 'The following are the data input values for
the ACID Transaction.'
 print '(user 1) o_key-',ordr, '  l_key-', line, '
delta-',delta

 execute {call acid_transaction( ^, ^,  ^,
       rprice, quantity, tax, disc, extprice, ototal)
       } substitute ordr, line, delta

execute {select now(*)} into times
print 'User 1 waiting to commit = ', times
print ' '
synchronize 2
sleep 10000
execute {select now(*)} into times
print 'User 1 about to commit = ', times
commit

execute { select round(cast(o_totalprice as
numeric(18,2)),2)
       from orders where o_orderkey = ^}
       substitute ordr into o_total
print 'User 1 new values: '
print 'user 1 ordr= ', ordr
print 'user 1 o_total= ', o_total
print ' '

End Test
```

acid_isolation_test1_query.tst

```
stringconnect "dsn=tpch;"

 synchronize 2
 print ' '
 execute {select now(*)} into times
 print 'User 2 start query = ', times

 execute {select ordr from acid_isolation_table}
        into ordr

 print 'user 2 ordr = ', ordr
 fetch { call acid_single_query (^) } substitute ordr
into o_total
 print 'user 2 o_total=' , o_total
 print ' '

execute {select now(*)} into times
print 'User 2 completed query = ', times

disconnect

END Test
```

acid_isolation_test2.tst

```
stringconnect "dsn=tpch;"

execute {select ordr, line, delta from
acid_isolation_table}
        into ordr, line, delta

 print 'The following are the data input values for
the ACID Transaction.'
 print '(user 1) o_key-',ordr, '  l_key-', line, '
delta-',delta

 execute {call acid_transaction( ^, ^,  ^,
       rprice, quantity, tax, disc, extprice, ototal)
       } substitute ordr, line, delta

execute {select now(*)} into times
print 'User 1 waiting to roll back = ', times
print ' '
synchronize 2
sleep 10000
execute {select now(*)} into times
print 'User 1 about to roll back = ', times
rollback

execute { select round(cast(o_totalprice as
numeric(18,2)),2)
       from orders where o_orderkey = ^}
       substitute ordr into o_total
print 'User 1 new values: '
print 'user 1 ordr= ', ordr
print 'user 1 o_total= ', o_total
print ' '

End Test
```

acid_isolation_test2_query.tst

```
stringconnect "dsn=tpch;"

 synchronize 2
 print ' '
 execute {select now(*)} into times
 print 'User 2 start query = ', times

 execute {select ordr from acid_isolation_table}
        into ordr

 print 'user 2 ordr = ', ordr
 fetch { call acid_single_query (^) } substitute ordr
into o_total
 print 'user 2 o_total=' , o_total
 print ' '

execute {select now(*)} into times
print 'User 2 completed query = ', times

disconnect

END Test
```

acid_isolation_test3_transaction1.tst

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print 'Isolation test 3 test start = ', times
print ' '

 execute {select ordr, line, delta from
acid_isolation_table}
        into ordr, line, delta

 print 'User 1 --  The input data values for User 1
Acid Transaction.'
 print 'User 1 -- o_key = ',ordr
 print 'User 1 -- l_key = ',line
 print 'User 1 -- delta1 = ',delta

 print ' '
 execute {select now(*)} into times
 print 'User 1 -- Starting the Acid Transaction: ',
times

 execute {call acid_transaction( ^, ^,  ^ )}
        substitute ordr, line, delta
```

```
       into rprice, quantity, tax, disc, extprice,
ototal

 print ' '
 execute {select now(*)} into times
 print 'User 1 -- Acid Transaction complete: ', times
 print '30 second timer started'
SYNCHRONIZE 2
 sleep 30000

 print ' '
 execute {select now(*)} into times
 print 'User 1 -- starting commit: ', times

 commit
 print ' '
 execute {select now(*)} into times
 print 'User 1 -- transaction commit complete: ',
times

 print ' '
 print 'USER 1 -- original extendedprice = ', extprice
 print 'USER 1 -- original quantity = ', quantity

 fetch { select cast(^ as numeric(18,6))
              + (cast(^ as numeric(18,6))*(cast (^ as
numeric(18,6))
              /cast (^ as numeric(18,6)))) }
       substitute extprice, delta, extprice, quantity
       into result1
 % make it format nicely...
 execute { select cast(^ as numeric(18,2)) }
substitute result1 into result2

 print ' '
 print 'User 1 -- result1 = '
 print '    txn1_extendedprice + (delta1 *
(txn1_extendedprice/txn1_quantity))'
 print 'User 1 -- result1= ', result2
 print ' '

 disconnect
 End Test
```

==========

acid_isolation_test3_transaction2.tst

==========

```
stringconnect "dsn=tpch;"

execute {select ordr, line, delta from
acid_isolation_table}
       into ordr, line, delta
% generate a new set of values; we only use delta2
execute { call generate_acid_values()} into ordr2,
line2, delta2

 print ' '
 print 'User 2 - The input data values for the Acid
Transaction.'
 print 'User 2 -- o_key = ',ordr
 print 'User 2 -- l_key= ',line
 print 'User 2 -- delta2 = ',delta2

SYNCHRONIZE 2
sleep 5000

 print ' '
 execute {select now(*)} into times
 print 'User 2 -- Starting the Acid Transaction: ',
times

execute {call acid_transaction( ^, ^,  ^ ) }
       substitute ordr, line, delta2
       into rprice, quantity, tax, disc, extprice,
ototal
execute {select round(cast(^ as numeric(20,6)),2) }
       substitute extprice into extprice2

sleep 5000
print ' '
execute {select now(*)} into times
print 'User 2 -- About to commit: ', times
commit

execute {select now(*)} into times
print 'User 2 -- transaction commit complete: ', times

print ' '

print 'USER 2 -- original extendedprice = ', extprice2
print 'USER 2 -- original quantity = ', quantity
print ' '

End Test
```

==========

acid_isolation_test4_transaction1.tst

==========

```
stringconnect "dsn=tpch;"

execute {select now(*)} into times
print 'Isolation test 3 test start = ', times
print ' '

 execute {select ordr, line, delta from
acid_isolation_table}
       into ordr, line, delta

 print 'User 1 --  The input data values for User 1
Acid Transaction.'
 print 'User 1 -- o_key = ',ordr
 print 'User 1 -- l_key = ',line
 print 'User 1 -- delta1 = ',delta

 print ' '
 execute {select now(*)} into times
 print 'User 1 -- Starting the Acid Transaction: ',
times

 execute {call acid_transaction( ^, ^,  ^ )}
       substitute ordr, line, delta
       into rprice, quantity, tax, disc, extprice,
ototal

 print ' '
 execute {select now(*)} into times
 print 'User 1 -- Acid Transaction complete: ', times
 print '30 second timer started'
SYNCHRONIZE 2
 sleep 30000

 print ' '
 execute {select now(*)} into times
 print 'User 1 -- starting rollback: ', times

 rollback
 print ' '
 execute {select now(*)} into times
 print 'User 1 -- transaction rollback complete: ',
times

 execute {select round(cast(^ as numeric(20,6)),2) }
       substitute extprice into extprice2
 print ' '
 print 'USER 1 -- original extendedprice = ',
extprice2
 print 'USER 1 -- original quantity = ', quantity
 print ' '

 disconnect
 End Test
```

```
==================================================
```

acid_isolation_test4_transaction2.tst

```
==================================================

stringconnect "dsn=tpch;"

execute {select ordr, line, delta from
acid_isolation_table}
       into ordr, line, delta
% generate a new set of values; we only use delta2
execute { call generate_acid_values()} into ordr2,
line2, delta2

 print ' '
 print 'User 2 - The input data values for the Acid
Transaction.'
 print 'User 2 -- o_key = ',ordr
 print 'User 2 -- l_key= ',line
 print 'User 2 -- delta2 = ',delta2

SYNCHRONIZE 2
sleep 5000

 print ' '
 execute {select now(*)} into times
 print 'User 2 -- Starting the Acid Transaction: ',
times

execute {call acid_transaction( ^, ^,  ^ ) }
       substitute ordr, line, delta2
       into rprice, quantity, tax, disc, extprice,
ototal
execute {select round(cast(^ as numeric(20,6)),2) }
       substitute extprice into extprice2

sleep 5000
print ' '
execute {select now(*)} into times
print 'User 2 -- About to commit: ', times
commit

execute {select now(*)} into times
print 'User 2 -- transaction commit complete: ', times
print ' '
print 'USER 2 -- original extendedprice = ', extprice2
print 'USER 2 -- original quantity = ', quantity
print ' '

End Test

==================================================
```

acid_isolation_test5_query.tst

```
==================================================

stringconnect "dsn=tpch;"

synchronize 2

execute { call generate_ps_values() } into ps_ptky,
ps_spky
print ' '
print 'user 2 ps_partkey = ', ps_ptky
print 'user 2 ps_suppkey = ', ps_spky
print ' '

execute {select now(*)} into times
print 'User 2 beginning query = ', times
execute {select * from partsupp where ps_partkey=^ and
ps_suppkey=^}
       substitute ps_ptky, ps_spky
       into ps_ptky, ps_spky, ps_aly, ps_spct, ps_ct

print ' '
print 'User2 gets all columns of the PARTSUPP table '
print ' for selected ps_partkey and ps_suppkey doing a
query.'
print ' '
print 'ps_partkey = ', ps_ptky, '     ps_suppkey = ',
ps_spky
print 'ps_availqty = ', ps_aly, '     ps_supplycost =
',ps_spct
print 'ps_comment = ', ps_ct
execute {select now(*)} into times
print 'User 2 query complete = ', times
print ' '

execute {select now(*)} into times
print 'User 2 about to commit = ', times
commit
execute {select now(*)} into times
print 'User 2 transaction commit complete = ', times

print ' '

End Test

==================================================
```

acid_isolation_test5_transaction1.tst

```
==================================================

stringconnect "dsn=tpch;"

execute {select ordr, line, delta from
acid_isolation_table}
       into ordr, line, delta

 print ' '
 print 'The following are the input values for the
users1 ACID Transaction.'
 print 'o_key = ',ordr,'      l_key = ',line,'
delta = ',delta
 print ''
execute {select now(*)} into times
print 'User 1 isolation test time = ', times
print ' '
print ' '
execute {select o_totalprice from orders where
o_orderkey=^ }
       substitute ordr into o_tprice
execute {select l_extendedprice, l_quantity,l_partkey,
l_suppkey
       from lineitem
       where l_orderkey=^ and l_linenumber=^}
       substitute ordr, line
       into l_price, l_quant, l_ptky, l_spky
print 'User 1 o_totalprice = ', o_tprice
print 'User 1 l_extendedprice = ', l_price,'
l_quantity = ', l_quant
print 'User 1 l_partkey       = ', l_ptky,'  l_suppkey
= ', l_spky
print ' '

execute {select now(*)} into times
print 'User 1 starting acid transaction = ', times

execute {call acid_transaction( ^, ^,  ^, rprice,
quantity, tax, disc,
       extprice, ototal) } substitute ordr, line,
delta

execute {select now(*)} into times
print 'User 1 waiting to commit = ', times
print ' '
synchronize 2
sleep 10000
execute {select now(*)} into times
print 'User 1 about to commit = ', times
commit
execute {select now(*)} into times
print 'User 1 transaction commit complete = ', times

execute {select o_totalprice from orders where
o_orderkey=^ }
       substitute ordr into o_tprice
```

```
execute {select l_extendedprice, l_quantity
       from lineitem where l_orderkey=^ and
l_linenumber=^}
       substitute ordr, line
       into l_price, l_quant
print 'User 1 o_totalprice = ', o_tprice
print 'User 1 l_extendedprice = ', l_price,'
l_quantity = ', l_quant
print 'User 1 l_partkey       = ', l_ptky,'  l_suppkey
= ', l_spky

print ' '
execute {select * from history where h_o_key=^
       and h_date_t=(select max(h_date_t) from
history where h_o_key=^)}
       substitute ordr, ordr
       into hpk, hsk, hok, hlk, hda, hdt

print 'User 1 history entry:'
print '  h_p_key = ', hpk
print '  h_s_key = ', hsk
print '  h_o_key = ', hok
print '  h_l_key = ', hlk
print '  h_delta = ', hda
print '  h_date_t = ', hdt

execute {select now(*)} into times
print 'User 1 isolation test time = ', times
print ''

End Test
```

==========

acid_isolation_test6_query.tst

==========

```
stringconnect "dsn=tpch;"

print 'User1 Query: '
print ' '
print 'User1 starts its query (Q1) here.'
execute {select now(*)} into qstart
print 'Start time for User1 Q1 =', qstart
print ' '
compare fetchall {select
        l_returnflag,
        l_linestatus,
        sum(l_quantity) as sum_qty,
        sum(l_extendedprice) as sum_base_price,
        sum(l_extendedprice * (1 - l_discount)) as
sum_disc_price,
        sum(l_extendedprice * (1 - l_discount) * (1 +
l_tax)) as sum_charge,
        avg(l_quantity) as avg_qty,
        avg(l_extendedprice) as avg_price,
        avg(l_discount) as avg_disc,
        count(*) as count_order
from    lineitem
where   l_shipdate <= dateadd(day, -1, '1998-12-01')
group by l_returnflag,l_linestatus
order by l_returnflag,l_linestatus
 } in 'queryresult'

execute {select now(*)} into qstop
print 'Stop time for User1 Q1 =', qstop
print ' '

End Test
```

==========

acid_isolation_test6_transaction1.tst

==========

```
stringconnect "dsn=tpch;"

execute {select ordr, line, delta from
acid_isolation_table}
       into ordr, line, delta

 execute {select now(*)} into qstart2
 print 'User2 acid Transaction = ', qstart2
 print 'o_key = ',ordr, '     l_key = ',line, '
delta = ',delta
 print ' '
execute {select o_totalprice from orders where
o_orderkey=^ }
       substitute ordr into o_tprice
execute {select l_extendedprice, l_quantity,l_partkey,
l_suppkey
       from lineitem where l_orderkey=^ and
l_linenumber=^}
       substitute ordr, line
       into l_price, l_quant, l_ptky, l_spky
print 'User 2 o_totalprice = ', o_tprice
print 'User 2 l_extendedprice = ', l_price,'
l_quantity = ', l_quant
print 'User 2 l_partkey       = ', l_ptky,'
l_suppkey = ', l_spky
print ' '

execute {select now(*)} into qstart2
print 'Start Time for User2 Transaction = ', qstart2
print ' '
execute {call acid_transaction( ^, ^,  ^, rprice,
quantity,
                                tax, disc, extprice,
ototal) }
       substitute ordr, line, delta

execute {select now(*)} into qstop2
print 'User 2 about to commit = ', qstop2
commit
execute {select now(*)} into qstop2
print 'User 2 transaction commit complete = ', qstop2
print ' '

execute {select o_totalprice from orders where
o_orderkey=^ }
       substitute ordr
       into o_tprice
execute {select l_extendedprice, l_quantity
       from lineitem where l_orderkey=^ and
l_linenumber=^}
       substitute ordr, line
       into l_price, l_quant
print 'User 2 o_totalprice = ', o_tprice
print 'User 2 l_extendedprice = ', l_price,'
l_quantity = ', l_quant
print 'User 2 l_partkey       = ', l_ptky,'
l_suppkey = ', l_spky
print ' '

print ' '
execute {select * from history
       where h_o_key=^
       and h_date_t=(select max(h_date_t) from
history where h_o_key=^)}
       substitute ordr, ordr
       into hpk, hsk, hok, hlk, hda, hdt

print 'User 2 history entry:'
print '  h_p_key = ', hpk
print '  h_s_key = ', hsk
print '  h_o_key = ', hok
print '  h_l_key = ', hlk
print '  h_delta = ', hda
print '  h_date_t = ', hdt

print ' '
execute {select now(*)} into times
print 'User 2 completed = ', times

End Test
```

==========

Disk Configuration Details

==========

Solaris Volume Manager Setup

```
 Note: The instructions below pertain to the
controller number and targets generated by the
configuration used in the benchmark. Even for
identically configured systems, the controller numbers
and SCSI targets will rarely match the numbers used
here.


Perform the following steps to create the RAID
devices:

1) create at least 100MB slices on the following disks
   using the Solaris format command:
     c5t0d0
     c5t1d0

2) create the SVM state replicas via
      metadb -a -f -c1  c5t1d0s7 -c2 c5t0d0s7

3) create 10GB s0 slice and 171GB s1 slice on the
   following disks using the Solaris format command:

       c0t0d0
       c0t1d0
       c0t2d0
       c0t3d0
       c0t4d0
       c0t5d0
       c0t6d0
       c0t7d0
       c1t0d0
       c1t1d0
       c1t2d0
       c1t3d0
       c1t4d0
       c1t5d0
       c1t6d0
       c1t7d0
       c4t0d0
       c4t1d0
       c4t2d0
       c4t3d0
       c4t4d0
       c4t5d0
       c4t6d0
       c4t7d0
       c5t1d0
       c5t2d0
       c5t3d0
       c5t4d0
       c5t5d0
       c5t6d0
       c5t7d0
       c6t0d0
       c6t1d0
       c6t2d0
       c6t3d0
       c6t4d0
       c6t5d0
       c6t6d0
       c6t7d0
       c7t0d0
       c7t1d0
       c7t2d0
       c7t3d0
       c7t4d0
       c7t5d0
       c7t6d0
       c7t7d0


4) create 23 mirrored devices via

metainit d10 1 1  c0t1d0s1
metainit d11 1 1  c0t2d0s1
metainit d15 -m d10 d11

metainit d20 1 1  c0t3d0s1
metainit d21 1 1  c0t4d0s1
metainit d25 -m d20 d21

metainit d30 1 1  c0t5d0s1
metainit d31 1 1  c0t6d0s1
metainit d35 -m d30 d31

metainit d40 1 1  c0t7d0s1
metainit d41 1 1  c1t1d0s1
metainit d45 -m d40 d41

metainit d50 1 1  c1t2d0s1
metainit d51 1 1  c1t3d0s1
metainit d55 -m d50 d51

metainit d60 1 1  c1t4d0s1
metainit d61 1 1  c1t5d0s1
metainit d65 -m d60 d61

metainit d70 1 1  c1t6d0s1
metainit d71 1 1  c1t7d0s1
metainit d75 -m d70 d71

metainit d80 1 1  c4t0d0s1
metainit d81 1 1  c4t1d0s1
metainit d85 -m d80 d81

metainit d90 1 1  c4t2d0s1
metainit d91 1 1  c4t3d0s1
metainit d95 -m d90 d91

metainit d100 1 1 c4t4d0s1
metainit d101 1 1 c4t5d0s1
metainit d105 -m d100 d101

metainit d110 1 1 c4t6d0s1
metainit d111 1 1 c4t7d0s1
metainit d115 -m d110 d111

metainit d120 1 1 c5t2d0s1
metainit d121 1 1 c5t3d0s1
metainit d125 -m d120 d121

metainit d130 1 1 c5t4d0s1
metainit d131 1 1 c5t5d0s1
metainit d135 -m d130 d131

metainit d140 1 1 c5t6d0s1
metainit d141 1 1 c5t7d0s1
metainit d145 -m d140 d141

metainit d150 1 1 c6t0d0s1
metainit d151 1 1 c6t1d0s1
metainit d155 -m d150 d151

metainit d160 1 1 c6t2d0s1
metainit d161 1 1 c6t3d0s1
metainit d165 -m d160 d161

metainit d170 1 1 c6t4d0s1
metainit d171 1 1 c6t5d0s1
metainit d175 -m d170 d171

metainit d180 1 1 c6t6d0s1
metainit d181 1 1 c6t7d0s1
metainit d185 -m d180 d181

metainit d190 1 1 c7t0d0s1
metainit d191 1 1 c7t1d0s1
metainit d195 -m d190 d191

metainit d200 1 1 c7t2d0s1
```

```
metainit d201 1 1 c7t3d0s1
metainit d205 -m d200 d201

metainit d210 1 1 c7t4d0s1
metainit d211 1 1 c7t5d0s1
metainit d215 -m d210 d211

metainit d220 1 1 c7t6d0s1
metainit d221 1 1 c7t7d0s1
metainit d225 -m d220 d221

metainit d230 1 1 c0t0d0s1
metainit d231 1 1 c1t0d0s1
metainit d235 -m d230 d231

5) create the following 2GB slices:
   c4t0d0s4
   c5t0d0s1
using the Solaris format command


6) create the mirrored volume d1 via the following:

metainit d2 1 1 c4t0d0s4
metainit d3 1 1 c5t0d0s1
metainit d1 -m d2 d3
```

File System Setup

```
7) create a filesystem on /dev/md/rdsk/d1


8) mount the filesystem on /sybase2
```

Database Device Links

```
# Create the symbolic links for the mirrored
# devices by running the following shellscript

cd /sybase2
ln -s /dev/md/rdsk/d15    M01
ln -s /dev/md/rdsk/d25    M02
ln -s /dev/md/rdsk/d35    M03
ln -s /dev/md/rdsk/d45    M04
ln -s /dev/md/rdsk/d55    M05
ln -s /dev/md/rdsk/d65    M06
ln -s /dev/md/rdsk/d75    M07
ln -s /dev/md/rdsk/d85    M08
ln -s /dev/md/rdsk/d105   M09
ln -s /dev/md/rdsk/d115   M10
ln -s /dev/md/rdsk/d125   M11
ln -s /dev/md/rdsk/d135   M12
ln -s /dev/md/rdsk/d145   M13
ln -s /dev/md/rdsk/d155   M14
ln -s /dev/md/rdsk/d165   M15
ln -s /dev/md/rdsk/d175   M16
ln -s /dev/md/rdsk/d185   M17
ln -s /dev/md/rdsk/d195   M18
ln -s /dev/md/rdsk/d205   M19
ln -s /dev/md/rdsk/d215   M20
ln -s /dev/md/rdsk/d225   M21
ln -s /dev/md/rdsk/d235   M22
ln -s /dev/md/rdsk/d245   M23

# Create symbolic links for the temp devices
# by running the following shellscript

cd /sybase2
ln -s /dev/rdsk/c0t0d0s0  T01
ln -s /dev/rdsk/c0t1d0s0  T02
ln -s /dev/rdsk/c0t2d0s0  T03
ln -s /dev/rdsk/c0t3d0s0  T04
ln -s /dev/rdsk/c0t4d0s0  T05
ln -s /dev/rdsk/c0t5d0s0  T06
ln -s /dev/rdsk/c0t6d0s0  T07
ln -s /dev/rdsk/c0t7d0s0  T08
ln -s /dev/rdsk/c1t0d0s0  T09
ln -s /dev/rdsk/c1t1d0s0  T10
ln -s /dev/rdsk/c1t2d0s0  T11
ln -s /dev/rdsk/c1t3d0s0  T12
ln -s /dev/rdsk/c1t4d0s0  T13
ln -s /dev/rdsk/c1t5d0s0  T14
ln -s /dev/rdsk/c1t6d0s0  T15
ln -s /dev/rdsk/c1t7d0s0  T16
ln -s /dev/rdsk/c4t1d0s0  T17
ln -s /dev/rdsk/c4t2d0s0  T18
ln -s /dev/rdsk/c4t3d0s0  T19
ln -s /dev/rdsk/c4t4d0s0  T20
ln -s /dev/rdsk/c4t5d0s0  T21
ln -s /dev/rdsk/c4t6d0s0  T22
ln -s /dev/rdsk/c4t7d0s0  T23
ln -s /dev/rdsk/c5t1d0s0  T24
ln -s /dev/rdsk/c5t2d0s0  T25
ln -s /dev/rdsk/c5t3d0s0  T26
ln -s /dev/rdsk/c5t4d0s0  T27
ln -s /dev/rdsk/c5t5d0s0  T28
ln -s /dev/rdsk/c5t6d0s0  T29
ln -s /dev/rdsk/c5t7d0s0  T30
ln -s /dev/rdsk/c6t0d0s0  T31
ln -s /dev/rdsk/c6t1d0s0  T32
ln -s /dev/rdsk/c6t2d0s0  T33
ln -s /dev/rdsk/c6t3d0s0  T34
ln -s /dev/rdsk/c6t4d0s0  T35
ln -s /dev/rdsk/c6t5d0s0  T36
ln -s /dev/rdsk/c6t6d0s0  T37
ln -s /dev/rdsk/c6t7d0s0  T38
ln -s /dev/rdsk/c7t0d0s0  T39
ln -s /dev/rdsk/c7t1d0s0  T40
ln -s /dev/rdsk/c7t2d0s0  T41
ln -s /dev/rdsk/c7t3d0s0  T42
ln -s /dev/rdsk/c7t4d0s0  T43
ln -s /dev/rdsk/c7t5d0s0  T44
ln -s /dev/rdsk/c7t6d0s0  T45
ln -s /dev/rdsk/c7t7d0s0  T46


# issue the following commands to change permissions
chown -hR sybase T*  M*
chmod 777 M* T*
```

Appendix C. Query Text and Query Output

```
====================================================
```

qualification query 1

```
====================================================

% select
% l_returnflag,
% l_linestatus,
% sum(l_quantity) as sum_qty,
% sum(l_extendedprice) as sum_base_price,
% sum(l_extendedprice * (1 - l_discount)) as
sum_disc_price,
% sum(l_extendedprice * (1 - l_discount) * (1 +
l_tax)) as sum_charge,
% avg(l_quantity) as avg_qty,
% avg(l_extendedprice) as avg_price,
% avg(l_discount) as avg_disc,
% count(*) as count_order
% from
% lineitem
% where
% l_shipdate <= dateadd(day,-90,'1998-12-01')
% group by
% l_returnflag,
% l_linestatus
% order by
% l_returnflag,
% l_linestatus;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.32000 seconds - current
time 16:40:13
'A','F',37734107,56586554400.7292032,53758257134.86945
63,55909065222.8284717,25.5220058532573342,38273.12973
46211374,.0499852958383577168,1478493
'N','F',991417,1487504710.38000107,1413082168.05409968
,1469649223.19436967,25.5164719205229819,38284.4677608
483374,.0500934266742134809,38854
'N','O',74476040,111701729697.737336,106118230307.6073
83,110367043872.495174,25.5022267695849895,38249.11798
8907361,.049996586053555131,2920374
'R','F',37719753,56568041380.8983326,53741292684.60453
75,55889619119.8339581,25.5057936126907617,38250.85462
60985255,.0500094058300870121,1478870
% total of 4 rows written

====================================================
```

qualification query 2

```
====================================================

% select top 100
% s_acctbal,
% s_name,
% n_name,
% p_partkey,
% p_mfgr,
% s_address,
% s_phone,
% s_comment
% from
% part,
% supplier,
% partsupp,
% nation,
% region
% where
% p_partkey = ps_partkey
% and s_suppkey = ps_suppkey
% and p_size = 15
% and p_type like 'BRASS'
% and s_nationkey = n_nationkey
% and n_regionkey = r_regionkey
% and r_name = 'EUROPE'
% and ps_supplycost = (
% select
% min(ps_supplycost)
% from
% partsupp,
% supplier,
% nation,
% region
% where
% p_partkey = ps_partkey
% and s_suppkey = ps_suppkey
% and s_nationkey = n_nationkey
% and n_regionkey = r_regionkey
% and r_name = 'EUROPE'
% )
% order by
% s_acctbal desc,
% n_name,
% s_name,
% p_partkey;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.76000 seconds - current
time 16:40:25
9938.53,'Supplier#000005359       ','UNITED KINGDOM
',185358,'Manufacturer#4
','QKuHYh,vZGiwu2FWEJoLDx04','33-429-790-
6131','blithely silent pinto beans are furiously.
slyly final deposits acros'
9937.84,'Supplier#000005969       ','ROMANIA
',108438,'Manufacturer#1
','ANDENSOSmk,miq23Xfb5RWt6dvUcvt6Qa','29-520-692-
3537','carefully slow deposits use furiously. slyly
ironic platelets above the ironic'
9936.22,'Supplier#000005250       ','UNITED KINGDOM
',249,'Manufacturer#4           ','B3rqp0xbSEim4Mpy2RH
J','33-320-228-2957','blithely special packages are.
stealthily express deposits across the closely final
instructi'
9923.77000000000119,'Supplier#000002324
','GERMANY                 ',29821,'Manufacturer#4
','y3OD9UywSTOk','17-779-299-1839','quickly express
packages breach quiet pinto beans. requ'
9871.22,'Supplier#000006373       ','GERMANY
',43868,'Manufacturer#5           ','J8fcXWsTqM','17-
813-485-8637','never silent deposits integrate
furiously blit'
9870.78,'Supplier#000001286       ','GERMANY
',81285,'Manufacturer#2
','YKA,E2fjiVd7eUrzp2Ef8j1QxGo2DFnosaTEH','17-516-924-
4574','final theodolites cajole slyly special,'
9870.78,'Supplier#000001286       ','GERMANY
',181285,'Manufacturer#4
','YKA,E2fjiVd7eUrzp2Ef8j1QxGo2DFnosaTEH','17-516-924-
4574','final theodolites cajole slyly special,'
9852.52000000000119,'Supplier#000008973
','RUSSIA                  ',18972,'Manufacturer#2
','t5L67YdBYYH6o,Vz24jpDyQ9','32-188-594-
7038','quickly regular instructions wake-- carefully
unusual braids into the expres'
9847.83,'Supplier#000008097       ','RUSSIA
',130557,'Manufacturer#2
','xMe97bpE69NzdwLoX','32-375-640-3593','slyly regular
dependencies sleep slyly furiously express dep'
9847.57,'Supplier#000006345       ','FRANCE
',86344,'Manufacturer#1
','VSt3rzk3qG698u6ld8HhOByvrTcSTSvQlDQDag','16-886-
766-7945','silent pinto beans should have to snooze
carefully along the final reques'
% total of 100 rows written
```

```
====================================================
```

qualification query 3

```
====================================================

% select top 10
% l_orderkey,
% sum(l_extendedprice * (1 - l_discount)) as revenue,
% o_orderdate,
% o_shippriority
% from
% customer,
% orders,
% lineitem
% where
% c_mktsegment = 'BUILDING'
% and c_custkey = o_custkey
% and l_orderkey = o_orderkey
% and o_orderdate < '1995-03-15'
% and l_shipdate > '1995-03-15'
% group by
% l_orderkey,
% o_orderdate,
% o_shippriority
% order by
% revenue desc,
% o_orderdate;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.36000 seconds - current
time 16:40:27
2456423,406181.011100000024,'1995-03-05',0
3459808,405838.698899999917,'1995-03-04',0
492164,390324.061,'1995-02-19',0
1188320,384537.935899999976,'1995-03-09',0
2435712,378673.055799999952,'1995-02-26',0
4878020,378376.795200000048,'1995-03-12',0
5521732,375153.9215,'1995-03-13',0
2628192,373133.309399999976,'1995-02-22',0
993600,371407.45949999994,'1995-03-05',0
2300070,367371.145200000107,'1995-03-13',0
% total of 10 rows written

====================================================
```

qualification query 4

```
====================================================

% select
% o_orderpriority,
% count(*) as order_count
% from
% orders
% where
% o_orderdate >= '1993-07-01'
% and o_orderdate < dateadd(month,3,'1993-07-01')
% and exists (
% select
% *
% from
% lineitem
% where
% l_orderkey = o_orderkey
% and l_commitdate < l_receiptdate
% )
% group by
% o_orderpriority
% order by
% o_orderpriority;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.25000 seconds - current
time 16:40:31
'1-URGENT       ',10594
'2-HIGH         ',10476
'3-MEDIUM       ',10410
'4-NOT SPECIFIED',10556
'5-LOW          ',10487
% total of 5 rows written

====================================================
```

qualification query 5

```
====================================================

% select
% n_name,
% sum(l_extendedprice * (1 - l_discount)) as revenue
% from
% customer,
% orders,
% lineitem,
% supplier,
% nation,
% region
% where
% c_custkey = o_custkey
% and l_orderkey = o_orderkey
% and l_suppkey = s_suppkey
% and c_nationkey = s_nationkey
% and s_nationkey = n_nationkey
% and n_regionkey = r_regionkey
% and r_name = 'ASIA'
% and o_orderdate >= '1994-01-01'
% and o_orderdate < dateadd(year,1,'1994-01-01')
% group by
% n_name
% order by
% revenue desc;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.65000 seconds - current
time 16:40:36
'INDONESIA                ',55502041.1696999431
'VIETNAM                  ',55295086.9966999531
'CHINA                    ',53724494.2565999746
'INDIA                    ',52035512.000200057
'JAPAN                    ',45410175.6954000235
% total of 5 rows written

====================================================
```

qualification query 6

```
====================================================

% select
% sum(l_extendedprice * l_discount) as revenue
% from
% lineitem
% where
% l_shipdate >= '1994-01-01'
% and l_shipdate < dateadd(year,1,'1994-01-01')
% and l_discount between .06 - 0.01 and .06 + 0.01
% and l_quantity < 24;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.15000 seconds - current
time 16:40:41
123141078.228299007
% total of 1 rows written

====================================================
```

qualification query 7

```
====================================================
% select
```

```
% supp_nation,
% cust_nation,
% l_year,
% sum(volume) as revenue
% from
% (
% select
% n1.n_name as supp_nation,
% n2.n_name as cust_nation,
% datepart(year, l_shipdate) as l_year,
% l_extendedprice * (1 - l_discount) as volume
% from
% supplier,
% lineitem,
% orders,
% customer,
% nation n1,
% nation n2
% where
% s_suppkey = l_suppkey
% and o_orderkey = l_orderkey
% and c_custkey = o_custkey
% and s_nationkey = n1.n_nationkey
% and c_nationkey = n2.n_nationkey
% and (
% (n1.n_name = 'FRANCE' and n2.n_name = 'GERMANY')
% or (n1.n_name = 'GERMANY' and n2.n_name = 'FRANCE')
% )
% and l_shipdate between '1995-01-01' and '1996-12-31'
% ) as shipping
% group by
% supp_nation,
% cust_nation,
% l_year
% order by
% supp_nation,
% cust_nation,
% l_year;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.67000 seconds - current
time 16:40:43
'FRANCE                    ','GERMANY
',1995,54639732.7335999489
'FRANCE                    ','GERMANY
',1996,54633083.3075999737
'GERMANY                   ','FRANCE
',1995,52531746.6696999669
'GERMANY                   ','FRANCE
',1996,52520549.0223998487
% total of 4 rows written
```

==========

qualification query 8

==========

```
% select
% o_year,
% sum(case
% when nation = 'BRAZIL' then volume
% else 0
% end) / sum(volume) as mkt_share
% from
% (
% select
% datepart(year, o_orderdate) as o_year,
% l_extendedprice * (1 - l_discount) as volume,
% n2.n_name as nation
% from
% part,
% supplier,
% lineitem,
% orders,
% customer,
% nation n1,
% nation n2,
% region
% where
% p_partkey = l_partkey
% and s_suppkey = l_suppkey
% and l_orderkey = o_orderkey
% and o_custkey = c_custkey
% and c_nationkey = n1.n_nationkey
% and n1.n_regionkey = r_regionkey
% and r_name = 'AMERICA'
% and s_nationkey = n2.n_nationkey
% and o_orderdate between '1995-01-01' and '1996-12-
31'
% and p_type = 'ECONOMY ANODIZED STEEL'
% ) as all_nations
% group by
% o_year
% order by
% o_year;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.86000 seconds - current
time 16:40:47
1995,.0344358904066548347
1996,.0414855212930530345
% total of 2 rows written
```

==========

qualification query 9

==========

```
% select
% nation,
% o_year,
% sum(amount) as sum_profit
% from
% (
% select
% n_name as nation,
% datepart(year, o_orderdate) as o_year,
% l_extendedprice * (1 - l_discount) - ps_supplycost *
l_quantity as
%     amount
% from
% part,
% supplier,
% lineitem,
% partsupp,
% orders,
% nation
% where
% s_suppkey = l_suppkey
% and ps_suppkey = l_suppkey
% and ps_partkey = l_partkey
% and p_partkey = l_partkey
% and o_orderkey = l_orderkey
% and s_nationkey = n_nationkey
% and p_name like 'green'
% ) as profit
% group by
% nation,
% o_year
% order by
% nation,
% o_year desc;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.69000 seconds - current
time 16:40:48
'ALGERIA                   ',1998,31342867.2345000029
```

```
'ALGERIA                  ',1997,57138193.0233001232
'ALGERIA                  ',1996,56140140.1330001235
'ALGERIA                  ',1995,53051469.6533999741
'ALGERIA                  ',1994,53867582.128600049
'ALGERIA                  ',1993,54942718.132400012
'ALGERIA                  ',1992,54628034.7126999021
'ARGENTINA                ',1998,30211185.708099997
'ARGENTINA                ',1997,50805741.75230003
'ARGENTINA                ',1996,51923746.5754999459
% total of 175 rows written

====================================================
```

qualification query 10

```
====================================================

% select top 20
% c_custkey,% c_name,
% sum(l_extendedprice * (1 - l_discount)) as revenue,
% c_acctbal,
% n_name,
% c_address,
% c_phone,
% c_comment
% from
% customer,
% orders,
% lineitem,
% nation
% where
% c_custkey = o_custkey
% and l_orderkey = o_orderkey
% and o_orderdate >= '1993-10-01'
% and o_orderdate < dateadd(month,3,'1993-10-01')
% and l_returnflag = 'R'
% and c_nationkey = n_nationkey
% group by
% c_custkey,
% c_name,
% c_acctbal,
% c_phone,
% n_name,
% c_address,
% c_comment
% order by
% revenue desc;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.50000 seconds - current
time 16:40:55
57040,'Customer#000057040',734235.2455,632.87,'JAPAN
','Eioyzjf4pp','22-895-641-3466','requests sleep
blithely about the furiously i'
143347,'Customer#000143347',721002.694799999952,2557.4
700000000003,'EGYPT
','1aReFYv,Kw4','14-742-935-3718','fluffily bold
excuses haggle finally after the u'
60838,'Customer#000060838',679127.307700000048,2454.77
,'BRAZIL
','64EaJ5vMAHWJlBOxJklpNc2RJiWE','12-913-494-
9813','furiously even pinto beans integrate under the
ruthless foxes; ironic, even dolphins across the slyl'
101998,'Customer#000101998',637029.566699999809,3790.8
9,'UNITED KINGDOM           ','01c9CILnNtfOQYmZj','33-
593-865-6378','accounts doze blithely! enticing, final
deposits sleep blithely special accounts. slyly
express accounts pla'
125341,'Customer#000125341',633508.086,4983.5100000000
006,'GERMANY
','S29ODD6bceU8QSuuEJznkNaK','17-582-695-
5962','quickly express requests wake quickly blithely'
25501,'Customer#000025501',620269.784899999976,7725.04
,'ETHIOPIA                  ','
W556MXuoiaYCCZamJI,Rn0B4ACUGdkQ8DZ','15-874-808-
6793','quickly special requests sleep evenly among the
special deposits. special deposi'
115831,'Customer#000115831',596423.867200000167,5098.1
,'FRANCE                    ','rFeBbEEyk dl
ne7zV5fDrmiq1oK09wV7pxqCgIc','16-715-386-
3788','carefully bold excuses sleep alongside of the
thinly idle'
84223,'Customer#000084223',594998.023899999976,528.65,
'UNITED KINGDOM           ','nAVZCs6BaWap rrM27N
2qBnzc5WBauxbA','33-442-824-8191','pending, final
ideas haggle final requests. unusual, regular
asymptotes affix according to the even foxes.'
54289,'Customer#000054289',585603.391799999952,5583.02
,'IRAN                      ','vXCxoCsU0Bad5JQI
,oobkZ','20-834-292-4707','express requests sublate
blithely regular requests. regular, even ideas solve.'
39922,'Customer#000039922',584878.113399999976,7321.10
999999999881,'GERMANY
','Zgy4s50l2GKN4pLDPBU8m342gIw6R','17-147-757-
8036','even pinto beans haggle. slyly bold accounts
inte'
6226,'Customer#000006226',576783.760599999905,2230.09,
'UNITED KINGDOM
','8gPu8,NPGkfyQQ0hcIYUGPIBWc,ybP5g,','33-657-701-
3391','quickly final requests against the regular
instructions wake blithely final instructions. pa'
922,'Customer#000000922',576767.533299999833,3869.25,'
GERMANY
','Az9RFaut7NkPnc5zSD2PwHgVwr4jRzq','17-945-916-
9648','boldly final requests cajole blith'
147946,'Customer#000147946',576455.132,2030.1300000000
003,'ALGERIA
','iANyZHjqhyy7Ajah0pTrYyhJ','10-886-956-
3143','furiously even accounts are blithely above the
furiousl'
115640,'Customer#000115640',569341.193299999952,6436.1
,'ARGENTINA                 ','Vtgfia9qI
7EpHgecU1X','11-411-543-4901','final instructions are
slyly according to the'
73606,'Customer#000073606',568656.857799999952,1785.67
,'JAPAN
','xuR0Tro5yChDfOCrjkd2ol','22-437-653-
6966','furiously bold orbits about the furiously busy
requests wake across the furiously quiet theodolites.
d'
110246,'Customer#000110246',566842.981499999881,7763.3
5,'VIETNAM                   ','7KzflgX MDOq7sOkI','31-
943-426-9837','dolphins sleep blithely among the slyly
final'
142549,'Customer#000142549',563537.236799999952,5085.9
899999999994,'INDONESIA
','ChqEoK43OysjdHbtKCp6dKqjNyvvi9','19-955-562-
2398','regular, unusual dependencies boost slyly;
ironic attainments nag fluffily into the unusual
packages?'
146149,'Customer#000146149',557254.9865,1791.55,'ROMAN
IA                  ','s87fvzFQpU','29-744-164-
6487','silent, unusual requests detect quickly slyly
regul'
52528,'Customer#000052528',556397.350899999976,551.79,
'ARGENTINA                ','NFztyTOR10UOJ','11-208-
192-3205','unusual requests detect. slyly dogged
theodolites use slyly. deposit'
23431,'Customer#000023431',554269.536000000119,3381.86
,'ROMANIA
','HgiV0phqhaIa9aydNoIlb','29-915-458-
2654','instructions nag quickly. furiously bold
accounts cajol'
% total of 20 rows written

====================================================
```

qualification query 11

```
====================================================

% select
% ps_partkey,
% sum(ps_supplycost * ps_availqty) as value
% from
```

```
% partsupp,
% supplier,
% nation
% where
% ps_suppkey = s_suppkey
% and s_nationkey = n_nationkey
% and n_name = 'GERMANY'
% group by
% ps_partkey having
% sum(ps_supplycost * ps_availqty) > (
% select
% sum(ps_supplycost * ps_availqty) * 0.0001000000
% from
% partsupp,
% supplier,
% nation
% where
% ps_suppkey = s_suppkey
% and s_nationkey = n_nationkey
% and n_name = 'GERMANY'
% )
% order by
% value desc;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.49000 seconds - current
time 16:41:01
129760,17538456.8599999994
166726,16503353.9199999988
191287,16474801.9699999988
161758,16101755.5399999976
34452,15983844.7200000018
139035,15907078.3400000006
9403,15451755.6199999988
154358,15212937.8799999982
38823,15064802.8599999994
85606,15053957.150000003
% total of 1048 rows written

==========
```

qualification query 12

```
==========

% select
% l_shipmode,
% sum(case
% when o_orderpriority = '1-URGENT'
% or o_orderpriority = '2-HIGH'
% then 1
% else 0
% end) as high_line_count,
% sum(case
% when o_orderpriority <> '1-URGENT'
% and o_orderpriority <> '2-HIGH'
% then 1
% else 0
% end) as low_line_count
% from
% orders,
% lineitem
% where
% o_orderkey = l_orderkey
% and l_shipmode in ('MAIL', 'SHIP')
% and l_commitdate < l_receiptdate
% and l_shipdate < l_commitdate
% and l_receiptdate >= '1994-01-01'
% and l_receiptdate < dateadd(year,1,'1994-01-01')
% group by
% l_shipmode
% order by
% l_shipmode;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.26000 seconds - current
time 16:41:03
'MAIL      ',6202,9324
'SHIP      ',6200,9262
% total of 2 rows written

==========
```

qualification query 13

```
==========

% select
% c_count,
% count(*) as custdist
% from
% (
% select
% c_custkey,
% count(o_orderkey)
% from
% customer left outer join orders on
% c_custkey = o_custkey
% and o_comment not like 'specialrequests'
% group by
% c_custkey
% ) as c_orders (c_custkey, c_count)
% group by
% c_count
% order by
% custdist desc,
% c_count desc;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.17000 seconds - current
time 16:41:06
0,50004
9,6641
10,6566
11,6058
8,5949
12,5553
13,4989
19,4748
7,4707
18,4625
% total of 42 rows written

==========
```

qualification query 14

```
==========

% select
% 100.00 * sum(case
% when p_type like 'PROMO'
% then l_extendedprice * (1 - l_discount)
% else 0
% end) / sum(l_extendedprice * (1 - l_discount)) as
promo_revenue
% from
% lineitem,
% part
% where
% l_partkey = p_partkey
% and l_shipdate >= '1995-09-01'
% and l_shipdate < dateadd(month,1,'1995-09-01');
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.24000 seconds - current
time 16:41:19
16.3807786263955563
```

```
% total of 1 rows written
```

==========

qualification query 15

==========

```
 Executing command:
% create view revenue0 (supplier_no, total_revenue) as
% select
% l_suppkey,
% sum(l_extendedprice * (1 - l_discount))
% from
% lineitem
% where
% l_shipdate >= '1996-01-01'
% and l_shipdate < dateadd(month,3,'1996-01-01')
% group by
% l_suppkey;
% execution time 0.81000 seconds - current time
16:41:21

 Executing command:
%
% select
% s_suppkey,
% s_name,
% s_address,
% s_phone,
% total_revenue
% from
% supplier,
% revenue0
% where
% s_suppkey = supplier_no
% and total_revenue = (
% select
% max(total_revenue)
% from
% revenue0
% )
% order by
% s_suppkey;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.27000 seconds - current
time 16:41:21
8449,'Supplier#000008449
','Wp34zim9qYFbVctdW','20-469-856-
8873',1772627.20870000005
% total of 1 rows written
```

==========

qualification query 16

==========

```
% select
% p_brand,
% p_type,
% p_size,
% count(distinct ps_suppkey) as supplier_cnt
% from
% partsupp,
% part
% where
% p_partkey = ps_partkey
% and p_brand <> 'Brand#45'
% and p_type not like 'MEDIUM POLISHED'
% and p_size in (49, 14, 23, 45, 19, 3, 36, 9)
% and ps_suppkey not in (
% select
% s_suppkey
% from
% supplier
% where
% s_comment like 'CustomerComplaints'
% )
% group by
% p_brand,
% p_type,
% p_size
% order by
% supplier_cnt desc,
% p_brand,
% p_type,
% p_size;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.27000 seconds - current
time 16:41:22
'Brand#41  ','MEDIUM BRUSHED TIN',3,28
'Brand#54  ','STANDARD BRUSHED COPPER',14,27
'Brand#11  ','STANDARD BRUSHED TIN',23,24
'Brand#11  ','STANDARD BURNISHED BRASS',36,24
'Brand#15  ','MEDIUM ANODIZED NICKEL',3,24
'Brand#15  ','SMALL ANODIZED BRASS',45,24
'Brand#15  ','SMALL BURNISHED NICKEL',19,24
'Brand#21  ','MEDIUM ANODIZED COPPER',3,24
'Brand#22  ','SMALL BRUSHED NICKEL',3,24
'Brand#22  ','SMALL BURNISHED BRASS',19,24

% total of 18314 rows written
```

==========

qualification query 17

==========

```
% select
% sum(l_extendedprice) / 7.0 as avg_yearly
% from
% lineitem,
% part
% where
% p_partkey = l_partkey
% and p_brand = 'Brand#23'
% and p_container = 'MED BOX'
% and l_quantity < (
% select
% 0.2 * avg(l_quantity)
% from
% lineitem
% where
% l_partkey = p_partkey
% );
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.22000 seconds - current
time 16:41:28
348406.054285713732
% total of 1 rows written
```

==========

qualification query 18

==========

```
% select top 100
% c_name,
% c_custkey,
% o_orderkey,
% o_orderdate,
% o_totalprice,
% sum(l_quantity)
% from
% customer,
% orders,
% lineitem
```

```
% where
% o_orderkey in (
% select
% l_orderkey
% from
% lineitem
% group by
% l_orderkey having
% sum(l_quantity) > 300
% )
% and c_custkey = o_custkey
% and o_orderkey = l_orderkey
% group by
% c_name,
% c_custkey,
% o_orderkey,
% o_orderdate,
% o_totalprice
% order by
% o_totalprice desc,
% o_orderdate;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.34000 seconds - current
time 16:41:29
'Customer#000128120',128120,4722021,'1994-04-
07',544089.089999999881,323
'Customer#000144617',144617,3043270,'1997-02-
12',530604.43999999994,317
'Customer#000013940',13940,2232932,'1997-04-
13',522720.61,304
'Customer#000066790',66790,2199712,'1996-09-
30',515531.82,327
'Customer#000046435',46435,4745607,'1997-07-
03',508047.99,309
'Customer#000015272',15272,3883783,'1993-07-
28',500241.33,302
'Customer#000146608',146608,3342468,'1994-06-
12',499794.58,303
'Customer#000096103',96103,5984582,'1992-03-
16',494398.78999999994,312
'Customer#000024341',24341,1474818,'1992-11-
15',491348.26,302
'Customer#000137446',137446,5489475,'1997-05-
23',487763.25,311
% total of 57 rows written
```

==========

qualification query 19

==========

```
% select
% sum(l_extendedprice* (1 - l_discount)) as revenue
% from
% lineitem,
% part
% where
% (
% p_partkey = l_partkey
% and p_brand = 'Brand#12'
% and p_container in ('SM CASE', 'SM BOX', 'SM PACK',
'SM PKG')
% and l_quantity >= 1 and l_quantity <= 1 + 10
% and p_size between 1 and 5
% and l_shipmode in ('AIR', 'AIR REG')
% and l_shipinstruct = 'DELIVER IN PERSON'
% )
% or
% (
% p_partkey = l_partkey
% and p_brand = 'Brand#23'
% and p_container in ('MED BAG', 'MED BOX', 'MED PKG',
'MED PACK')
% and l_quantity >= 10 and l_quantity <= 10 + 10
% and p_size between 1 and 10
% and l_shipmode in ('AIR', 'AIR REG')
% and l_shipinstruct = 'DELIVER IN PERSON'
% )
% or
% (
% p_partkey = l_partkey
% and p_brand = 'Brand#34'
% and p_container in ('LG CASE', 'LG BOX', 'LG PACK',
'LG PKG')
% and l_quantity >= 20 and l_quantity <= 20 + 10
% and p_size between 1 and 15
% and l_shipmode in ('AIR', 'AIR REG')
% and l_shipinstruct = 'DELIVER IN PERSON'
% );
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.35000 seconds - current
time 16:41:46
3083843.05780000031
% total of 1 rows written
```

==========

qualification query 20

==========

```
% select
% s_name,
% s_address
% from
% supplier,
% nation
% where
% s_suppkey in (
% select
% ps_suppkey
% from
% partsupp
% where
% ps_partkey in (
% select
% p_partkey
% from
% part
% where
% p_name like 'forest'
% )
% and ps_availqty > (
% select
% 0.5 * sum(l_quantity)
% from
% lineitem
% where
% l_partkey = ps_partkey
% and l_suppkey = ps_suppkey
% and l_shipdate >= '1994-01-01'
% and l_shipdate < dateadd(year,1,'1994-01-01')
% )
% )
% and s_nationkey = n_nationkey
% and n_name = 'CANADA'
% order by
% s_name;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.37000 seconds - current
time 16:41:51
'Supplier#000000020
','iybAE,RmTymrZVYaFZva2SH,j'
'Supplier#000000091
','YV45D7TkfdQanOOZ7q9QxkyGUapU1oOWU6q3'
```

```
'Supplier#000000197
','YC2Acon6kjY3zj3Fbxs2k4Vdf7X0cd2F'
'Supplier#000000226       ','83qOdU2EYRdPQAQhEtn
GRZEd'
'Supplier#000000285
','Br7e1nnt1yxrw6ImgpJ7YdhFDjuBf'
'Supplier#000000378       ','FfbhyCxWvcPrO8ltp9'
'Supplier#000000402
','i9Sw4DoyMhzhKXCH9By,AYSgmD'
'Supplier#000000530       ','0qwCMwobKY
OcmLyfRXlagA8ukENJv,'
'Supplier#000000688       ','D
fw5ocppmZpYBBIPI718hCihLDZ5KhKX'
'Supplier#000000710       ','f19YPvOyb
QoYwjKC,oPycpGfieBAcwKJo'
% total of 204 rows written

==================================================
```

qualification query 21

```
==================================================

% select top 100
% s_name,
% count(*) as numwait
% from
% supplier,
% lineitem l1,
% orders,
% nation
% where
% s_suppkey = l1.l_suppkey
% and o_orderkey = l1.l_orderkey
% and o_orderstatus = 'F'
% and l1.l_receiptdate > l1.l_commitdate
% and exists (
% select
% *
% from
% lineitem l2
% where
% l2.l_orderkey = l1.l_orderkey
% and l2.l_suppkey <> l1.l_suppkey
% )
% and not exists (
% select
% *
% from
% lineitem l3
% where
% l3.l_orderkey = l1.l_orderkey
% and l3.l_suppkey <> l1.l_suppkey
% and l3.l_receiptdate > l3.l_commitdate
% )
% and s_nationkey = n_nationkey
% and n_name = 'SAUDI ARABIA'
% group by
% s_name
% order by
% numwait desc,
% s_name;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.54000 seconds - current
time 16:41:53
'Supplier#000002829       ',20
'Supplier#000005808       ',18
'Supplier#000000262       ',17
'Supplier#000000496       ',17
'Supplier#000002160       ',17
'Supplier#000002301       ',17
'Supplier#000002540       ',17
'Supplier#000003063       ',17
'Supplier#000005178       ',17
'Supplier#000008331       ',17
% total of 100 rows written
==================================================
```

qualification query 22

```
==================================================

% select
% cntrycode,
% count(*) as numcust,
% sum(c_acctbal) as totacctbal
% from
% (
% select
% substring(c_phone,1,2) as cntrycode,
% c_acctbal
% from
% customer
% where
% substring(c_phone,1,2) in
% ('13', '31', '23', '29', '30', '18', '17')
% and c_acctbal > (
% select
% avg(c_acctbal)
% from
% customer
% where
% c_acctbal > 0.00
% and substring(c_phone,1,2) in
% ('13', '31', '23', '29', '30', '18', '17')
% )
% and not exists (
% select
% *
% from
% orders
% where
% o_custkey = c_custkey
% )
% ) as custsale
% group by
% cntrycode
% order by
% cntrycode;
% Estimated 1 rows in query (I/O estimate 1010)
% PLAN> vt_1 (seq)
%
%
% 1 record(s) selected -- actual I/O 0
% select time including I/O 0.18000 seconds - current
time 16:42:07
'13',888,6737713.98999999881
'17',861,6460573.72
'18',964,7236687.40000001431
'23',892,6701457.95000000954
'29',948,7158866.62999999642
'30',909,6808436.13000000119
'31',922,6806670.17999998569
% total of 7 rows written
Appendix D. Seed and Query Substitution Parameters
```

This Appendix contains Seed values and substitution parameters for each stream

Seed Values

```
stream0 830044113
stream1 830044114
stream2 830044115
stream3 830044116
stream4 830044117
stream5 830044118
stream6 830044119
stream7 830044120
```

Query Parameters

```
====================================================
```

stream0:830044113

```
====================================================
14      1995-01-01
2       22      COPPER  AFRICA
9       puff
20      green   1997-01-01      BRAZIL
6       1996-01-01      0.08    25
17      Brand#14        JUMBO CAN
18      314
8       MOZAMBIQUE      AFRICA  ECONOMY PLATED TIN
21      VIETNAM
13      express         requests
3       MACHINERY       1995-03-01
22      17      34      23      30      21      24
14
16      Brand#11        ECONOMY PLATED 19       20
44      5       36      31      33      39
4       1993-02-01
11      SAUDI ARABIA    0.0000001000
15      1993-01-01
1       101
10      1994-07-01
19      Brand#42        Brand#51        Brand#51        9
        11      20
5       ASIA    1996-01-01
7       CHINA   MOZAMBIQUE
12      MAIL    FOB     1995-01-01

====================================================
```

stream1:830044114

```
====================================================
21      JORDAN
3       BUILDING        1995-03-17
18      312
5       MIDDLE EAST     1996-01-01
11      INDIA   0.0000001000
7       IRAN    INDIA
6       1996-01-01      0.05    24
20      rosy    1995-01-01      PERU
17      Brand#11        WRAP CASE
12      TRUCK   FOB     1995-01-01
16      Brand#51        STANDARD POLISHED       41
39      2       35      24      47      5       14
15      1996-01-01
13      express         requests
10      1993-05-01
2       10      STEEL   ASIA
8       INDIA   ASIA    ECONOMY ANODIZED TIN
14      1995-01-01
19      Brand#54        Brand#34        Brand#55        4
        12      27
9       papaya
22      27      32      30      11      13      21
17
1       109
4       1995-09-01

====================================================
```

stream2:830044115

```
====================================================
6       1997-01-01      0.02    24
17      Brand#13        WRAP JAR
14      1995-01-01
16      Brand#31        LARGE ANODIZED 28       10
44      36      2       3       43      18
19      Brand#51        Brand#22        Brand#54        9
        13      23
10      1994-02-01
9       navajo
2       48      BRASS   AFRICA
15      1994-01-01
8       ALGERIA         AFRICA  LARGE POLISHED NICKEL
5       AFRICA  1997-01-01
22      16      30      15      31      23      14
21
12      RAIL    SHIP    1995-01-01
7       BRAZIL  ALGERIA
13      express         accounts
18      314
1       117
4       1993-06-01
20      cornflower      1994-01-01      FRANCE
3       MACHINERY       1995-03-03
11      VIETNAM         0.0000001000
21      ETHIOPIA

====================================================
```

stream3:830044116

```
====================================================
8       PERU    AMERICA         LARGE BURNISHED NICKEL
5       AMERICA         1997-01-01
4       1996-01-01
6       1997-01-01      0.08    25
17      Brand#15        WRAP CAN
7       ROMANIA         PERU
1       64
18      315
22      18      23      10      12      22      27
20
14      1996-01-01
9       medium
10      1994-11-01
15      1996-01-01
11      INDONESIA       0.0000001000
20      navy    1997-01-01      VIETNAM
2       36      TIN     EUROPE
21      UNITED KINGDOM
19      Brand#54        Brand#55        Brand#44        4
        14      30
13      express         accounts
16      Brand#21        PROMO BURNISHED         48
40      47      15      25      8       20      36
12      REG AIR         SHIP    1996-01-01
3       BUILDING        1995-03-19

====================================================
```

stream4:830044117

```
====================================================
5       ASIA    1997-01-01
21      MOROCCO
14      1996-01-01
19      Brand#11        Brand#43        Brand#43
10      15      27
15      1994-01-01
17      Brand#12        SM CASE
12      SHIP    MAIL    1994-01-01
6       1997-01-01      0.05    24
4       1993-10-01
9       lemon
8       INDONESIA       ASIA    MEDIUM BRUSHED NICKEL
16      Brand#51        SMALL POLISHED 1        2       9
        44      32      24      46      4
11      RUSSIA  0.0000001000
2       24      COPPER  AFRICA
10      1993-08-01
18      313
1       72
13      express         accounts
7       IRAQ    INDONESIA
22      21      27      25      32      23      26
19
3       HOUSEHOLD       1995-03-05
20      aquamarine      1996-01-01      IRAQ

====================================================
```

stream5:830044118

```
====================================================
```

```
21      GERMANY                                                 7       JAPAN   IRAN
15      1996-01-01                                              10      1993-12-01
4       1996-05-01                                              16      Brand#51        MEDIUM PLATED   6       15
6       1997-01-01      0.03    24                              28      10      7       13      16      41
7       CANADA  ARGENTINA                                       6       1993-01-01      0.06    24
16      Brand#31        LARGE BRUSHED   5       23      4       14      1997-01-01
        11      9       16      25      1                       15      1997-01-01
19      Brand#13        Brand#21        Brand#42        5       12      TRUCK   REG AIR         1997-01-01
        16      23
18      314
14      1996-01-01
22      11      25      19      21      10      12
16
11      IRAN    0.0000001000
13      express         accounts
3       BUILDING        1995-03-21
1       80
2       11      STEEL   EUROPE
5       EUROPE  1997-01-01
8       ARGENTINA       AMERICA         MEDIUM PLATED
NICKEL
20      lavender        1994-01-01      ARGENTINA
12      FOB     SHIP    1996-01-01
17      Brand#14        SM JAR
10      1994-05-01
9       indian

====================================================
```

stream6:830044119

```
====================================================
10      1993-03-01
3       HOUSEHOLD       1995-03-07
15      1994-01-01
13      special         deposits
6       1993-01-01      0.08    25
8       CHINA   ASIA    MEDIUM ANODIZED BRASS
9       ghost
7       SAUDI ARABIA    CHINA
4       1994-02-01
11      UNITED KINGDOM 0.0000001000
22      25      27      12      24      28      17
26
18      312
12      MAIL    REG AIR         1996-01-01
1       88
5       MIDDLE EAST     1993-01-01
16      Brand#21        STANDARD BURNISHED      33      9
        17      15      28      2       49      22
2       49      BRASS   AMERICA
14      1996-01-01
19      Brand#15        Brand#54        Brand#31
10      18      30
20      slate   1997-01-01      MOROCCO
17      Brand#11        SM CAN
21      UNITED STATES

====================================================
```

stream7:830044120

```
====================================================

18      313
8       IRAN    MIDDLE EAST     SMALL POLISHED BRASS
20      drab    1996-01-01      ETHIOPIA
21      MOZAMBIQUE
2       37      NICKEL  EUROPE
4       1996-09-01
22      12      17      31      21      10      25
22
17      Brand#13        LG CASE
1       96
11      IRAQ    0.0000001000
9       drab
19      Brand#22        Brand#42        Brand#31        5
        19      26
3       AUTOMOBILE      1995-03-24
13      special         deposits
5       AFRICA  1993-01-01
```

Appendix E. Implementation-Specific Layer/Driver Code

```
================================================
```

```
================================================
```

ntest

```
================================================
```

```
dbisqlc -c "DSN=tpch" -q load_lineitem.sql >
load_lineitem.out &
loadlpid=$!
sleep 2200
dbisqlc -c "DSN=tpch" -q load_region.sql
dbisqlc -c "DSN=tpch" -q load_nation.sql
dbisqlc -c "DSN=tpch" -q load_customer.sql
dbisqlc -c "DSN=tpch" -q load_part.sql
dbisqlc -c "DSN=tpch" -q load_supplier.sql
dbisqlc -c "DSN=tpch" -q load_partsupp.sql
dbisqlc -c "DSN=tpch" -q load_orders.sql
loadopid=$!
wait $loadopid
wait $loadlpid
end_load.out
echo "  "
seed=`date '+%m%d%H%M%S'`;
echo $seed;
./gen_streams.ksh $seed 1000
dbisqlc -c "DSN=tpch" -q dbtables-syb.sql >
rdbtablest.out
dbisqlc -c "DSN=tpch" -q dew_cat1.sql >
dew_cat1_start.out
dbisqlc -c "DSN=tpch" -q dew_cat2.sql >
dew_cat2_start.out
dbisqlc -c "DSN=tpch" -q dew_cat3.sql >
dew_cat3_start.out
dbisqlc -c "DSN=tpch" -q check_options.sql >
check_options_start.out

touch /export/home/sybase/run/scripts/rf1.lock
touch /export/home/sybase/run/scripts/rf2.lock
dbisqlc -c "DSN=tpch" -q update_power.sql >
update_power.out &
rfspid=$!
while [ -f /export/home/sybase/run/scripts/rf1.lock ]
do
 sleep 10
done

dbisqlc -c "DSN=tpch" -q stream0.sql > stream0.out

rm -f /export/home/sybase/run/scripts/rf2.lock
wait $rfspid

dbisqlc -c "DSN=tpch" -q stream1.sql > stream1.out &
dbisqlc -c "DSN=tpch" -q stream2.sql > stream2.out &
dbisqlc -c "DSN=tpch" -q stream3.sql > stream3.out &
dbisqlc -c "DSN=tpch" -q stream4.sql > stream4.out &
dbisqlc -c "DSN=tpch" -q stream5.sql > stream5.out &
dbisqlc -c "DSN=tpch" -q stream6.sql > stream6.out &
dbisqlc -c "DSN=tpch" -q stream7.sql > stream7.out &

dbisqlc -c "DSN=tpch" -q update_throughput7.sql >
update_throughput.out &
wait


mv stream0.out m1s00q.out
mv update_power.out m1s00rf.out
mv stream1.out m1s01q.out
mv stream2.out m1s02q.out
mv stream3.out m1s03q.out
mv stream4.out m1s04q.out
mv stream5.out m1s05q.out
mv stream6.out m1s06q.out
mv stream7.out m1s07q.out

mv update_throughput.out m1s01rf.out

touch /export/home/sybase/run/scripts/rf1.lock
touch /export/home/sybase/run/scripts/rf2.lock

dbisqlc -c "DSN=tpch" -q update_power.sql >
update_power.out &
rfspid=$!
while [ -f /export/home/sybase/run/scripts/rf1.lock ]
do
 sleep 10
done

dbisqlc -c "DSN=tpch" -q stream0.sql > stream0.out
rm -f /export/home/sybase/run/scripts/rf2.lock
wait $rfspid

dbisqlc -c "DSN=tpch" -q stream1.sql > stream1.out &
dbisqlc -c "DSN=tpch" -q stream2.sql > stream2.out &
dbisqlc -c "DSN=tpch" -q stream3.sql > stream3.out &
dbisqlc -c "DSN=tpch" -q stream4.sql > stream4.out &
dbisqlc -c "DSN=tpch" -q stream5.sql > stream5.out &
dbisqlc -c "DSN=tpch" -q stream6.sql > stream6.out &
dbisqlc -c "DSN=tpch" -q stream7.sql > stream7.out &

dbisqlc -c "DSN=tpch" -q update_throughput20.sql >
update_throughput.out &
wait


dbisqlc -q -c "DSN=tpch" -q dbtables-syb.sql >
rdbtablest_end.out
dbisqlc -q -c "DSN=tpch" -q dew_cat1.sql >
dew_cat1_end.out
dbisqlc -q -c "DSN=tpch" -q dew_cat2.sql >
dew_cat2_end.out
dbisqlc -q -c "DSN=tpch" -q dew_cat3.sql >
dew_cat3_end.out
dbisqlc -q -c "DSN=tpch" check_options.sql >
check_options_end.out

mv stream0.out m2s00q.out
mv update_power.out m2s00rf.out
mv stream1.out m2s01q.out
mv stream2.out m2s02q.out
mv stream3.out m2s03q.out
mv stream4.out m2s04q.out
mv stream5.out m2s05q.out
mv stream6.out m2s06q.out
mv stream7.out m2s07q.out

mv update_throughput.out m2s01rf.out

exit
```

```
================================================
```

tpch_wait.sql

```
if exists (select 1
           from SYS.SYSPROCEDURE
           where proc_name = 'tpch_wait') then
    DROP procedure tpch_wait;
end if
;

-- Script to put a dealy between TPCH updates.
-- Normally we just want to sleep a bit to spread
updates out
-- through the entire throughput test. Sometimes we
run out of
```

```
-- space; if so, just wait some more...
create procedure tpch_wait()
begin

  declare local temporary table t_iq_spaceused(
    mainKB     unsigned bigint,
    mainKBUsed unsigned bigInt,
    tempKB     unsigned bigInt,
    tempKBUsed unsigned bigInt,
    )
    in SYSTEM on commit preserve rows;

  declare maintotal unsigned bigint;
  declare mainused unsigned bigint;
  declare temptotal unsigned bigint;
  declare tempused unsigned bigint;
  declare mainfree unsigned bigint;
  declare command varchar(255);

  select 'xp_cmdshell ''sleep 120''' into command;

  waitloop:
  LOOP
        truncate table t_iq_spaceused;
        execute immediate
             'iq utilities main into t_iq_spaceused
command statistics 30000' ;

        select          mainKB,
                        mainKBUsed,
                        tempKB,
                        tempKBUsed
          into maintotal, mainused, temptotal,
tempused
          from t_iq_spaceused;

        message 'TPCH main total: ',maintotal,'  main
used : ',mainused;
        message 'TPCH temp total: ',temptotal,'  temp
used : ',tempused;
        set mainfree = maintotal-mainused;
        message 'TPCH main free : ',mainfree;

        if ( mainfree > 12400000 )
                then leave waitloop;
                end if;

        select 'xp_cmdshell ''sleep 300''' into
command;
        execute immediate command;

  END LOOP waitloop;

  drop table t_iq_spaceused;
  commit;
end
;
```

Appendix F. Misc database scripts

The dbtables-syb.sql script was run to validate the correctness of the database after the database load. Three other scripts were used to extract basic information about tables and indexes from the database dew_cat1.sql, dew_cat2.sql, dew_cat3.sql.

Auditor Scripts

==========

dbtables-syb.sql

==========

```
-- ================================================
--  FILENAME
--       DBTABLES.SQL
--  DESCRIPTION
--       CHECK ROW COUNT AND ROW STRUCTURE/CONTENT FOR
EACH TABLE
--       IN THE TPC-H DATABASE.
--
-- ================================================
--
-- GET TIMESTAMP
SELECT 'START TIME', CONVERT(CHAR(30), GETDATE(),
120);
go
-- ================================================
--           TABLE: LINEITEM
-- ================================================
SELECT COUNT(*) FROM LINEITEM;
go
SELECT * FROM LINEITEM
WHERE L_ORDERKEY IN
      ( 4, 26598,  148577,  387431, 56704, 517442,
600000)
      AND L_LINENUMBER = 1
ORDER BY L_ORDERKEY;
go
-- ================================================
--           TABLE: ORDERS
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
SELECT COUNT(*) FROM ORDERS;
go
SELECT * FROM ORDERS
WHERE O_ORDERKEY IN ( 7, 44065, 287590, 411111,
483876, 599942 )
ORDER BY O_ORDERKEY;
go
-- ================================================
--           TABLE: PART
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
SELECT COUNT(*) FROM PART;
go
SELECT * FROM PART
WHERE P_PARTKEY IN (1,984,8743,9028,13876,17899,20000)
ORDER BY P_PARTKEY;
go
-- ================================================
--           TABLE: PARTSUPP
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
SELECT COUNT(*) FROM PARTSUPP;
go
SELECT* FROM PARTSUPP
   WHERE PS_PARTKEY = 3398
   AND PS_SUPPKEY = (SELECT MIN(PS_SUPPKEY)
      FROM PARTSUPP WHERE PS_PARTKEY = 3398);
go
SELECT* FROM PARTSUPP
   WHERE PS_PARTKEY =15873
   AND PS_SUPPKEY = (SELECT MIN(PS_SUPPKEY)
      FROM PARTSUPP WHERE PS_PARTKEY = 15873);
go
SELECT* FROM PARTSUPP
   WHERE PS_PARTKEY = 11394
   AND PS_SUPPKEY = (SELECT MIN(PS_SUPPKEY)
      FROM PARTSUPP WHERE PS_PARTKEY = 11394);
go
SELECT* FROM PARTSUPP
   WHERE PS_PARTKEY = 6743
   AND PS_SUPPKEY = (SELECT MIN(PS_SUPPKEY)
      FROM PARTSUPP WHERE PS_PARTKEY = 6743);
go
SELECT* FROM PARTSUPP
   WHERE PS_PARTKEY = 19763
   AND PS_SUPPKEY = (SELECT MIN(PS_SUPPKEY)      FROM
PARTSUPP WHERE PS_PARTKEY =19763);
go
-- ================================================
--           TABLE: SUPPLIER
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
SELECT COUNT(*) FROM SUPPLIER;
go
SELECT * FROM SUPPLIER
WHERE  S_SUPPKEY IN (83,265,492,784,901,1000)
ORDER BY S_SUPPKEY;
go
-- ================================================
--           TABLE: CUSTOMER
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
SELECT COUNT(*) FROM CUSTOMER;
go
SELECT * FROM CUSTOMER
WHERE  C_CUSTKEY IN (832,2653,4924,7845,92016,108070)
ORDER BY C_CUSTKEY;
go
-- ================================================
--           TABLE: NATION & REGION
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
SELECT * FROM REGION;
go
SELECT COUNT(*) FROM NATION;
go
SELECT * FROM NATION
WHERE N_NATIONKEY IN (3,10,14,20)
ORDER BY N_NATIONKEY;
go
-- ================================================
--           CHECK KEY VALUES
-- ================================================
-- GET TIMESTAMP
SELECT 'TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
if exists (select name from sysobjects where
name='MINMAX')
  drop table MINMAX
go
CREATE TABLE MINMAX
(TNAME CHAR(15),
KEYMIN INTEGER,
KEYMAX INTEGER);
go
INSERT INTO MINMAX
```

```
SELECT 'LINEITEM_ORD',MIN(L_ORDERKEY),MAX(L_ORDERKEY)
FROM LINEITEM;
go
INSERT INTO MINMAX
SELECT
'LINEITEM_NBR',MIN(L_LINENUMBER),MAX(L_LINENUMBER)
FROM LINEITEM;
go
INSERT INTO MINMAX
SELECT 'ORDERS',MIN(O_ORDERKEY),MAX(O_ORDERKEY)
FROM ORDERS;
go
INSERT INTO MINMAX
SELECT 'CUSTOMER',MIN(C_CUSTKEY),MAX(C_CUSTKEY)
FROM CUSTOMER;
go
INSERT INTO MINMAX
SELECT 'PART',MIN(P_PARTKEY),MAX(P_PARTKEY)
FROM PART;
go
INSERT INTO MINMAX
SELECT 'SUPPLIER',MIN(S_SUPPKEY),MAX(S_SUPPKEY)
FROM SUPPLIER;
go
INSERT INTO MINMAX
SELECT 'PARTSUPP_PART',MIN(PS_PARTKEY),MAX(PS_PARTKEY)
FROM PARTSUPP;
go
INSERT INTO MINMAX
SELECT 'PARTSUPP_SUPP',MIN(PS_SUPPKEY),MAX(PS_SUPPKEY)
FROM PARTSUPP;
go
INSERT INTO MINMAX
SELECT 'NATION',MIN(N_NATIONKEY),MAX(N_NATIONKEY)
FROM NATION;
go
INSERT INTO MINMAX
SELECT 'REGION',MIN(R_REGIONKEY),MAX(R_REGIONKEY)
FROM REGION;
go
SELECT * FROM MINMAX;
go
if exists (select name from sysobjects where
name='MINMAX')
  drop table MINMAX
go
SELECT 'END TIME', CONVERT(CHAR(30), GETDATE(), 120);
go
```

==========

dew_cat1.sql

==========

```
SELECT  st.table_name,
                 st.table_type,
                 su.user_name,
                 st.server_type
          from SYS.SYSTABLE st, SYS.SYSUSERPERMS su
          where creator = user_id
order by 4,1,3;
```

==========

dew_cat2.sql

==========

```
 select T.table_name    ,
       T.table_type    ,
        C.column_name   ,
        C.column_id
 From   SYS.SYSTABLE T,
        SYS.SYSCOLUMN C,
        SYS.SYSDOMAIN D,
        SYS.SYSUSERPERMS SU
 where T.creator = SU.user_id
   and T.table_id = C.table_id
   and C.domain_id = D.domain_id
order by 1,2;
```

==========

dew_cat3.sql

==========

```
SELECT  index_name,T.table_name  ,
        column_name   ,
        index_type
 from   SYS.SYSTABLE T,
        SYS.SYSCOLUMN C,
        SYS.SYSINDEX I,
        SYS.SYSUSERPERMS UP,
        SYS.SYSFILE F,
        SYS.SYSIXCOL IC
 where T.table_id = C.table_id
   and C.table_id = I.table_id
   and T.file_id = F.file_id
   and I.table_id = IC.table_id
   AND I.index_id = IC.index_id
   AND IC.column_id = C.column_id
   and T.creator = UP.user_id;
```

Appendix G. Pricing information

Price quotes from Sybase Inc and Innovative Systems Design are included below.

Company Sun Microsystems
Contact Richard Gostanian
Phone 781-442-3063
Fax
Address 1 Network Drive, Burlington MA 01803

Quotation for Software and Support

SYBASE Sales Rep: Hollie Nash
Phone: 972-687-6412
Fax: 972-687-6409

CBSS#

	Catalogue Number	Product Description	License Type	Machine	P/S	List Price Per Unit	Quantity	Discount	Extended Price	Extended Support Fees
										3 YEARS
1	12841	Sybase IQ Single App Svr, per cpu core	CP	Sun	P	2,595	4		10,380.00	
3	98480	3 yr support Single App Svr, per cpu core				1,557	4			6,228.00
4		Discount						0		
5		10% if license + support > 50000								
6		5% if license + support > 25000								
7		0 otherwise								
8										
9										
10										
11										
12										

Quote Date: ***5/25/07***
Valid thru:

Total 16,608.00
Licence + 3 year support

Payment terms : Net 30 Days

5400 LBJ Freeway, Suite 1500, Dallas, TX 75240

innovativ®
SYSTEMS DESIGN

204 Fernwood Avenue, Edison, NJ 08837
Phone: (732) 417-1162 Fax: (732) 225-8351

www.innovativ.com

To: Sun Microsystems

QUOTE QT042214

Please reference this quote # on your purchase ord

Date: 10/11/07
Issued By: Dan Pearson
Phone #: (800) 352-8064
Email: dpearson@innovativ.com
Project

Thank you for your inquiry. We are pleased to quote as follow

Please fax all purchase orders to: (732) 225-8351

Master ID	Salesperson	Customer ID	Payment Terms	Purchase Order
39089	Miscellaneous Ph: () -	SUN MICRO 01	NET 45	

Line	Item / Description	Qty	List Price	Discount	Unit Price	Ext. Price
1	A76-PPZ2-16G-GMH SUN FIRE X4500 X64 SERVER: 2X AMD OPTERON MODEL DUAL-CORE 290 (2.8GHZ/1MB) PROCESSOR, 16GB PC3200 DDR1/400 (8 X 2GB) MEMORY, 48 SATA 3.5" 250GB 7200RPM HDD; 12TB, 2X PSU, SERVICE PROCESSOR, 4X 10/100/1000 ETHERNET PORTS, 4X USB 2.0 PORTS,	1	$23,995.00	10.00%	$21,595.50	$21,595.50
2	X320A Power Cord Sun Fire 3800-4810 server, Sun Fire V490 server, Sun Fire V890 server, Direct to wall, N. American, RoHS-6	2				
3	W9D-A76-3G Sun Fire X4500 server upgrade to 3 years of Gold support.	1	$7,236.00		$7,236.00	$7,236.00

Please Note: **Quote expires 30 days from date of Quote.** This quote is provided subject to the attached ISD Terms and Conditions. Some conditions or additions may be necessary before this quote is final, which may include but is not limited to Insurance, Frieght, and applicable Sales

Systems will not be integrated unless requested and quoted.

Returns must be in original unopened packaging and factory seals must be intact. All returns must be made within 15 days and have an RMA# assigned by Innovativ. The RMA number must be clearly marked on the shipping label ONLY. Writing on boxes will invalidate the return. **No discontinued, promotional, special order, remanufactured or specially configured/integrated products may be returned to Innovativ Systems**

Total $28,831.50

(excluding tax and Freight)

The information contained in this quote is proprietary and is provided for the use of the intended recipiant and may not be disclosed to any other parties without the express written consent of Innovativ Systems Design, In

Innovativ Systems Design, Inc. Terms & Conditions

"**Agreement**" means the terms and conditions set fourth herein and any Software License set forth in Section 9 of this Order in which case the software license terms contained in or with the Software will control.

"**ISD**" means ISD incorporated, the Seller and/or Licensor.

"**Customer**" means the Purchaser and/or Licensee designated on the reverse side of this Order.

"**Order**" means the transaction noted on the reverse side of this Sales Order and these terms and conditions of Agreement.

"**System**" means the hardware and software items listed on the reverse side of this Order.

"**Licensed Software**" means all application and/or operating system software appearing on the reverse side of this Order (except as otherwise noted thereon or on the ISD Sales Order Acknowledgement) including the media upon which it is stored, related materials, instructional material, updates and pertinent information furnished to Customer by ISD pursuant to a valid software license created by this or any other agreement.

"**Use**" means copying any portion of the Licensed Software from storage units or media into the System for processing, or use in the course of the Customer's internal operations.

2. **ORDERS** This Order shall not become binding upon ISD until Customer receives a ISD Order Acknowledgement. Notwithstanding the Customer's receipt of a ISD Order Acknowledgement or anything to the contrary contained in any Customer correspondence or Customer purchase order, all changes or additions to the terms of the initial or any subsequent Order must be accepted in writing by an authorized representative of ISD at its home office. Any such acceptance may be rescinded in the event ISD receives an unsatisfactory credit report within 30 days of said acceptance. Shipping dates are approximate and deliveries are subject to delays. ISD shall not be liable for any loss, damage or delays due to transportation, fire, strike, civil or military authority, insurrection or any other causes beyond its control.

3. **PRICES** All prices and license fees quoted on the reverse side of this Order shall be F.O.B. ISD or its supplier's US plant and shall not include taxes, transportation, insurance in transit, export fees, or other custom duties. Customer shall either pay for such items directly or promptly reimburse ISD for any payments made on Customer's behalf. Customers wishing to claim tax exemption shall submit proper exemption forms prior to delivery.

4. **PAYMENT** Invoices under this Agreement shall be paid net within thirty (30) days after date of invoice. A late charge will be assessed against and paid by Customer on invoice(s) balance(s) thirty (30) days or more overdue at the rate of one and one-half percent (11/2 %) per month or part hereof (or the maximum legal rate allowed, whichever is less).

5. **TAXES** Customer shall pay all federal, state and local sales, use property, excise, or other taxes imposed on or with respect to the purchase price of the hardware or license of software under this Agreement, except taxes levied on ISD net income.

6. **FREIGHT AND INSTALLATION CHARGES** Customer shall pay all freight and installation charges.

7. **DELIVERY** Delivery shall be F.O.B. ISD's plant; Title to hardware and risk of loss and damage shall pass to Customer upon delivery of the hardware to a common carrier at ISD's plant. In the absence of Customer's prior written instruction to the contrary, ISD shall select the common carrier for shipment; although the common carrier shall not be considered ISD's agent.

ISD reserves a security interest in the Designated Hardware and in any proceeds thereof to secure Customer's obligations to ISD. Customer shall promptly execute any documents requested by ISD to perfect such security interest. In the event of non-payment when due, ISD may upon written notice, repossess the Designated Hardware without prejudice to any other legal remedy available for said non-payment.

8. **ACCEPTANCE**

A. **HARDWARE ACCEPTANCE** Hardware acceptance shall take place upon the earlier of two occurrences: (i) delivery of the designated Hardware to the Customer; or (ii) where the Customer has previously contracted to have ISD perform the installation, a ISD representative will promptly notify Customer upon completion of the installation.

B. **SOFTWARE ACCEPTANCE** Software Acceptance shall take place upon the earlier of two occurrences: (i) delivery of Licensed Software to the Customer in an appropriate medium for loading onto the Designated Hardware; or (ii) where ISD Software policies dictate, installation of certain of the Licensed Software by a ISD representative at or around the time of the Designated Hardware installation referred to in the above.

9. **SOFTWARE LICENSE** ISD hereby grants Customer a non-exclusive non-assignable, non-transferable personal license of the Licensed Software for the Customer's internal perpetual Use on the Designated Hardware Customer agrees not to, without ISD's prior written consent, a) rent, lease, lend, sublicense, or otherwise transfer their Licensed Software or associated documentation hereunder b) remove or obscure the proprietary legend, copyright notice or any similar proprietary notice of ISD and/or its suppliers c) alter, de-compile or disassemble any of the programs which comprise the Licensed Software d) utilize the Licensed Software on any service bureau, time-sharing or interactive cable system not otherwise included in the Designated Hardware.

10. **COPIES** Customer may make up to five (5) copies, in whole or in part; of the Licensed Software and/or associated documentation as may be reasonably necessary for the in-house backup or archive purposes; additionally the Licensed Software may be temporarily transferred for a reasonable period of time, not to exceed fifteen days (15), for Use on Customer's back-up hardware if the Designated Hardware is inoperable.

11. **PROPRIETARY DATA** The Licensed Software is a proprietary product of ISD and/or its suppliers (for certain designated Licensed Software Customer shall execute a Sublicense Agreement, Exhibit A). The Customer, by accepting this license, receives a lease to Use the Licensed Software and associated documentation as specified herein but gains no other right, title or interest therein. Customer recognizes the Licensed Software and associated documentation may be copyrighted, although the act of copyrighting should not be construed as causing the Licensed Software to be in the public domain. Customer agrees to immediately notify ISD of circumstances surrounding and unauthorized knowledge, possession or use of the Licensed Software or any such materials by any person or entity.

12. **PROTECTION OF LICENSED SOFTWARE** Customers agrees not to provide or otherwise make available any Licensed Software, in any form, to any other person. Customer agrees that it will take appropriate action with its employees or other persons permitted access to Licensed Software to satisfy its obligations under the Agreement with respect to Use, copying, modification and security of the Licensed Software.

13. **ISD LIMITED WARRANTY**

A. **LIMITED HARDWARE AND SOFTWARE WARRANTY** – ISD is a value add reseller of Hardware manufactured and Software published by a third party. ISD provides all Hardware and Software in new condition and subject to the respective manufactures or publisher's new warranty. These warranties are offered in lieu of all other warranties express or implied at law.

B. **SERVICES** – Services are provided in a good and workmanlike manner. In the event any Service fails to comply with this warranty and Customer notifies ISD in writing within 90 days from the date of Service delivery, then ISD's exclusive liability and Customer's exclusive remedy is ISD providing a like number of hours of good and workmanlike Services.

C. **RESIDUAL WARRANTY DISCLAIMER** – ISD MAKES NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY AND/OR FITNESS FOR A PARTICULAR PURPOSE: EXCEPT AS STATE ABOVE, ISD SHALL HAVE NO OBLIGATION OR LIABILITIES TO CUSTOMER OR ANY OTHER PERSON FOR ANY SPECIAL, INDIRECT, CONSEQUENTIAL OR INCIDENTIAL DAMAGES, ARISING OUT OF OR RELATED TO THIS AGREEMENT, THE USE OR PERFORMANCE OF THE SYSTEM, OR ANY OTHER MANNER.

14. **INDEMNIFICATION** ISD will hold Customer harmless from, and at its own expense, will defend any action brought against Customer based on any System component supplied under this Agreement infringe a United States Patent, Trademark or Copyright when used within the scope of this Agreement, provided the Customer notifies ISD promptly in writing of such claim, ISD has sole control of the defense of the action and all negotiations for its settlement or compromise, and Customer cooperates with ISD in the defense of the action and all negotiations for its settlement or compromise, and Customer cooperates with ISD in the defense of the action. In the event that any component of the above referenced System becomes, of in ISD's opinion is likely to become, the subject of a claim of infringement of a United States Patent, Trademark, or Copyright, ISD, at its option may: (i) secure for Customer the right to continue using the affected System (ii) modify or replace the System so that it becomes non-infringing, provided that the performance is not materially adversely affected or (ii), if (i) and (ii) are not reasonably practicable, accept return of the System and, refund to Customer the depreciated value of the System based upon a five year straight-line depreciation schedule.

ISD shall not have any liability under this Agreement if the infringement or claim is based upon: (i) interconnection and/or use of the System with equipment not supplied by ISD (ii) use
of the System in a manner for which the System was not designed (iii) modification of the System by a party other than ISD or (iv) modification by ISD in compliance with any designs, specifications or instructions furnished to ISD by Customer.

THE FOREGOING STATES CUSTOMER'S EXCLUSIVE RIGHTS AND REMEDIES WITH RESPECT TO AN INFRINGEMENT OF ANY UNITED STATES PATENT TRADEMARK OR COPYRIGHT BY ANY SYSTEM, IN PART OR IN WHOLE, SUPPLIED TO CUSTOMER UNDER THIS AGREEMENT.

15. **LIMITATION OF REMEDIES** ISD liability under this Agreement from any and all causes, including negligence but exclusive of claims for damages arising from bodily injury or loss of tangible property shall be limited to general money damages in an amount not to exceed the total amount of payment due under its Agreement. Such amount shall be the extent of ISD's liability regardless of the form in which any legal or equitable action may be brought and the foregoing shall constitute damaged party's sole remedy. In no event will ISD's be responsible for special, indirect, incidental or consequential damages including but not limited to, loss of data or damage to business reputation, even if previously advised of the possibility of such damages. No legal action regardless of the form, relating in any manner to this Agreement may be brought by either party more than one year after recognition of the event giving rise to the cause of action with the exception of non-payment hereunder, or actions for breach of ISD's intellectual property rights.

16. **ENVIRONMENTAL CONSTRAINTS** Customer acknowledges that ISD has advised Customer of the environmental conditions required to be maintained for the System to assure proper operation and functioning of the System. Compliance with said environmental conditions is a prerequisite for any Warranty eligibility under this Agreement and/or coverage under the ISD Maintenance Agreement.

17. **ASSIGNMENT** This Agreement is non-transferable and un-assignable by Customer without the prior written consent of ISD, said consent shall not be unreasonably withheld.

18. **TERMINATION**

A. **EVENTS CONSTITUTING TERMINATION**: The License granted herein shall terminate at such time as: (i) Customer discontinues use of the Licensed Software, or upon sale, lease or transfer of the System, with the exception of an assignment in accordance with Article 17 of this Agreement; (ii) if Customer becomes insolvent, ceases doing business, files a petition in Bankruptcy; or (iii) if the Customer fails to cure any breach of this Agreement within (30) days of written notice from ISD specifying such breach.

B. **OBLIGATIONS UPON TERMINATION**. Upon termination of this Agreement or the License granted herein. Customer shall discontinue use of the Licensed Software within (10) ten days and certify in writing to ISD that all copies of the Licensed Software, in whole or in part, in any form, have been destroyed or returned to ISD.

C. **SURVIVAL UPON TERMINATION**. The other rights and obligations of the parties pursuant to Articles 9, 10, 11, 12, 14, 15, 18, and 19 of this Agreement shall survive and continue after any termination of this License.

19. **THIRD PARTY RIGHTS** Where ISD's rights to any of the products or services licensed or sold hereunder arise under an agreement with a third party supplier such supplier shall have the benefit of ISD's rights, as set forth in this Agreement, and may enforce such rights directly.

20. **WAIVER** Failure on the part of either party to give notice of default, or delay in exercising any right or remedy hereunder, shall not operate as a waiver of any such right or remedy except as otherwise stated in Paragraph number 15 of this Agreement.

21. **SEVERABILITY** In the event that any provision of this Agreement is held invalid, illegal or unenforceable, the remaining provisions shall be enforced to the maximum extent permitted by applicable law.

22. **APPLICABLE LAW** This contract is governed by the laws of the State of New Jersey, excluding choice of Law rules.

23. **ENTIRE AGREEMENT** This Agreement sets forth the entire understanding of the parties with respect to the subject matter hereof and is binding upon both parties in accordance with its terms. There are no understandings, representations, agreements with respect to this matter, and this Agreement may only be amended by mutual written consent of the parties.