Hewlett-Packard Company
Network Server Division

HP NetServer LX Pro
Using Microsoft SQL Severer 6.5 on Microsoft NT 4.0

TPC Benchmark® C
Full Disclosure Report

First Edition
Submitted for Review
April 3, 1997

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All performance data contained in this report was obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. Hewlett-Packard Company does not warrant or represent that a user can or will achieve similar performance expressed in transactions per minute (tpmC®) or normalized price/performance ($/tpmC®). No warranty of system performance or price/performance is expressed or implied in this report.

Printed in U.S.A., April 3, 1997

Abstract

Overview

This report documents the methodology and results of the TPC Benchmark® C test conducted on the NetServer LX Pro in a client/server configuration, using Microsoft SQLServer 6.5 SP3™ and the TUXEDO transaction monitor. The operating system used for the benchmark was Microsoft NT Server 4.0. The application was written in C and compiled using Microsoft Visual C++.

TPC Benchmark® C Metrics

The standard TPC Benchmark® C metrics, tpmC® (transactions per minute), price per tpmC® (five year capital cost per measured tpmC®), and the availability date are reported as required by the benchmark specification.

Standard and Executive Summary Statements

Page ***iv*** contains the standard system summary and pages ***v-vi*** contain the executive summary of the benchmark results for the HP NetServer LX Pro system.

Auditor

The benchmark configuration, environment and methodology used to produce and validate the test results, and the pricing model used to calculate the cost per tpmC®, were audited by Richard Gimarc of Performance Metrics, Inc. to verify compliance with the relevant TPC specifications.

Standard System Summary

Company Name	System Name	Database Software	Operating System Software
Hewlett-Packard Co.	Hewlett-Packard NetServer 6/200 LX Pro SMP (4-way)	Micorosoft SQL Server v6.5.242	Microsoft NT Server 4.0
Availability Date — HW: April 3, 1997 SW: April 3, 1997			

Total System Cost	TPC-C® Throughput	Price/Performance
Hardware software 5-year maintenance	Sustained maximum throughput of system running TPC-C® expressed in transactions per minute	Total system cost/tpmC® ($581,896/8028.07)
$581,896	**8028.07 tpmC®**	**$72.48 per tpmC®**

Additional copies of this Full Disclosure Report can be obtained from either the Transaction Processing Performance Council or Hewlett-Packard Company at the following address:

Transaction Processing Performance Council (TPC)
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San Jose, CA 95112, USA
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or

Hewlett-Packard Company/NetWork Server Division
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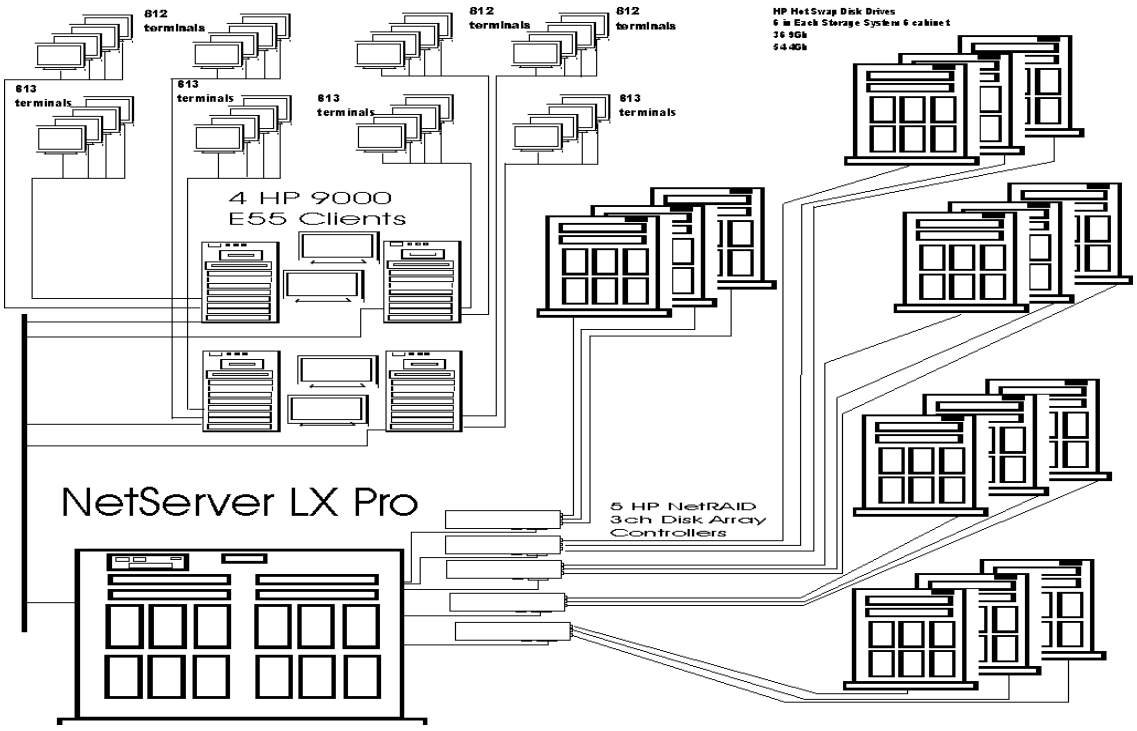
Santa Clara, CA 95052-8059 USA

attention: Jim Nagler, bldg 53U

Hewlett-Packard Co.	NetServer LX Pro Client/Server with 4 HPUX Model E55 front-ends			TPC-C® Rev 3.2 Report Date: April 3, 1997
Total System Cost	**TPC-C® Throughput**		**Price/Performance**	**Availability Date**
$581,896	**8028.07 tpmC®**		**$72.48 / tpmC®**	**April 3, 1997**
Processors	**Database Manager**	**Operating System**	**Other Software**	**Number of Users**
4 Intel Pentium Pro 200MHz	**Microsoft SQL Server v. 6.5.SP3**	**Microsoft NT Server 4.0 HPUX 10.01**	**Microsoft C++ Compiler Visigenic ODBC Library TUXEDO Transaction Monitor**	**6,500**



System Components	*Server (LX Pro)*		*Each Client (E55)*	
	Qty	*Type*	*Qty*	*Type*
Processors	**4**	**200 MHz Intel Pentium Pro**	**1**	**96 MHz PA-RISC 7100LC**
Cache memory	***each***	**512KB cache**		**256 KB combined external cache**
Memory	**2**	**GB**	**512**	**MB**
Disk Array Controllers	**5**	**HP NetRaid Controllers**	**1**	**HP-PB SE SCSI-2**
Disk Drives	**38** **61**	**HP Hot-Swap 9G SCSI** **HP Hot-Swap 4G SCSI**	**1**	**1 GB Disk**
Total Storage (GB)	**591**	**GB**		
Tape Drives	**1**	**DAT Storage System**		
Terminals	**1**	**Console terminal**	**1**	**Console terminal**

Hewlett-Packard Co.	NetServer LX Pro	TPC-C® Rev 3.2 Report Date: April 3, 1997

Hardware and Software Pricing

Description	Part Number	3d Party Brand	3d Party $	Unit Price	Qty.	Extended Price	5 Year Maint. $
Server Hardware							
HP NetServer LX Pro 6/200 SMP M1 Array Dual Pentium Pro	D4958B	HP	1	25,909	1	25,909	
3 year, on-site, next day warranty	included						
2 200MHz Pentium Pro processors, 512 MB memory	included						
12 Hot swap disk bays	included						
HP NetRaid Disk Array Controller - F/W SCSI-2	included						
Integrated dualPCI F/W SCSI-2cntrlrs&IDEcontrller	included						
Integrtd1024x768 16color 512KB video memory	included						
CD-ROM drive, 3.5-inch, 1.44MB floppy drive	included						
1 parallel, 2 serial ports, keyboard & mouse	included						
3 410W hot-swap power modules & redundant fans	included						
HP NetServer Navigator, HP NetServer Assistant	included						
HP Open View for Windows.	included						
NetServer LX 6/200 Dual Processor card	D4866A	HP	1	856	1	856	
NetServer LX 6/200 Pentium Pro chip	D4867A	HP	1	2532	2	5,064	
128Mbyte SIMM Module Memory Upgrade	D4893A	HP	3	2697	12	32,364	
SupportPack-NetServer(upgd wrnty to same day,4hr)	H5520A	HPnote1	3	2900	1		5,396
15" VGA Monitor	D2808A	HP	1	372	1	372	168
HP 10/100 PCI Network Adaptor	J3171A	HP	1	121	1	121	
HP 3-Channel NetRAID PCI Array controller	D4349A	HP	1	2117	4	8,468	
HP 4. GB SCSI-2 disk drive (common tray)	D4956A	HP	1	1039	1	1,039	
HP SureStore Tape 6000i 8Gb Internal DAT	C1528F	HP	1	946	1	946	
Server Storage	**Server Hardware Subtotals:**					**64,686**	**5,564**
InternalSCSIcable(int68-pin-ext68pin)+10% spare	5182-6740	HP	3	65	4	260	
ExternalSCSIcable(ext68pin-to SS/6) + 10% spare	5182-6737	HP	3	100	17	1,700	
HP Storage System/6 + 10% spare	D3604A	HP	1	897	17	15,249	
HP 9GB SCSI-2 hot swap drives + 10% spares	D4289A	HP	1	2337	42	98,154	
HP 4.2 GB SCSI-2hot swap drive+10% spares	D3583B	HP	1	1281	68	87,108	
Server Software	**Server Storage Subtotals:**					**212,924**	
Microsoft Windows NT Server 4.0	Runtime	Microsoft	1	714	1	714	10,475
Microsoft SQL Server 6.5, unlimited license		Microsoft	4	24999	1	24,999	
	Server Software Subtotals:					**25,713**	**10,475**
Client Hardware							
HPseries9000mlE55(with2UserHPUX LTUbundled)	A3194AWopt OS3	HPnote2	8	8,900	4	35,600	6,984
MUX Personality card for base system I/O	A2442A opt 001	HP	8	150	4	600	
1 GB SE SCSI2 disk drive with HPUX v10.01	A3349A opt OD1	HP	8	300	4	1,200	4,224
650Mb CDROM	A3184A opt ODZ	HP	8	250	4	1,000	1,920
Lan/9000 Link for HP-PB based servers	C1064WX	HP	8	750	8	6,000	
System Console	J2146A Opt. 0DM	HP	8	200	4	800	960
128 MB Memory Module	A3131A opt ODZ	HP	8	1,450	16	23,200	
Client Software	**Client Hardware Subtotals:**					**68,400**	**14,088**
Visigenic ODBC MS SQL Server Driver		Visigenic	6	9,975	4	39,900	39,900
Visigenic ODBC SDK		Visigenic	6	995	1	995	
Tuxedo 6.2		Bea Sys.	7	3,000	4	12,000	9,000
HP/C ANSI Compiler, LTU	B2412A opt AHO	HP	8	1,575	1	1,575	1,125
Communications	**Client Software Subtotals:**					**54,470**	**50,025**
NetLux 24-Port 10Base-T EtherNet Hub	DEH1487	NetLux.	5	251	301	75,551	
	Communications Subtotals:					**75,551**	
				Total		**501,744**	**80,152**

Notes:	**Five Year Cost:**	**581,896**
1a.Support pack H5520A ($2900/3yrs) upgrades NetServer 3yr warranty to same day, 4hr response, includes SPU internal components (CPUs, mem, NIC, DACs, DAT, etc); 1b. NetServer support for yrs 4-5 via HP contract support 02A ($104/mo)	**tpmC Rating:**	**8028.07**
2a. Series 9000 model E55 option OS3 (648/yr) upgrades1 yr warranty hardware support to 4 hour response for all SPU components for 1 year; 2b. support for years 2 to 5, order service contract O2A ($33/mo) which includes: personaliyt card, LAN link and memory modules. Pricing Key: 1=Metropolitan, 3=HP Corporate Price List, 4=Microsoft, 5=NETLUX, 6=Visigenic Software, 7=BEA Systems, 8=Forsythe Solutions	**$/tpmC:**	**72.48**

Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections fo 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.

Note: audited by Richard Gimarc of Performance Metrics, Inc,

Numerical Quantities Summary for NetServer LX Pro

MQTH, Computed Maximum Qualified Throughput **8028.07 tpmC®**

Response Times (in seconds)	90th %-ile	Maximum	Average
New-Order	1.24	10.57	0.72
Payment	0.91	14.40	0.77
Order-Status	1.67	8.20	1.64
Delivery (interactive portion)	0.22	0.38	0.12
Delivery (deferred portion)	1.30	9.00	1.18
Stock-Level	4.68	14.57	3.45
Menu	0.04	0.17	0.01

Transaction Mix, in percent of total transactions

New-Order	44.80%
Payment	43.08%
Order-Status	4.03%
Delivery	4.03%
Stock-Level	4.05%

Keying/Think Times (in seconds)	Keying Time			Think Time		
	Min.	Avg.	Max.	Min.	Avg.	Max.
New-Order	18.01	18.02	18.18	0.01	12.12	159.59
Payment	3.01	3.02	3.07	0.01	12.05	144.83
Order-Status	2.01	2.02	2.07	0.01	10.21	153.70
Delivery (interactive)	2.01	2.02	2.07	0.01	5.09	43.63
Stock-Level	2.01	2.02	2.07	0.01	5.08	49.88

Numerical Quantities Summary for NetServer LX Pro, continued

Test Duration

Ramp-up time		34.9 minutes
Measurement interval		30 minutes
Transactions during measurement interval		537,563
Ramp down time		87 minutes

Checkpointing

Number of checkpoints in measurement interval		1
Checkpoint interval		30 minutes

Reproducibility Run

Reproducibility Run	7972.10 tpmC	-0.7%

Preface

This is the full disclosure report for a benchmark test of the NetServer LX Pro using Microsoft SQLServer 6.5 SP3. It meets the requirements of the TPC Benchmark® C Standard Specification, Revision 3.2 dated 27 June, 1996.

TPC Benchmark® C was developed by the **T**ransaction Processing **P**erformance **C**ouncil (TPC). It is the intent of this group to develop a suite of benchmarks to measure the performance of computer systems executing a wide range of applications. Hewlett-Packard Company and Sybase, Inc. are active participants in the TPC.

TPC Benchmark® C Overview

*TPC Benchmark® C is an **O**n **L**ine **T**ransaction **P**rocessing (OLTP) workload. It is a mixture of read-only and update intensive transactions that simulate the activities found in complex OLTP application environments. It does so by exercising a breadth of system components associated with such environments, which are characterized by:*

- *The simultaneous execution of multiple transaction types that span a breadth of complexity*
- *On-line and deferred transaction execution modes*
- *Multiple on-line terminal sessions*
- *Moderate system and application execution time*
- *Significant disk input/output*
- *Transaction integrity (ACID properties)*
- *Non-uniform distribution of data access through primary and secondary keys*

- *Databases consisting of many tables with a wide variety of sizes, attributes, and relationships*
- *Contention of data access and update*

The performance metric reported by TPC-C® is a "business throughput" measuring the number of orders processed per minute. Multiple transactions are used to simulate the business activity of processing an order, and each transaction is subject to a response time constraint. The performance metric for this benchmark is expressed in transactions-per-minute-C® (tpmC®). To be compliant with the TPC-C® standard, all references to tpmC® results must include the tpmC® rate, the associated price-per-tpmC®, and the availability date of the priced configuration.

Despite the fact that this benchmark offers a rich environment that emulates many OLTP applications, this benchmark does not reflect the entire range of OLTP requirements. In addition, the extent to which a customer can achieve the results reported by a vendor is highly dependent on how closely TPC-C® approximates the customer application. The relative performance of systems derived from this benchmark does not necessarily hold for other workloads or environments. Extrapolations to other environments are not recommended.

Hewlett-Packard Company does not warrant or represent that a user can or will achieve performance similar to the benchmark results contained in this report. No warranty of system performance or price/performance is expressed or implied by this report.

System Overview

The hardware configuration used in this TPC-C test was based on the Hewlett-Packard NetServer LX Pro 6/200 Model 1 server. The full configuration was built by adding additional memory, additional disk adapters and drives, and a network adaptor. The operating system used was Microsoft's NT 4.0 and the database was Microsoft's SQL 6.5.SP3(242).

The architecture of the NetServer LX Pro was designed by Hewlett-Packard and based on the Intel Pentium Pro chip and associated chipset. The LX used in this test was powered by four 200 MHz Intel Pentium Pro(R) processor chips, each with 512K bytes of SRAM 2nd level cache. In the LX, two separate dual processor cards are used, each containing two Pentium Pro chips. Within the cards there is an interface between the two chips called the P6 bus. Both of these processor cards plug directly into a motherboard. The interface between the motherboard and the processor cards is an extension of the same P6 bus.

This configuration used 2 Gbytes of HP 60-ns RAM. This was achieved by adding 16 128 Mbyte SIMMs. This RAM was attached to the system bus via a controller.

This configuration also used two SCSI-2 Fast/Wide PCI Disk controllers that were embedded onto the motherboard and 5 HP NetRaid 3-channel PCI Disk Array Controllers (DACs). These cards plugged into PCI slots on the motherboard, which are connected to two separate 33MHz PCI I/O buses. Both PCI busses attached directly to the P6 bus through separate PCI bridges so that PCI bus masters can have direct access to memory.

One HP 4Gbyte SCSI-2 (common tray) Fast hard disk and one CDROM drive were attached to one of the embedded PCI SCSI controllers. This disk drive was used exclusively for the Operating System (NT v4.0) and swap space.

In the measured configuration, four 4Gbyte HP SCSI-2 Hot Swap hard disks were attached to the second embedded PCI SCSI controller. These disks were used exclusively for the database log. 72 HP 4Gbyte Hot Swap drives and 18 9G Hot Swap disk drives were equally distributed across the 5 3-Channel HP NetRaid PCI Disk Array Controllers (DACs). Six Hot Swap disks were assigned per DAC SCSI channel. Each channel was striped and the channels spanned using the HP NetRaid Utility. Controller write-back caching and read ahead were specifically disabled.

At the operating system, NT's disk administrator shows 8 logical disk drives - the 4Gbyte SCSI-2 boot drive, the two mirrored sets of 4Gbyte Hot Swap drives used for the log, one 156,179 megabyte disk drives externalized by the HP NetRaid controller containing the 9.1 Gbyte disks, and four 73,156 Gbyte disks that are externalized by the NetRaid controllers with the 4Gbyte disk drives. Each of these 4 73Gbyte logical drives represent a hardware stripe set of 18 4Gbyte Hot Swap drives, created at the HP NetRaid level with channel spanning. The 156G disk is hardware striped in the same manner using the 9G disks.

The five logical disk drives were used to hold all the TPC database. This was done for maximum performance. Protection against data loss from a failed drive was achieved by normal database level recovery and from the NT mirrored log drives.

This configuration also used one HP J3171A PCI network adaptor card, attached to the LX motherboard via the PCI bus. This network adaptor supplied a 10BaseT network interface to the four HP-UX clients. Each of the clients had 512Mbytes of RAM, one 1Gbyte SCSI hard disk, one HP Lan/9000 Link network adaptor, and was running HP-UX 10.01. HP Monochrome VGA displays were used on the NetServer LX Pro and the HP System Console was used on each of the four clients.

Section 1.0 – General Items

1.1 Test Sponsor

A statement identifying the sponsor of the Benchmark and any other companies who have participated.

The Network Server Division of the Hewlett-Packard Company was the test sponsor of this TPC Benchmark C.

1.2 Application Code and Definition Statements

The application program must be disclosed. This includes, but is not limited to, the code implementing the five transactions and the terminal input/output functions.

The Section 3.0 entitled Clause 3 Related Items contains a brief discussion of the database design and loading. The database definiton statements, distribution across disk drives, loading scripts, and tables are provided in Appendix A- Database Generation

The program that implements the TPC Benchmark C translation and collects appropriate transaction statistics is referred to as the Remote Terminal Emulator (RTE) or Driver program. The Driver program is discussed in Section 7.0. The source code for this driver program is provided in Apprendix B - Source Code.

1.3 Parameter Settings

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

- *Database options*
- *Recover/commit options*
- *Consistency/locking options*
- *System parameter, application parameters, and configuration parameters.*

This requirement can be satisfied by providing a full listing of all parameters and options.

Appendix C contains all the database and operating system parameters used in this benchmark. Appendix D contains all the hardware configuration details.

1.4 Configuration Diagrams

Diagrams of both the measured priced system must be provided, accompanied by a description of the differences.

Figure 1-1 and 1-2 show the measured and priced client/server configurations. The SUT in the measured system is idential to the priced one, except for the addition of 2 4GB and 2 9GB Hot Swap disks for the log growth space and the exchange of 18 9GB disks for 18 4GB disks for the 180 day growth space.

FIGURE 1-1: NetServer LX Pro - Measured Configuration

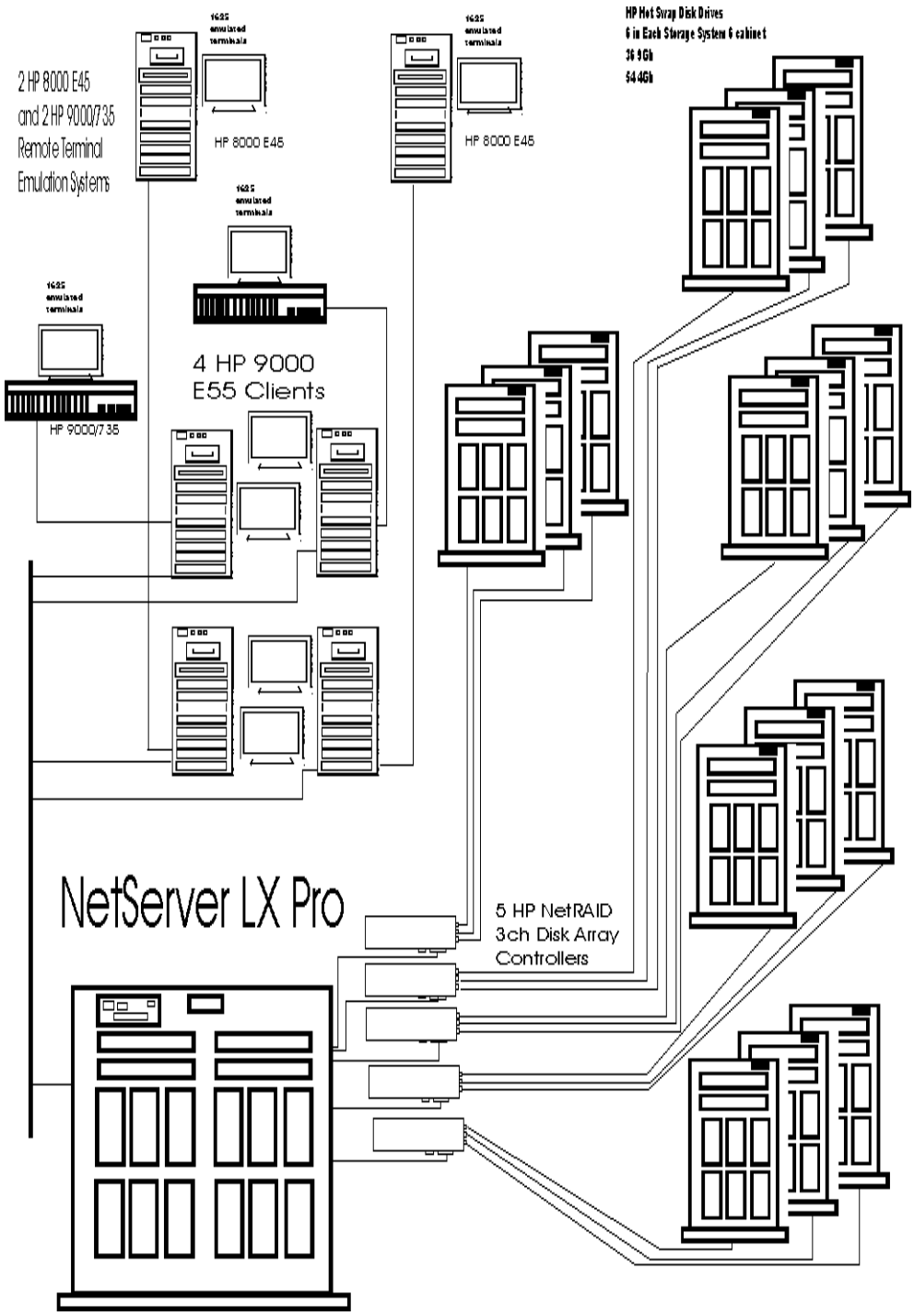
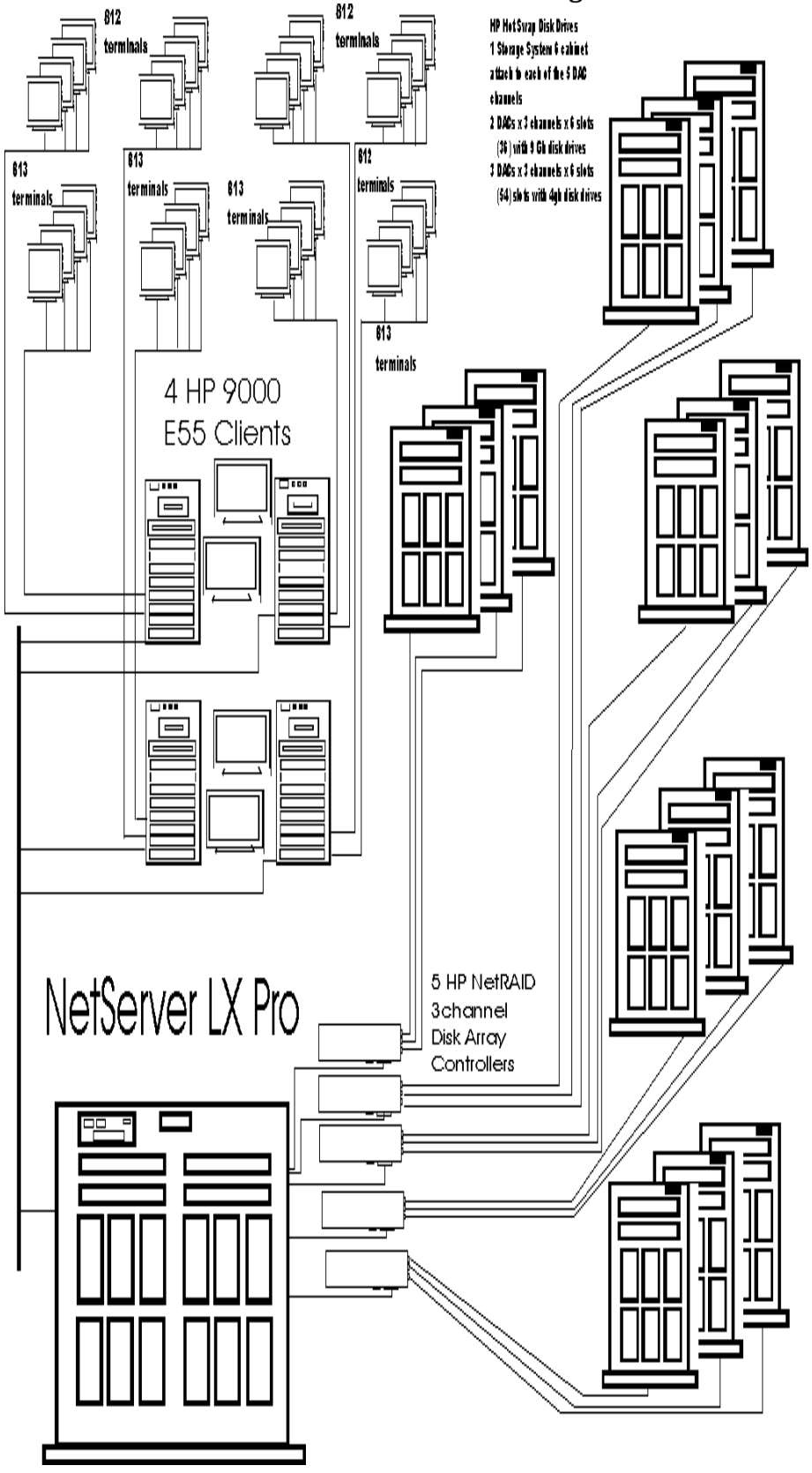


FIGURE 1-2: NetServer LX Pro - Priced Configuration



Section 2.0 – Clause 1 Related Items

2.1 Table Definitions

A listing must be provided for all table definitions statements and all other statements used to set up the database.

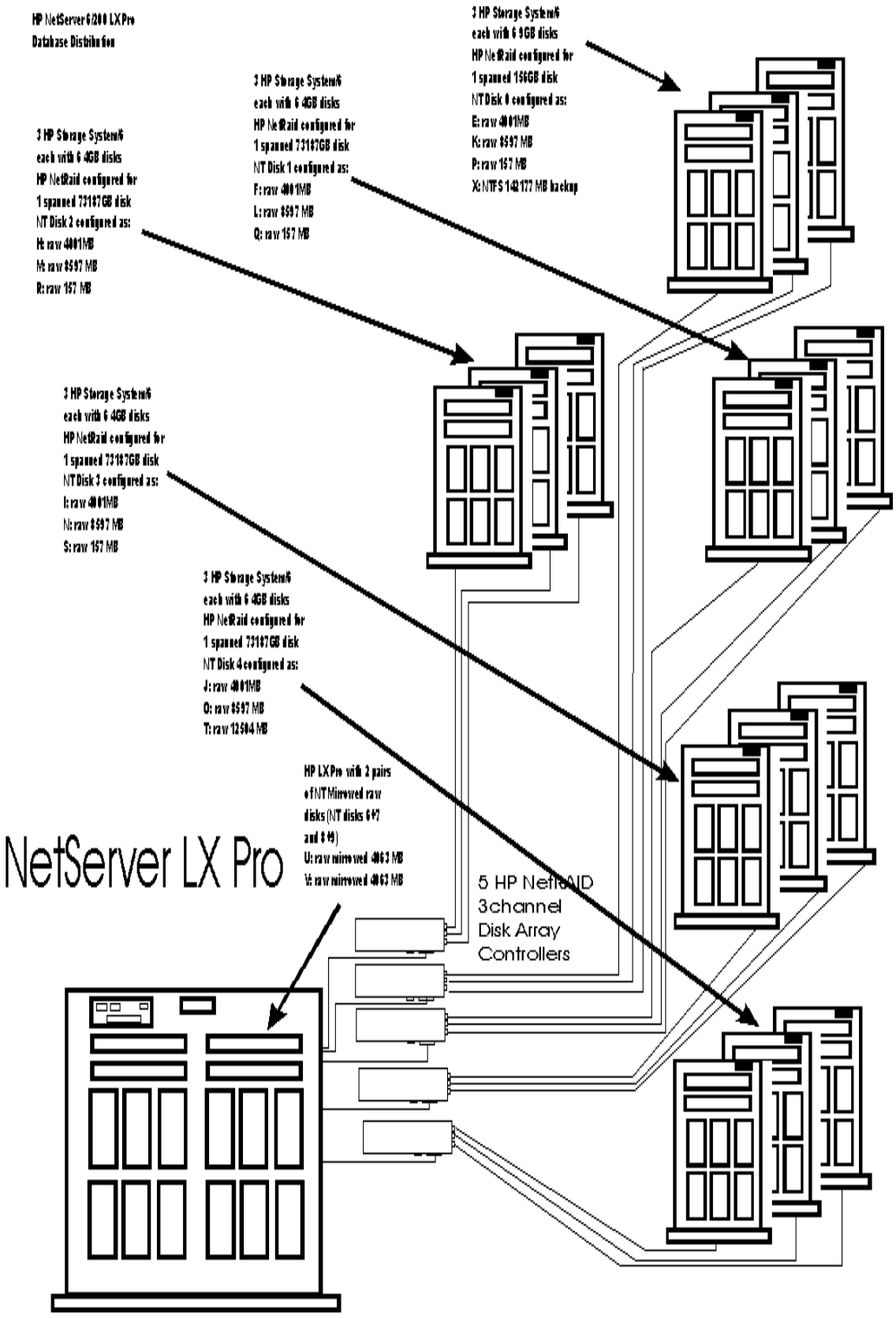
Appendix B contains the code used to define and load the database tables.

2.2 Physical Organization of the Database

The physical organization of tables and indices within the database must be disclosed.

The measured configuration used a total of one 4Gb (common tray), 54 4Gb, and 36 9Gb Hot Swap disk drives. Figure 3-1 below depicts the data distribution of the files across the hard drives of the HP NetServer LX Pro.

FIGURE 3.1: HP NetServer 6/200 LX Pro Database Distribution



2.3 Insert and Delete Operations

It must be ascertained that inset and delete operations to any of the tables can occur concurrently with the TPC-C transaction mix. Furthermore, any restrictions in the SUT database implementation that precludes inserts beyond the limits defined in Clause 1.4.11 must be disclosed. This includes the maximum number of rows that can be inserted and the minimum key value for these new rows.

All insert and delete functions were fully operational and verified during the entire benchmark.

2.4 Partitioning

While there are a few restrictions placed upon horizontal or vertical partitioning of tables and rows in the TPC-C Benchmark, any such partitioning must be disclosed.

Partitioning was not used on any table.

2.5 Replication, Duplication or Additions

Replication of tables, if used, must be dislosed. Additional and/or duplicated attributes in any table must be disclosed along with a statement on the impact on performance.

No replications, duplications or additional attributes were used.

Section 3.0 – Clause 2 Related Items

3.1 Random Number Generation

The method of verification for the random number generation must be disclosed

The library routine SRAND48 (3C) was used to seed the library routine DRAND48 (3C) which generated pseudo-random numbers using the well-known linear congruential algorithm and 48-bit integer arithmetic. Further information on SRAND48 (3C) and DRAND48 (3C) can be found in the HP-UX Reference Manual Vol. 3.

The actual layout of the terminal input/output screens must be disclosed.

3.2 Input/Output Screen Layout

The screen layouts corresponded exactly to those in Clauses 2.4.3, 2.5.3, 2.6.3, 2.7.3, and 2.8.3 of the TPC-C® Standard Specification.

3.3 Priced Terminal Feature Verification

The method used to verify that the emulated terminals provide all the features described in Clause 2.2.2.4 must be explained. Although not specifically priced, the type and model of the terminals used for the demonstration in 8.1.3.3 must be disclosed and commercially available (including supporting software and maintenance).

The terminal features were verified by manually exercising each specification on an HP-Unix 712/80 Workstation running an ANSI terminal emulator via a NetServer LC.

3.4 Presentation Manager or Intelligent Terminal

Any usage of presentation managers or intelligent terminals must be explained.

Application code running on the client implemented the TPC-C® user interface. A listing of this code is included in Appendix A. Used capabilities of the terminal beyond basic ASCII entry and display were restricted to cursor positioning.

A presentation manager was not used.

3.5 Transaction Statistics

Table 2.3 lists the numerical quantities that Clauses 8.1.3.5 to 8.1.3.11 require.

Table 3.1: Transaction Statistics

Type	Item	Value
New Order	Home warehouse items	90.46%
	Remote warehouse items	9.54%
	Rolled back transactions	.98%
	Average items per order	10.00
Payment	Home warehouse	85%
	Remote Warehouse	15.
	Non-primary key access	59.88
Order Status	Non primary key access	59.95
Delivery	Skipped transactions	0
Transaction Mix	New Order	44.80%
	Payment	43.08%
	Order Status	4.03%
	Delivery	4.03%
	Stock Level	4.05%

3.6 Queueing Mechanism

The queueing mechanism used to defer the execution of the Delivery transaction must be disclosed.

Delivery transactions were submitted to servers using the same TUXEDO mechanism that other transactions used. The only difference was that the call was asynchronous, i.e., control would return to the client process immediately and the deferred delivery part would complete asychronously.

Section 4.0 – Clause 3 Related Items

4.1 Transaction System Properties (ACID Tests)

Results of the ACID test must describe how the requirements were met. This includes disclosing which case was followed for the execution of Isolation Test 7.

The TPC Benchmark C standard specification defines a set of transaction processing system properties that a System Under Test (SUT) must support during the execution of the benchmark. Those properties are Atomicity, Consistency, Isolation and Durability (ACID). The following subsections will define each of these properties and describe the series of tests that were performed by HP to demonstrate that the properties were met.

All of the specified ACID tests were performed on the HP NetServer LX Pro. A fully scaled database was used except for the durability tests of durable media failure. The test was performed on a database scaled to 10 warehouses, using the standard driving mechanism. However a fully scaled database under a full load would also pass this durability test.

4.2 Atomicity Tests

The system under test (SUT) 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 have any effects on the data.

4.2.1 COMMIT Transaction

The following steps were done to demonstrate the COMMIT property of Atomicity:

1. A row was randomly selected from the Warehouse, District and Customer tables, and the present balances noted

2. The standard payment transaction was started against the above identifiers using a known amount.

3. The transaction was committed and the rows were verified to contain the correct updated balances.

4.2.2 ROLLBACK Transaction

The following steps were done to demonstrate the ROLLBACK property of Atomicity:

1. A row was randomly selected from the Warehouse, District, Customer tables, and the present balances noted.

2. The standard payment transaction was started against the above identifiers using a known amount.

3. The transaction was rolled back and the rows were verified to contain the original balances.

4.3 Consistency Tests

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

To prove consistency, queries were issued to the database. The results of the queries verified that the database was consistent for all conditions as specified in clause 3.3.2.1 to 3.3.2.4.

The consistency tests were run before and after the performance run.

4.4 Isolation Tests

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 some order.

This property is commonly called serializability. Sufficient conditions must be enabled at either the system or application level to ensure serializability of transactions under any mix of arbitrary transactions.

We ran a total of nine isolation tests. Seven of these tests are detailed in the TPC-C specification (clause 3.4.2.1to 3.4.2.7). The additional two are to fully comply with the isolation requirements that are not directly specified in the TPC-C specification. These two tests are known as Phantom Protection One and Two. They demonstrate that the applications are protected from phantom inserts.

4.5 Durability Tests

The tested system must guarantee the ability to preserve the effects of committed transactions and insure database consistency after recovery from any one of the failures listed in clause 3.5.3.1, 3.5.3.2, and 3.5.3.3.

There 3 types of failures were tested to ensure the durability of the database: Loss of Data drive, Loss of Log drive, and Loss of Memory test.

A fully scaled database was used for the Loss of Memory and the Loss of Log test while a 10 warehouse database was used for the Loss of Data test. With this exception of scaling, all other aspects of the configurations on the 10 warehouse database were identical to the fully scaled database configuration, including the use of the standard RTE drivers. Given this, the Loss of Data test would pass in a fully scaled database configuration.

TESTING PROCEDURE AND RESULTS:

The following steps detail the testing procedure and results for all the three durability tests. Each test was done separately.

Step 1: Database was backed up.

Step 2: The total number of new orders was calculated and recorded. Consistency test #3 was run to show that the database was in a consistent state prior to the durability tests.

Step 3: The standard TPC-C benchmark was launched. For the Loss of Data test, the benchmark was run with 100 users. The transaction rate was monitored until the system was in steady state. During this time, the number of users in the benchmark run was verified. After this, a checkpoint was issued. An additional 3-minute run was performed.

Step 4:The failure was initiated. For the Loss of Data drive test, one HP 4Gb Hot Swap drive holding a portion of the database data was pulled out while the benchmark was running. For the Loss of Log drive test, one HP 4Gb Hot Swap drive holding a portion of the mirrored database log was pulled out while the benchmark was running. For the Loss of Memory test, the power switch on the NetServer LX was depressed (turning off the system) while the benchmark was running.

Step 5: The recovery process was performed.

For the loss of Data drive test, we then backed up the transaction log, and restored the combination of the initial back up (step 1) and the just-backed-up transaction log to bring it to the most recent consistent state.

For the loss of log test, as would be expected, NT produced an alert message informing us that one of the members of the mirror set has failed. The SUT slowed down for a brief period as it needs to alter its log-write destination to the primary drives of the mirror. These activities were transparent to the database server as we observed that it continued to run after the aforementioned slow-down period.

For the loss of memory test, we re-powered the system, and started the server. As we would have expected, the server performed the automatic recovery.

Step 6: We computed the total number of order transactions again, and the difference between it and the one measured in step two. We verified that this difference was the same as the total number of new order transactions recorded in the “success” file. This file records committed transactions on the clients. In addition, we reran the consistency test #3 to show the database was in a consistent state after the durability tests.

We sampled the after-failure database with those recorded in the “success” file. We chose the first, last and middle two transactions from the “success” file to sample the database.

Section 5.0 – Clause 4 Related Items

5.1 Database Layout

The distribution of tables and logs across all media must be explicitly depicted for the tested and priced systems.

The measured (tested) and priced system have identical controller configurations and differ by 2 4GB and 2 9GB additional Hot Swap disks added to the priced configuration to supply growth space for the log and the substitution of 18 9GB Hot Swap disks for 4GB dirves for the 180 day growth.

Both configurations used two SCSI-2 Fast/Wide PCI Disk controllers that were embedded onto the motherboard and 5 HP NetRAID 3-channel PCI Disk Array Controllers (DACs). These cards plugged into PCI slots on the motherboard.

One HP 4Gb HP Fast SCSI-2 hard disk (common tray) and one CDROM drive were attached to the first (A) of the two embedded PCI SCSI controllers. The 4Gb drive was used for the Operating System (NT v4.0). For the measured configuration, four 4Gbyte HP SCSI-2 Hot Swap hard disks were attached to the same embedded PCI SCSI controller (A) and were used exclusively for the log.

For the priced configuration a total of 6 4GB and 2 9GB HP SCSI-2 Hot Swap hard disks are used to supply growth space for the log. These are distributed with the first 4 attached to the first internal PCI SCSI controller (A) and the remaining 4 (mirrored pairs of the first 4) attached to the second embedded SCSI controller. 54 HP 4Gbyte Hot Swap drives are attached to 3 of the HP NetRAID PCI Disk Array controllers and 36 HP 9Gbyte Hot Swap drives are attached to the other two controllers. Six Hot Swap disks were placed in each HP Storage System 6. Each channel was striped using the NetRAID Utility and channel spanning was used. Controller write-back caching and read ahead were specifically disabled.

At the operating system, NT's disk administrator shows 10 logical disks - the 4Gbyte SCSI-2 boot drive (common tray), the four mirrored drives used for the log, three 73GB logical drive disks and two 156 GB logical drive disks. Each of these 73GB logical drives represent a hardware stripe set of eighteen 4Gbyte Hot Swap drives, created at the DAC level spaning the three channels. The 156Gbyte drives are the same DAC configuration, except that the hard disks are 9GB each. Protection against data loss from a failed drive was achieved by normal database level recovery from the log drives, which are mirrored. The preceeding Figure 3-1 depicts the data distribution of the files across the hard drives of the HP NetServer LX Pro.

5.2 Initial Cardinality of Tables

The cardinality (e.g. number of rows) of each table, as it existed at the start of the benchmark run, must be disclosed. If the database was over-scaled and inactive rows of the WAREHOUSE table were deleted, the cardinality of the WAREHOUSE table as initially configured and the number of rows deleted must be disclosed

Table 5.1: Number of Rows

Table	Occurrences
Warehouse	650
District	6500
Customer	19500000
History	19500000
Orders	19500000
New Orders	5850000
Order Line	19500000
Stock	65000000
Item	100000

No rows were deleted for the benchmark runs.

5.3 180 Day Space

Details of the 180 day space computations along with proof that the database is configured to sustain 8 hours of growth for the dynmic tables must be disclosed.

Transaction Log Space Requirements

To calculate the space required to sustain the database log for 8 hours of growth at steady state, the following steps were followed:

1. The free space on the logfile was queried using **dbcc checktable(syslogs)**.

2. Transactions were run against the database with a full load of users.

3. The free space was again queried using **dbcc checktable(syslogs**)

4. The space used was calculated as the difference between the first and second query.

5. The number of NEW-ORDERS was verified from an RTE report covering the entire run.

6. The space used was divided by the number of NEW-ORDERS giving a space used per NEW-ORDER transaction.

7. The space used per transaction was multiplied by the measured tpmC rate times 480 minutes.

The result of the above steps yielded a requirement of 21.2GB (including mirror). to sustain the log for 8 hours. Space in the priced configuration available on the transaction log was 21.4GB (including mirror), indicating enough storage was configured to sustain 8 hour growth.

The same methodology was used to calculate the growth requirements for the other dynamic tables Order, Order-Line and History.

The details of the 180 day growth calculation are shown in appendix D.

5.4 Type of Database Used

A statement must be provided that describes 1) the data model implemented by DBMS used and 2) the database interface and access language

Microsoft SQL Server 6.5 is a relational DBMS.

The interface was SQL Server stored procedures accessed with ODBC library calls embedded in C code.

5.5 Database Mapping

The mapping of database partitions and replications must be described.

The database was neither partitioned nor replicated.

Section 6.0 – Clause 5 Related Items

6.1 Throughput

Measured tpmC® must be reported.

Table 6.1: Throughput

tpmC®	8028.07

6.2 ResponseTimes

Ninetieth percentile, maximum and average response times must be reported for all transactions types as well as for the menu response time.

Table 6.2: Response Times

Type	Average	Maximum	90th Percentile
New Order	0.72	10.57	1.24
Payment	0.47	14.40	0.91
Order-Status	1.07	8.20	1.67
Interactive Delivery	0.12	0.38	0.22
Deferred Delivery	0.83	9.00	1.30
Stock-Level	2.92	14.57	4.68
Menu	0.01	0.17	0.04

6.3 Keying and Think Times

The minimum, the average, and the maximum keying and think times must be reported for each transaction type.

Table 6.3: Keying Times

Type	Minimum	Average	Maximum
New-Order	18.01	18.02	18.18
Payment	3.01	3.02	3.07
Order-Status	2.01	2.02	2.07
Interactive Delivery	2.01	2.02	2.07
Stock Level	2.01	2.02	2.07

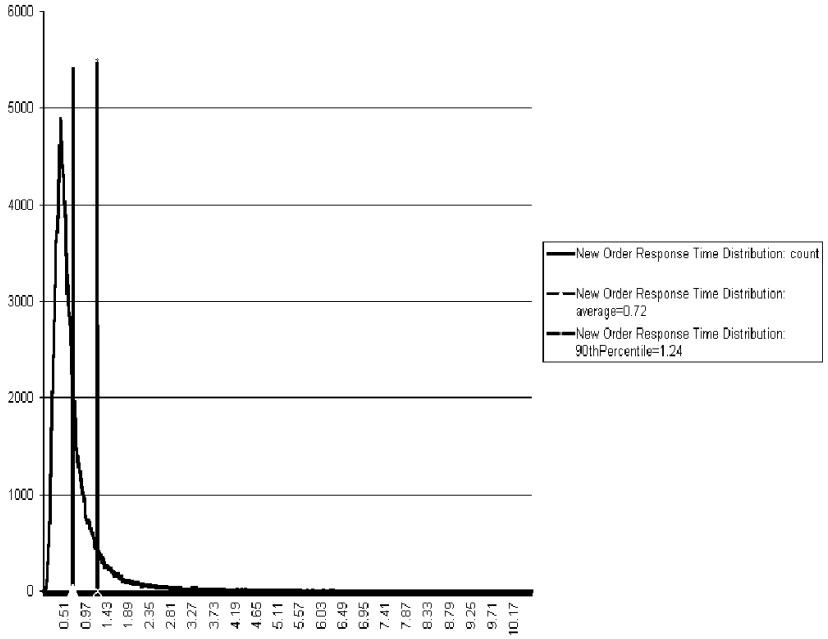
Table 6.4: Think Times

Type	Minimum	Average	Maximum
New-Order	0.01	12.09	159.59
Payment	0.01	12.03	144.83
Order-Status	0.01	10.20	153.70
Interactive Delivery	0.01	5.09	43.67
Stock-Level	0.01	5.07	49.88

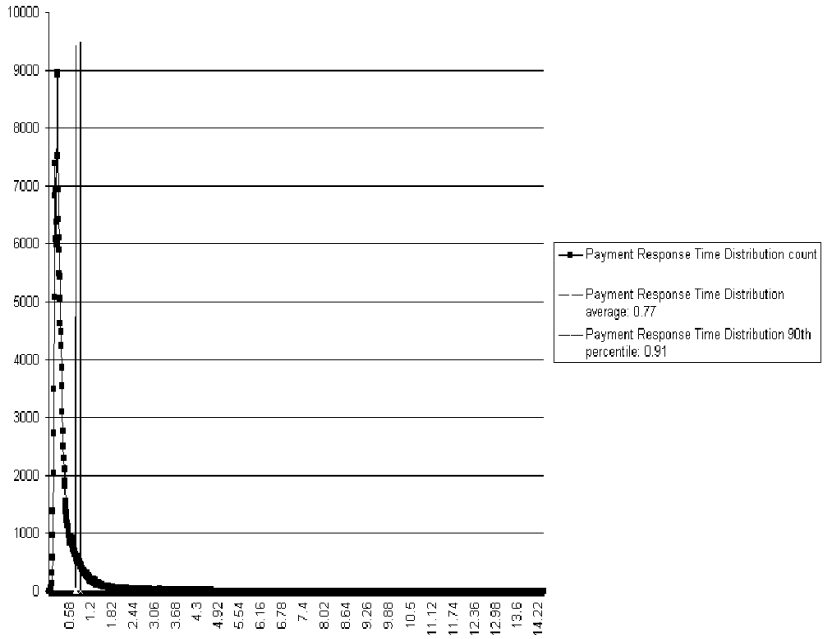
6.4 Response Time Frequency and

Response Time frequency distribution curves (see Clause 5.6.1) must be reported for each transaction type. The performance curve for response times versus throughput (see Clause 5.6.2) must be reported for the New-Order transaction. Think Time frequency distribution curves (see Clause 5.6.3) must be reported for each transaction type. Keying Time frequency distribution curves (see Clause 5.6.4) must be reported for each transaction type. A graph of throughput versus elapsed time (see Clause 5.6.5) must be reported for the New-Order transaction.

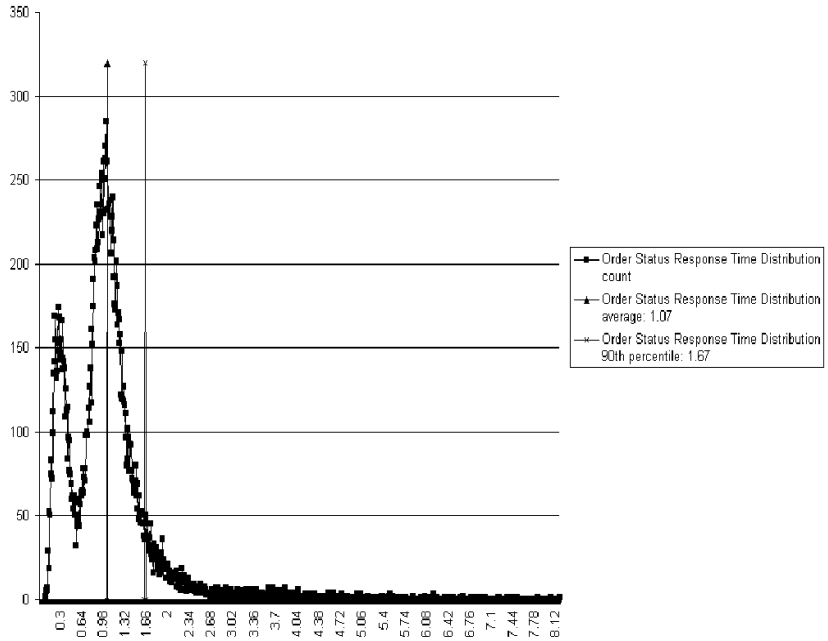
6.4.1 New Order Response Time



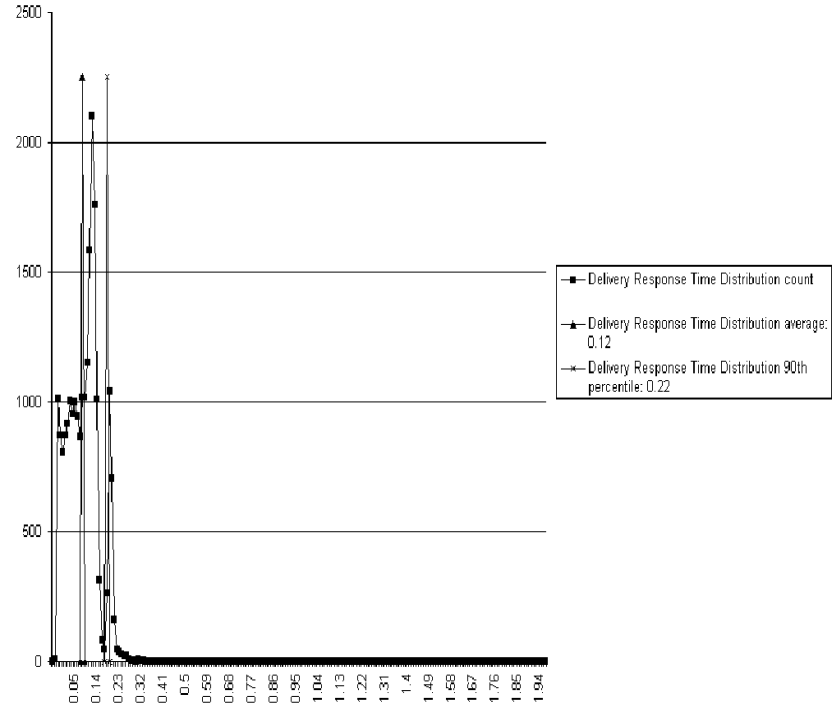
6.4.2 Payment Response Time Distribution



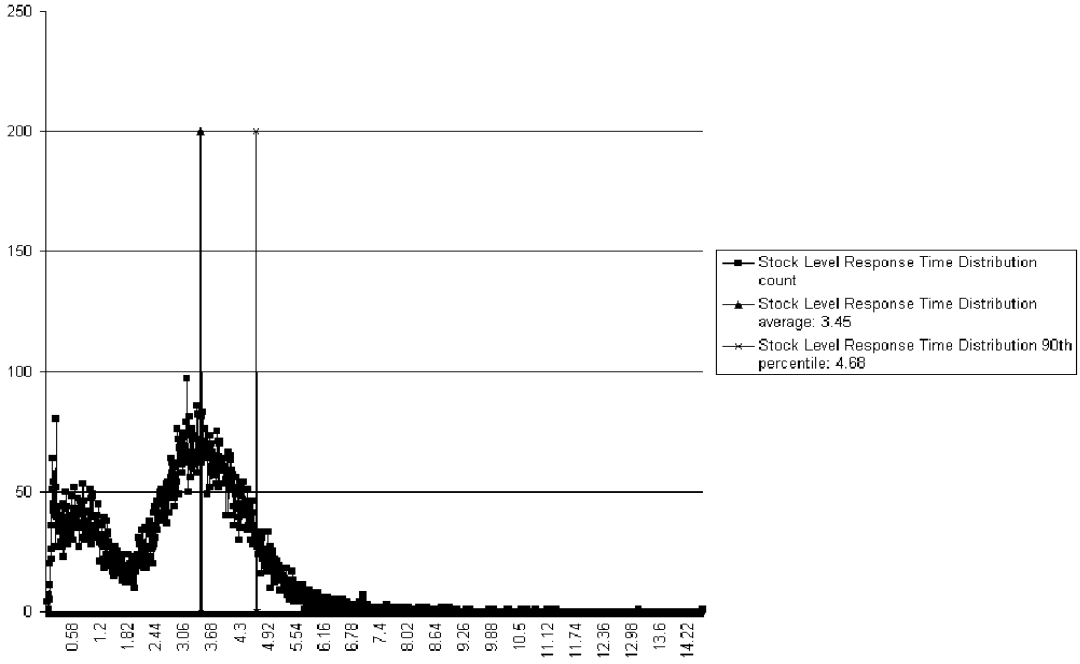
6.4.3 Order Status Response Time



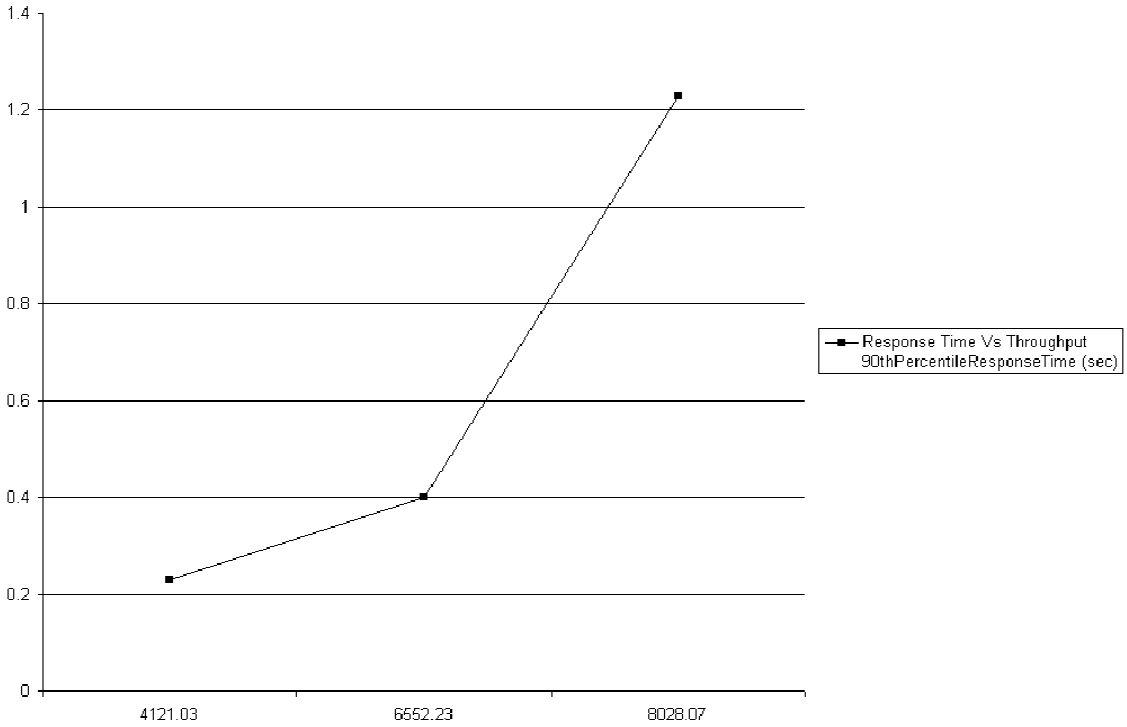
6.4.4 Delivery Response Time Distribution



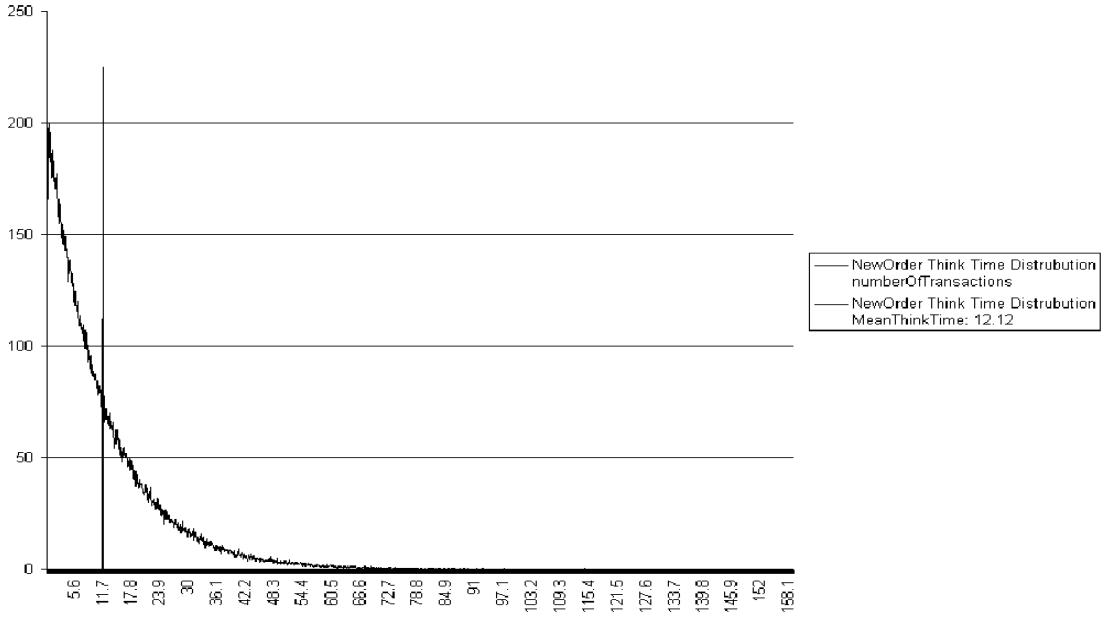
6.4.5 Stock Level Response Time



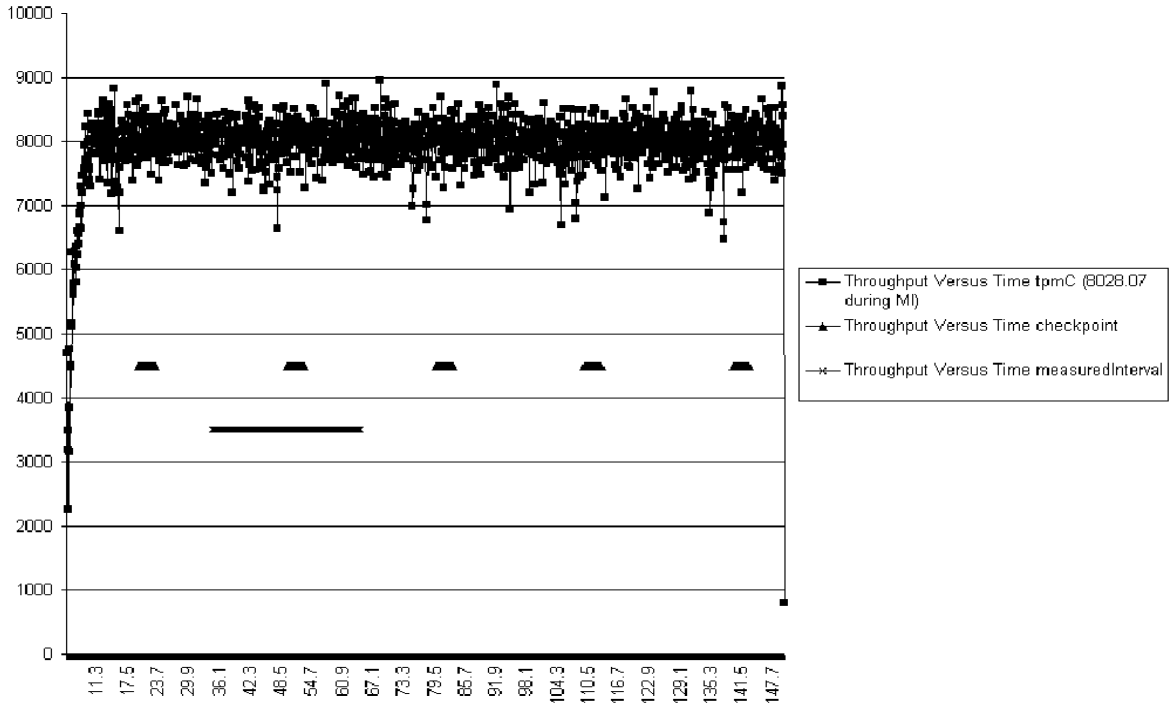
6.4.6 Response Time Versus Throughput



6.4.7 New Order Think Time Distribution



6.4.8 Throughput Versus Time Distribution



6.5 Steady State Determination

The method used to determine that the SUT had reached a steady state prior to commencing the measurement interval must be disclosed.

The transaction throughput rate (tpmC®) and response time were relatively constant after the initial 'ramp up' period. The throughput and response time behavior were determined by examining data reported for each interval over the duration of the benchmark. Ramp up, steady state and ramp down regions are discernible in the graph (6.4.8).

6.6 Work Performed During Steady State

A description of how the work normally performed during a sustained test (for example checkpointing, writing redo/undo log records, etc.), actually occurred during the measurement interval must be reported.

6.6.1 Checkpoint

The checkpoint mechanism is an automatic means for guaranteeing that completed transactions are regularly written from SQL Server's won disk cache to the database device. A checkpoint writes all "dirty pages"-cached pages that have been modified since the last checkpoint-to the database device.

6.6.2 Checkpoint Conditions

There are two types of checkpoints:

- Checkpoints that are executed automatically by SQL Server.
- Checkpoints that are forced by database owners of the SA with the CHECKPOINT statement.

Forcing dirty pages onto the database device means that all completed transactions are written out. By calling all completed transactions to be written out, the check point shortens the time it takes to recover, since the database pages are current and there are no transactions that need to be rolled forward.

6.6.3 Checkpoint Implementation

For each benchmark measurement after all users are active, the script **checkpoint_tpcc.sh** issues a checkpoint. A background process sleeps and performs another checkpoint every 30 minutes. The recovery interval (used to control the checkpoints executed automatically by SQL Server) is configured large enough that no other checkpoints occur during the measurement.

6.7 Reproducibility

A description of the method used to determine the reproducibility of the measurement results.

A second measurement achieved a throughput of 7972.10 tpmC® during a 30-minute, steady state interval.

6.8 Measurement Period Duration

A statement of the duration of the measurement interval for the reported Maximum Qualified Throughput (tpmC®) must be included.

The measurement interval was 30 minutes.

6.9 Regulation of Transaction Mix

The method of regulation of the transaction mix (e.g. card decks, or weighted random distribution) must be described. If weighted distribution is used and the RTE adjusts the weights associated with each transaction type, the maximum adjustments to the weight from the initial value must be disclosed.

The weighted average method of *Clause 5.2.4.1* was used. The weights were not adjusted during the run.

6.10 Transaction Mix

The percentage of the total mix for each transaction type must be disclosed.

Table 6.5: Transaction Mix

Type	Percentage
New-Order	44.80%
Payment	43.08%
Order-Status	4.03%
Delivery	4.03%
Stock-Level	4.68%

6.11 Transaction Statistics

The percentage of New-Order transactions rolled back as a result of invalid item number must be disclosed. The average number of order-lines entered per New-Order transaction must be disclosed. The percentage of remote order-lines entered per New-Order transaction must be disclosed. The percentage of selections made by customer last name in the Payment and Order-Status transactions must be disclosed. The percentage of Delivery transactions skipped due to there being fewer than necessary orders in the New-Order table must be disclosed.

Table 2.1 contains the required items.

6.12 Checkpoint Count and Location

The number of checkpoints in the measurement interval, the time in seconds from the start of the measurement interval to the first checkpoint, and the Checkpoint Interval must be disclosed.

Times in the following table are relative to the beginning of the driver-times phase of the test. The checkpoint interval is 30 minutes. The first checkpoint within the 30 minute measure interval was 907 seconds from its start. In accord with *5.5.2.2*, there is no checkpoint within the "guard zones" 1800/4=450 seconds from the beginning and end of the measurement interval.

Table 6.6: Checkpoints

Event	From (sec)	To (sec)	Duration (sec)
checkpoint	1200	1395	195
measured interval	2094	3894	1800
checkpoint	3001	3208	207
checkpoint	4801	5010	209
checkpoint	6601	6809	208
checkpoint	8401	8996	195

Section 7.0 – Clause 6 Related Items

7.1 RTE description

If the RTE is commercilally available, then its inputs must be specified. Otherwise, a description must be supplied of that inpute (e.g., scripts) to the RTE had been used. The RTE input parameters, code fragments, functions, et cetera used to generate each transaction input filed must be disclosed. Comment: the t is to demonstrate the RTE was configured to generate transaction input data as specified in Clause 2. Appendix A.3 lists RTE input parameters and code fragments used to generate each transaction input field.

The RTE (remote Terminal Emulator) on the driver system was developed at Hewlett Packard and is not commerically available.

For this instance of the TPC-C benchmark, four driver and four client systems were used. The drivers emulated 6500 users logged in to the clients. An overview of the benchmark software on the drivers, clients and server is shown in figure 7.1

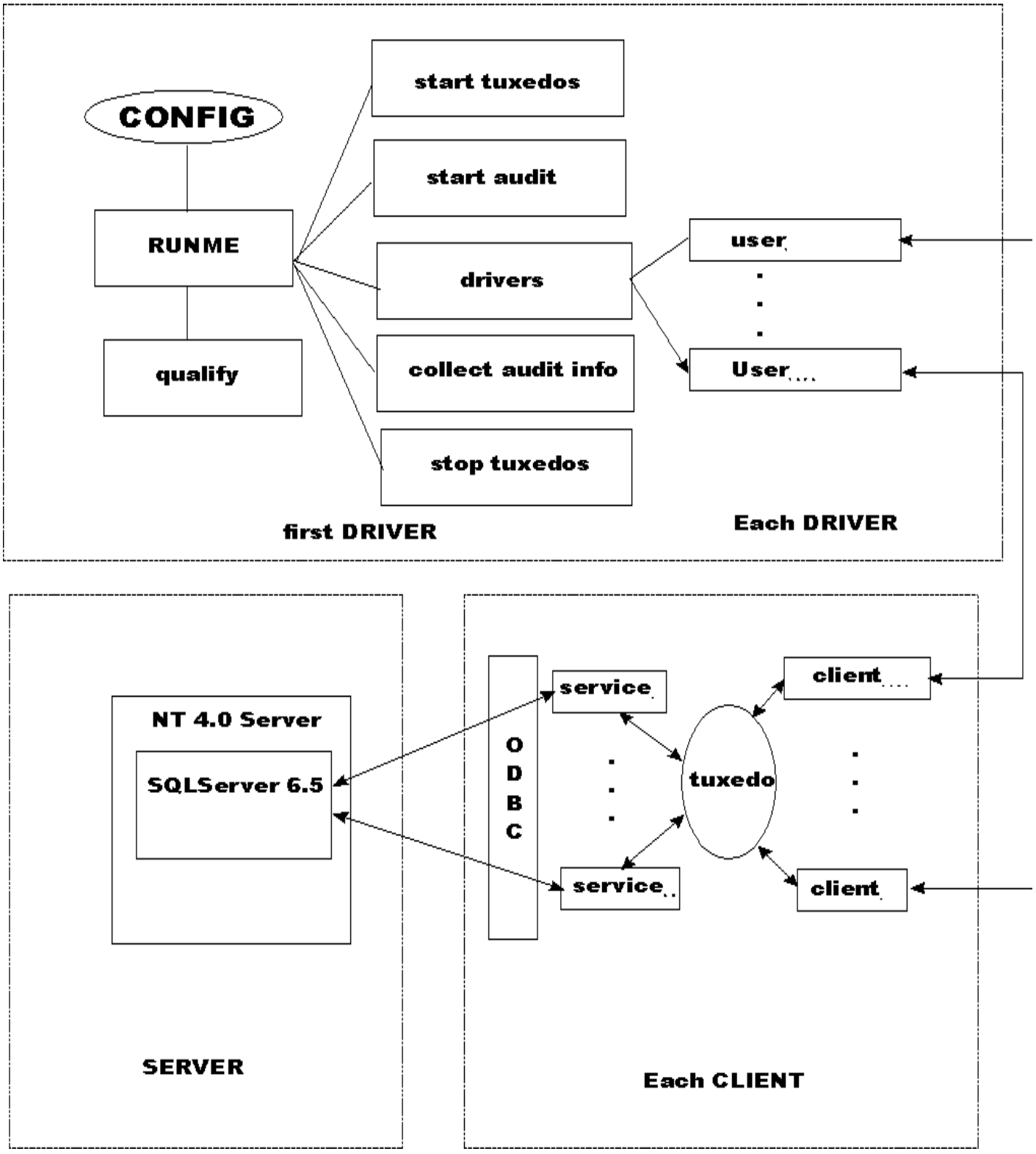
The benchmark is started with the RUNME command on the driver system. RUNME controls the overall execution of the benchmark. After reading a configuration file, RUNME starts the TUXEDO servers on the clients, collects pre-benchmark audit information and inserts a timestamp into a database audit table. When all the initial steps are completed, RUNME invokes another program, DRIVER, to start the benchmark. Results are collected into a single location at the completion of the run.

DRIVER is the heart of the benchmark software. It simulates users as they log in. execute transactions and view results. DRIVER collects response times for each transaction and saves them in a file for future analysis.

QUALIFYis the post-processing analysis program. This is executed on the master RTE machine, RTE1, the first RTE. It produces the numerical summaries and histograms needed for the disclosure report.

Appendix A contains listings of the code used to generate the transaction input.

FIGURE 7-1: Benchmark Software



7.3 Functional Diagram

A complete functional diagram of the hardware and software of the benchmark configuration including the driver must be provided. the sponsor must list all hardware and software functionality of the driver and its interface to the SUT.

Figures 1.1 and 1.2 in chapter 1 show functional diagrams of the benchmark and configured systems. A description of the RTE and benchmark software is provided above.

7.4 Networks

The network configuration of both the tested and proposed services which are being represented and a thorough explanation of exactly which parts are being replaced with the Driver System must be disclosed.

Figures 1.1 and 1.2 in chapter 1 diagram the network configurations of the benchmark and configured systems, and represent the Driver connected via LAN replacing the workstations and HUBS connected via LANs.

The bandwidth of the networks used in the tested/priced configurations must be disclosed.

Ethernet and 10 Base-T local area networks (LAN) with a bandwidth of 10 megabits per second are used in the tested/priced configurations.

7.5 Additional Production Information

VISIGENIC ODBC SDK

COMPANY DESCRIPTION:

Visigenic is a leading supplier of ODBC technology and database connectivity. Visigenic markets and supports the ODBC Driver Set and the Visigenic ODBC Software Development Kits (SDKs). Developers, VARs, and ISVs can write applications that communicate simultaneously with multiple databases and on multiple platforms - all through the ODBC standard interface.

VISIGENIC ODBC DRIVER SET:

The ODBC Driver Set provides cross-plarform access to multiple SQL databases from ODBC-enabled applications. The Driver Set includes drivers that provide your application access to enterprise-wide relational databases including Oracle, Informix, Sybase, Ingres, Microsoft SQL Server and IBM DB2 family. The operating systems currently supported include HP-UX, IBM AIX, SCO, OS/2, Macintosh, Windows, Windows NT, Solaris and Sun OS, with additional support being added continuously.

Visigenic Software, Inc
951 Mariner's Island Blvd, suite 460
San Mateo, CA 94494
415-286-1900

Section 8.0 – Clause 7 Related Items

8.1 System Pricing

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

The total 5 year price of the entire configuration must be reported, including: hardware, software, maintenance charges. Separate component pricing is recommended. The basis of all discounts used must be disclosed.

The details of the hardware, software and maintenance components of this system are reported in the front of this report as part of the executive summary. All 3rd party quotations are included at the end of this report in Appendix E.

8.2 General Availability, Throughput, and Price Performance

The committed delivery date for general availability (availability date) of products used in the price calculation must be reported. When the priced system includes products with different availabilty 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 of this system are currently available.

A statement of the measured tpmC as well as the respective calculations for the 5-year pricing, price/performance and the availability date must be included.

MAXIMUM QUALIFIED THROUGHPUT:	**8028.07 tpmC**
PRICE per tpmC:	**$73.78 per tpmC**
HARDWARE AVAILABILITY:	**current**
SOFTWARE AVAILABILITY:	**current**

8.3 Country Specific Pricing

Additional Clause 7 related items may be included in the Full Disclosure Report for each country specific priced item configuration. Country specific pricing is subject to Clause 7.1.7.

The system is being priced for the United States of America.

8.4 Usage Pricing

For any usage pricing, the sponser must disclose 1) Usage level at which the component was priced, 2) a statement of the company policy allowing such pricing.

The component pricing based on usage is shown below:

a) Microsoft SQL Server v6.5 User License was priced for unlimited number of users.

b) As part of HP series 9000 model E55 system prices, two 2-user HP-UX 10.01 Licenses were priced.

9.0 Clause 9 Related Items

9.1 Auditor's Information

The auditor's name, address, phone number, and a copy of the auditor's attestation letter indicating compliance must be included in the Full Disclosure Report.

The test methodology and results of this TPC Benchmark C were audited by:

Performance Metrics, Inc
TPC Certified Auditors
2229 Benita Drive, Suite 101
Rancho Cordova, CA 95670
phone: 916-635-2822
fax: 916-8580109

The auditor was Richard Gimarc. A copy of the Attestation Letter received from the auditor is attached on the following pages.

Requests for this Full Disclosure Report (FDR) should sent to:

Hewlett-Packard Company/Network Server Division
Attention: Jim Nagler, MS 53U FG
5301 Stevens Creek Blvd
Santa Clara, CA 95052-8059

PERFORMANCE METRICS INC.
TPC Certified Auditors

Anh Nguyen and Jim Nagler
Network Server Division
Hewlett-Packard Company
5301 Stevens Creek Boulevard
Santa Clara, CA 95052-8059

April 2, 1997

I have verified remotely the TPC Benchmark™ C C/S for the following configuration:

Platform: Hewlett-Packard NetServer LX Pro
Database Manager: Microsoft SQL Server 6.5 SP3 (6.50.242)
Operating System: Microsoft Windows NT Server 4.0
Transaction Manager: Tuxedo CFS 6.2

CPUs	Memory	Disks	New-Order Response Time @ 90%	tpmC
Server: HP NetServer LX Pro				
4 Pentium Pro @ 200 MHz	Main: 2 GB L2 Cache: 512 KB	78 @ 3.97 GB 18 @ 8.47 GB	1.24 sec.	8,028.07
4 Clients: HP 9000 Model E55				
1 PA-RISC 7100LC @ 96 MHz	512 MB	1 @ 0.98 GB	n.a.	n.a.

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark.

The following attributes of the benchmark were given special attention:

- The transactions were correctly implemented.
- The database files were properly sized and populated.
- The database was properly scaled with 650 warehouses.
- The ACID properties were met, including phantom protection.
- The durability data loss test was performed on a 10-warehouse database.
- Input data was generated according to the specified percentages.

2229 Benita Drive, Suite 101, Rancho Cordova, CA 95670
(916) 635-2822 Fax: (916) 858-0109 e-mail: Lorna@PerfMetrics.com

PERFORMANCE METRICS INC.
TPC Certified Auditors

- Eight hours of mirrored log space was configured on the priced system. Two 3.97 GB and two 8.47 GB disks were added to the priced configuration to satisfy the log space requirement. Measurement data was collected during steady state to demonstrate that this substitution was performance neutral.
- The data for the 180-day space calculation was verified. Eighteen 8.47 GB disks were substituted for eighteen 3.97GB disks in the priced configuration to satisfy this requirement. Measurement data was collected during steady state to demonstrate that this substitution was performance neutral.
- Measurement cycle times did not include delays for emulated components.
- The steady state portion of the test was 30 minutes.
- One checkpoint was taken during the steady state portion of the test.
- Checkpoints were verified to be clear of the guard zones.
- There were 6,500 user contexts present on the system.
- Each emulated user had a unique starting random number seed.
- The NURand constants used for database load and at run time were verified.
- System pricing was checked for major components and maintenance.

Additional Audit Notes: none

Regards,

Richard L. Gimarc

Richard L. Gimarc
Auditor

Appendix A – Application Source

A.1 Client Front-End

This appendix contains the source and makefiles for the Tuxedo client and server programs. All of the programs ran on the client machine.

client/client.c

```
/*************************************************************
*******************
 @(#) Version: A.10.10 $Date: 96/04/15 15:15:37 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights
reserved.
*************************************************************
*****************/
/*************************************************************
**********
History
941101 JVM Fixed login screen to detect broken connection
(used to loop)
941013 JVM Added audit strings to the login form
941013 VM modified the getfield procedure to add digit and
char check
       according to the field type.
941014 VM added the status_msg routine to display
transaction results.
941015 VM added zip routine to format zip codes and phone
routine
       to format phone numbers.
*************************************************************
***********/
#include "iobuf.h"
#include "tpcc.h"
#include <signal.h>
#define until(c)  while(!(c))
/* a generic transaction variable. */
generic_trans generic_transaction;
generic_trans *trans=&generic_transaction;
/* global variables set up during initialization */
int user;
ID warehouse;
ID district;
main(argc, argv)
    int argc;
    char **argv;
    {
    int key;
    /* setup the transactions */
    key = setup(argc, argv);
    /* repeat until done */
    while (key != '9' && key != EOF)
       {
        /* get the menu choice */
        key = menu_read();
        /* process according to the choice */
        switch(key)
            {
            case '1': key = neworder(&trans->neworder);
break;
            case '2': key = payment(&trans->payment); break;
            case '3': key = ordstat(&trans->ordstat); break;
            case '4': key = delivery(&trans->delivery);
break;
            case '5': key = stocklev(&trans->stocklev);
break;
            case EOF: break;
            case '9': break;
            default:    msgline("Please enter a valid menu
choice");
            }
        }

    /* done */
    cleanup();
    }
```

```
/************************************************************
***********
************************************************************
***********
Neworder form processing
************************************************************
***********
************************************************************
***********/
define_iobuf(neworder_form, 900);
int neworder(trans)
    neworder_trans *trans;
    {
    int key;
    display(neworder_form);
    key = neworder_read(trans);
    if (key != ENTER) return key;
    neworder_transaction(trans);
    neworder_write(trans);
    return key;
    }
int neworder_read(trans)
    neworder_trans *trans;
    {
    int i;
    int field;
    int key;
    int ol;
    /* Our warehouse number is fixed */
    trans->W_ID = warehouse;
    trans->D_ID = EMPTY_NUM;
    /* assume nothing set yet */
    trans->C_ID = EMPTY_NUM;
    for (i=0; i<15; i++)
        {
        trans->item[i].OL_I_ID = EMPTY_NUM;
        trans->item[i].OL_QUANTITY = EMPTY_NUM;
        trans->item[i].OL_SUPPLY_W_ID = EMPTY_NUM;
        }
    /* Process fields until done */
    for (field = 1; field > 0; field = next_field(field,
key, 47))
        retry: switch (field)
            {
            case 1: key = read_number(4, 29, &trans->D_ID,
2);
                    break;
            case 2: key = read_number(5, 12, &trans->C_ID,
4);
                    break;
            case 3: case 6: case 9: case 12: case 15:
            case 18: case 21: case 24: case 27: case 30:
            case 33: case 36: case 39: case 42: case 45:
                ol = (field - 3) / 3;
                key = read_number(9+ol, 3, &trans-
>item[ol].OL_SUPPLY_W_ID,4);
                break;
            case 4: case 7: case 10: case 13: case 16:
            case 19: case 22: case 25: case 28: case 31:
            case 34: case 37: case 40: case 43: case 46:
                ol = (field - 3) / 3;
                key = read_number(9+ol,10, &trans-
>item[ol].OL_I_ID, 6);
                break;
            case 5: case 8: case 11: case 14: case 17:
            case 20: case 23: case 26: case 29: case 32:
            case 35: case 38: case 41: case 44: case 47:
                ol = (field - 3) / 3;
                key = read_number(9+ol, 45, &trans-
>item[ol].OL_QUANTITY, 2);
                break;
            }
    /* abort the screen if requested */
    if (key != ENTER)
        return key;
    /* calculate how many items were entered */
    for (i=15; i>0; i--)
        if ((trans->item[i-1].OL_I_ID != EMPTY_NUM) ||
       (trans->item[i-1].OL_SUPPLY_W_ID != EMPTY_NUM) ||
       (trans->item[i-1].OL_QUANTITY != EMPTY_NUM)) break;
    trans->O_OL_CNT = i;
    /* make sure all necessary fields are filled in */
    if (trans->D_ID == EMPTY_NUM)
```

```
        {field=1; msgline("Please specify district"); goto
retry;}
    if (trans->C_ID == EMPTY_NUM)
        {field=2; msgline("Please specify customer id");
goto retry;}
    if (trans->O_OL_CNT == 0)
        {field=3; msgline("Please enter at least one
orderline"); goto retry;}
    for (i=0; i<trans->O_OL_CNT; i++)
        {
        if (trans->item[i].OL_SUPPLY_W_ID == EMPTY_NUM)
            {field=i*3+3; msgline("Please enter supply
warehouse"); goto retry;}
        if (trans->item[i].OL_I_ID == EMPTY_NUM)
            {field=i*3+4; msgline("Please enter Item id");
goto retry;}
        if (trans->item[i].OL_QUANTITY == EMPTY_NUM
         || trans->item[i].OL_QUANTITY <= 0)
            {field=i*3+5; msgline("Please enter quantity >
0"); goto retry;}
        }
    /* decide if they were all local */
    for (i=0; i<trans->O_OL_CNT; i++)
        if (trans->item[i].OL_SUPPLY_W_ID != trans->W_ID)
break;
    trans->all_local = (i == trans->O_OL_CNT);
    /* display number of order lines */
    number(6, 42, trans->O_OL_CNT, 2);
    msgline("");
    flush();
    return key;
    }
neworder_write(t)
    neworder_trans *t;
    {
    int i;
    MONEY amount, total_amount, cost;
    /* CASE: invalid item, display only these values */
    if (t->status == E_INVALID_ITEM)
        {
        text(5, 25, t->C_LAST);
        text(5,52,  t->C_CREDIT);
        number(6, 15, t->O_ID, 8);
        }
    /* CASE: everything OK, display everything */
    else if (t->status == OK)
        {
        text(5, 25, t->C_LAST);
        text(5,52,  t->C_CREDIT);
        number(6, 15, t->O_ID, 8);
        date(4, 61, t->O_ENTRY_D);
        real(5, 64, t->C_DISCOUNT * 100, 5, 2);
        real(6, 59, t->W_TAX*100, 5, 2);
        real(6, 74, t->D_TAX*100, 5, 2);

        total_amount = 0;
        for (i=0; i < t->O_OL_CNT; i++)
            {

            /* keep track of amount of each line and total
*/
            amount = t->item[i].I_PRICE * t-
>item[i].OL_QUANTITY;
            total_amount += amount;

            /* display the item line */
            text(9+i, 19, t->item[i].I_NAME);
            number(9+i, 51, t->item[i].S_QUANTITY, 3);
            position(9+i, 58);   pushc(t-
>item[i].brand_generic);
            money(9+i, 62, t->item[i].I_PRICE, 7);
            money(9+i, 71, amount, 8);
            }
        /* Clear the screen of any empty input fields */
        clear_screen();

        /* display the total cost */
        text(24, 63, "Total:");
        cost = total_amount * (1 - t->C_DISCOUNT) * (1 + t-
>W_TAX + t->D_TAX);
        money(24, 71, cost, 9);
        }
    /* display the status message */
    status(24, 1, t->status);
    }
```

```
neworder_setup()
    {
    int item;
    iobuf *old;
    /* start with an empty form */
    reset(neworder_form);
    /* redirect the data to a special menu buffer */
    old = out_buf;  out_buf = neworder_form;
    /* clear the iobuf below the menu */
    position(3,1);
    clear_screen();
    /* set up all the field labels */
    text(3, 36, "New Order");
    text(4, 1, "Warehouse:");
    number(4, 12, warehouse, 4);
    text(4, 19, "District:");
    empty(4, 29, 2);
    text(4, 55, "Date:");
    text(5, 1, "Customer:");
    empty(5, 12, 4);
    text(5, 19, "Name:");
    text(5, 44, "Credit:");
    text(5, 57, "Disc.:");
    text(6, 1, "Order Number:");
    text(6, 25, "Number of Lines:");
    text(6, 52, "W_Tax:");
    text(6, 67, "D_Tax:");
    text(8, 2, "Supp_W Item_Num   Item_Name");
    text(8, 45, "Qty Stock   B/G     Price  Amount");
    /* display blank fields for each item */
    for (item = 1; item <= 15; item++)
        {
        empty(8+item, 3, 4);
        empty(8+item, 10, 6);
        empty(8+item, 45, 2);
        }
    trigger();
    /* restore to the previous I/O buffer */
    out_buf = old;
    }
```

```
/*************************************************************
**********
*************************************************************
**********
Payment form processing
*************************************************************
**********
*************************************************************
*********/
define_iobuf(payment_form, 400);
int payment(trans)
    payment_trans *trans;
    {
    int key;
    display(payment_form);
    key = payment_read(trans);
    if (key != ENTER)  return key;
    payment_transaction(trans);
    payment_write(trans);
    return key;
    }
payment_setup()
    {
    int item;
    iobuf *old;
    /* start with an empty form */
    reset(payment_form);
    /* redirect the data to a special menu buffer */
    old = out_buf;  out_buf = payment_form;
    /* clear the iobuf below the menu */
    position(3,1);
    clear_screen();
    /* set up all the field labels */
    text(3, 38, "Payment");
    text(4, 1, "Date:");
    text(6, 1, "Warehouse:");
    number(6, 12, warehouse, 4);
    text(6, 42, "District:");
    empty(6, 52, 2);
    text(11, 1, "Customer:");
    empty(11, 11, 4);
    text(11, 17, "Cust-Warehouse:");
```

```
    empty(11, 33, 4);
    text(11, 39, "Cust-District:");
    empty(11, 54, 2);
    text(12, 1, "Name:");
    empty(12, 29, 16);
    text(12, 50, "Since:");
    text(13, 50, "Credit:");
    text(14, 50, "%Disc:");
    text(15, 50, "Phone:");
    text(17, 1, "Amount Paid:");
    empty(17, 23, 8);
    text(17, 37, "New Cust-Balance:");
    text(18, 1, "Credit Limit:");
    text(20, 1, "Cust-Data:");
    trigger();
    out_buf = old;
    }
int payment_read(t)
    payment_trans *t;
    {
    int i;
    int field;
    int key;
    /* Our warehouse number is fixed */
    t->W_ID = warehouse;
    t->C_ID = EMPTY_NUM;
    t->D_ID = EMPTY_NUM;
    t->C_W_ID = EMPTY_NUM;
    t->C_D_ID = EMPTY_NUM;
    t->H_AMOUNT = EMPTY_FLT;
    t->C_LAST[0] = '\0';
    /* Process fields until done */
    for (field = 1; field > 0; field = next_field(field,
key, 6))
        retry: switch (field)
            {
            case 1: key = read_number(6, 52, &t->D_ID, 2);
                    break;
            case 2:
                /* if last name specified, skip this field
*/
                if (t->C_LAST[0] != '\0')
                    break;
                /* read in the customer id */
                key = read_number(11, 11, &t->C_ID, 4);
                /* if specified, don't allow last name to
be entered */
                if (t->C_ID != EMPTY_NUM)
                    {
                    blanks(12, 29, 16);
                    t->C_LAST[0] = '\0';
                    }

                /* refresh the C_LAST underlines, if
possibly needed */
                else if (t->C_LAST[0] == '\0')
                    empty(12, 29, 16);
                break;
            case 3: key = read_number(11, 33,  &t->C_W_ID,
4);
                    break;
            case 4: key = read_number(11, 54, &t->C_D_ID,
2);
                    break;
            case 5:
                /* skip this field if C_ID was already
specified */
                if (t->C_ID != EMPTY_NUM)
                    break;

                /* read in the customer last name */
                key = read_text(12, 29, t->C_LAST, 16);
                /* if specified, don't allow c_id to be
entered */
                if (t->C_LAST[0] != '\0')
                    {
                    blanks(11, 11, 4);
                    t->C_ID = EMPTY_NUM;
                    }
                /* refresh the C_ID underlines, if possibly
needed */
                else if (t->C_ID == EMPTY_NUM)
                    empty(11, 11, 4);
                break;
```

```
            case 6: key = read_money(17, 23, &t->H_AMOUNT,
8);
                    break;
            }
    /* if Aborted, then done */
    if (key != ENTER)
        return key;
    /* Make sure all the fields were entered */
    if (t->D_ID == EMPTY_NUM)
        {field=1; msgline("Please enter district id"); goto
retry;}
    if (t->C_ID == EMPTY_NUM && t->C_LAST[0] == '\0')
        {field=2; msgline("C_ID or C_LAST must be
entered"); goto retry;}
    if (t->C_W_ID == EMPTY_NUM)
        {field=3; msgline("Please enter customer's
warehouse"); goto retry;}
    if (t->C_D_ID == EMPTY_NUM)
        {field=4; msgline("please enter customer's
district"); goto retry;}
    if (t->H_AMOUNT == EMPTY_FLT)
        {field=6; msgline("Please enter payment amount");
goto retry;}
    if (t->H_AMOUNT <= 0)
    {field=6; msgline("Please enter a positive payment");
goto retry;}
    t->byname = (t->C_ID == EMPTY_NUM);
    msgline("");
    flush();
    return key;
    }
payment_write(t)
    payment_trans *t;
    {
    /* if errors, display a message and quit */
    if (t->status != OK)
        {
        status(24, 1, t->status);
        return;
        }
    /* display the screen */
    date(4, 7, t->H_DATE);
    text(7, 1, t->W_STREET_1);
    text(7, 42, t->D_STREET_1);
    text(8, 1, t->W_STREET_2);
    text(8, 42, t->D_STREET_2);
    text(9, 1, t->W_CITY);
    text(9, 22, t->W_STATE);
    zip(9, 25, t->W_ZIP);
    text(9, 42, t->D_CITY);
    text(9, 63, t->D_STATE);
    zip(9, 66, t->D_ZIP);
    number(11, 11, t->C_ID, 4);
    text(12, 9, t->C_FIRST);
    text(12, 26, t->C_MIDDLE);
    text(12, 29, t->C_LAST);
    date_only(12, 58, t->C_SINCE);
    text(13, 9, t->C_STREET_1);
    text(13, 58, t->C_CREDIT);
    text(14, 9, t->C_STREET_2);
    real(14, 58, t->C_DISCOUNT*100, 5, 2);  /* percentage
or fraction? */
    text(15, 9, t->C_CITY);
    text(15, 30, t->C_STATE);
    zip(15, 33, t->C_ZIP);
    phone(15, 58, t->C_PHONE);
    money(17, 17, t->H_AMOUNT,14);
    money(17, 55, t->C_BALANCE, 15);
    money(18, 17, t->C_CREDIT_LIM, 14);
    /* Display cust data if bad credit. */
    if (t->C_CREDIT[0] == 'B' && t->C_CREDIT[1] == 'C')
        long_text(20, 12, t->C_DATA, 50);
    }

/*************************************************************
******
*************************************************************
******
ORDSTAT form processing
*************************************************************
******
*************************************************************
******/
define_iobuf(ordstat_form, 300);
int ordstat(t)
```

```
    ordstat_trans *t;
    {
    int key;
    display(ordstat_form);
    key = ordstat_read(trans);
    if (key != ENTER)  return key;
    ordstat_transaction(trans);
    ordstat_write(trans);
    return key;
    }
ordstat_setup()
    {
    int item;
    iobuf *old;
    /* start with an empty form */
    reset(ordstat_form);
    /* redirect the data to a special menu buffer */
    old = out_buf;  out_buf = ordstat_form;
    /* clear the iobuf below the menu */
    position(3,1);
    clear_screen();
    /* set up all the field labels */
    text(3, 35, "Order-Status");
    text(4, 1, "Warehouse:");
    number(4, 12, warehouse, 4);
    text(4, 19, "District:");
    empty(4, 29, 2);
    text(5, 1, "Customer:");
    empty(5, 11, 4);
    text(5, 18, "Name:");
    empty(5, 44, 16);
    text(6, 1, "Cust-Balance:");
    text(8, 1, "Order-Number");
    text(8, 26, "Entry-Date:");
    text(8, 60, "Carrier-Number:");
    text(9, 1, "Supply-W");
    text(9, 14, "Item-Num");
    text(9, 25, "Qty");
    text(9, 33,"Amount");
    text(9, 45, "Delivery-Date");
    trigger();
    /* done */
    out_buf = old;
    }
int ordstat_read(t)
    ordstat_trans *t;
    {
    int i;
    int field;
    int key;
    /* Our warehouse number is fixed */
    t->W_ID = warehouse;
    t->C_ID = EMPTY_NUM;
    t->D_ID = EMPTY_NUM;
    t->C_LAST[0] = '\0';
    /* Process fields until done */
    for (field = 1; field > 0; field = next_field(field,
key, 3))
        retry: switch (field)
            {
            case 1: key = read_number(4, 29, &t->D_ID, 2);
                    break;
            case 2:
                /* if last name specified, skip this field
*/
                if (t->C_LAST[0] != '\0')
                    break;
                /* read in the customer id */
                key = read_number(5, 11, &t->C_ID, 4);
                /* if specified, don't allow last name to
be entered */
                if (t->C_ID != EMPTY_NUM)
                    {
                    blanks(5, 44, 16);
                    t->C_LAST[0] = '\0';
                    }

                /* refresh the C_LAST underlines, if
possibly needed */
                else if (t->C_LAST[0] == '\0')
                    empty(5, 44, 16);
                break;
            case 3:
```

```
                /* skip this field if C_ID was already
specified */
                if (t->C_ID != EMPTY_NUM)
                    break;

                /* read in the customer last name */
                key = read_text(5, 44, t->C_LAST, 16);
                /* if specified, don't allow c_id to be
entered */
                if (t->C_LAST[0] != '\0')
                    {
                    blanks(5, 11, 4);
                    t->C_ID = EMPTY_NUM;
                    }
                /* refresh the C_ID underlines, if possibly
needed */
                else if (t->C_ID == EMPTY_NUM)
                    empty(5, 11, 4);
                break;
            }
    /* if Aborted, then done */
    if (key != ENTER)
        return key;
    /* ensure all the necessary fields were entered */
    if (t->D_ID == EMPTY_NUM)
        {field=1; msgline("Please enter district id"); goto
retry;}
    if (t->C_ID == EMPTY_NUM && t->C_LAST[0] == '\0')
        {field=2;  msgline("C_ID or C_LAST must be
entered"); goto retry;}
    t->byname = (t->C_ID == EMPTY_NUM);
    msgline("");
    flush();
    return key;
    }
ordstat_write(t)
    ordstat_trans *t;
    {
    int i;
    /* if errors, display a status message and quit */
    if (t->status != OK)
        {
        status(24, 1, t->status);
        return;
        }
    /* display the results */
    number(5, 11, t->C_ID, 4);
    text(5, 24, t->C_FIRST);
    text(5, 41, t->C_MIDDLE);
    text(5, 44, t->C_LAST);
    money(6, 15, t->C_BALANCE, 10);
    number(8, 15, t->O_ID, 8);
    date(8, 38, t->O_ENTRY_DATE);
    if (t->O_CARRIER_ID > 0)
        number(8, 76, t->O_CARRIER_ID, 2);
    for (i=0; i< t->ol_cnt; i++)
        {
        number(i+10, 3, t->item[i].OL_SUPPLY_W_ID, 4);
        number(i+10, 14, t->item[i].OL_I_ID, 6);
        number(i+10, 25, t->item[i].OL_QUANTITY, 2);
        money(i+10, 32, t->item[i].OL_AMOUNT, 9);
        date_only(i+10, 47, t->item[i].OL_DELIVERY_DATE);
        }
    }
/************************************************************
***
************************************************************
****
delivery form processing
************************************************************
*****
************************************************************
*****/
define_iobuf(delivery_form, 300);
int delivery(t)
    delivery_trans *t;
    {
    int key;
    display(delivery_form);
    key = delivery_read(trans);
    if (key != ENTER)  return key;
    delivery_enque(trans);
    delivery_write(trans);
    return key;
```

```
    }
delivery_setup()
    {
    int item;
    iobuf *old;
    /* start with an empty form */
    reset(delivery_form);
    /* redirect the data to a special menu buffer */
    old = out_buf;  out_buf = delivery_form;
    /* clear the iobuf below the menu */
    position(3,1);
    clear_screen();
    /* set up all the field labels */
    text(3, 38, "Delivery");
    text(4, 1, "Warehouse:");
    number(4, 12, warehouse, 4);
    text(6, 1, "Carrier Number:");
    empty(6, 17, 2);
    trigger();
    /* done */
    out_buf = old;
    }
int delivery_read(t)
    delivery_trans *t;
    {
    int i;
    int field;
    int key;
    /* Our warehouse number is fixed */
    t->W_ID = warehouse;
    t->O_CARRIER_ID = EMPTY_NUM;
    /* Process fields until done */
    for (field = 1; field > 0; field = next_field(field,
key, 1))
        retry: switch (field)
            {
            case 1: key = read_number(6, 17, &t-
>O_CARRIER_ID, 2);
                    break;
            }
    /* if Aborted, then done */
    if (key != ENTER)
        return key;
    /* Must enter the carrier id */
    if (t->O_CARRIER_ID == EMPTY_NUM)
        {field=1; msgline("Please enter the Carrier
Number"); goto retry; }
    /* clear the message line */
    msgline("");
    flush();
    return key;
    }
delivery_write(t)
    delivery_trans *t;
    {
    if (t->status == OK)
        text(8, 1, "Execution Status: Delivery has been
queued");
    else
        status(8, 1, t->status);
    }
/*************************************************************
***
*************************************************************
****
stocklev form processing
*************************************************************
*****
*************************************************************
*****/
define_iobuf(stocklev_form, 300);
int stocklev(t)
    stocklev_trans *t;
    {
    int key;
    display(stocklev_form);
    key = stocklev_read(trans);
    if (key != ENTER)  return key;
    stocklev_transaction(trans);
    stocklev_write(trans);
    return key;
    }
stocklev_setup()
    {
```

```
    int item;
    iobuf *old;
    /* start with an empty form */
    reset(stocklev_form);
    /* redirect the data to a special menu buffer */
    old = out_buf;  out_buf = stocklev_form;
    /* clear the iobuf below the menu */
    position(3,1);
    clear_screen();
    /* set up all the field labels */
    text(3, 35, "Stock-Level");
    text(4, 1, "Warehouse:");
    number(4, 12, warehouse, 4);
    text(4, 19, "District:");
    number(4, 29, district, 2);
    text(6, 1, "Stock Level Threshold:");
    empty(6, 24, 2);
    text(8, 1, "low stock");
    trigger();
    /* done */
    out_buf = old;
    }
int stocklev_read(t)
    stocklev_trans *t;
    {
    int field;
    int key;
    t->W_ID = warehouse;
    t->D_ID = district;
    t->threshold = EMPTY_NUM;
    /* Process fields until done */
    for (field = 1; field > 0; field = next_field(field,
key, 1))
        retry: switch (field)
            {
            case 1: key = read_number(6, 24, &t->threshold,
2);
                    break;
            }
    /* if Aborted, then done */
    if (key != ENTER)
        return key;
    /* make sure the necessary fields were entered */
    if (t->threshold == EMPTY_NUM || t->threshold <= 0)
        {field=1; msgline("Please enter a threshold > 0");
goto retry; }
    /* clear the message line */
    msgline("");
    flush();
    return key;
    }
stocklev_write(t)
    stocklev_trans *t;
    {
    if (t->status == OK)
        number(8, 12, t->low_stock, 3);
    else
       status(10, 1, t->status);
    }
/************************************************************
***********
************************************************************
**********
login form processing
************************************************************
***********
************************************************************
************/
int login()
    {
    int field;
    int key;
    char auditstr[21];
    int w_id, d_id;
    /* assume the default values */
    w_id = warehouse;
    d_id = district;
    auditstr[0] = '\0';
    /* display the login menu */
    position(1,1);  clear_screen();
    text(3, 30, "Please login.");
    text(5,5,"Warehouse:");
    number(5, 16, w_id, 4);
    text(5, 24, "District:");
```

```
    number(5, 34, d_id, 2);
    text(15, 5, "Audit String:");
    text(15, 19, CLIENT_AUDIT_STRING);
    empty(16, 19, 20);
    trigger();
    /* Get values until done */
    for (field = 1; field > 0;  field = next_field(field,
key, 3))
        retry: switch (field)
            {
            case 1:
                key = read_number(5, 16, &w_id, 4, Num);
                break;
            case 2:
                key = read_number(5, 34, &d_id, 2, Num);
                break;
            case 3:
                key = read_text(16, 19, auditstr, 20);
                break;
            }
    if (key != ENTER)
        return EOF;
    if (w_id == EMPTY_NUM && warehouse == EMPTY_NUM)
        {
        msgline("You must enter a warehouse id");
        field =1;
        goto retry;
        }
    if (d_id == EMPTY_NUM && district == EMPTY_NUM)
        {
        msgline("You must enter a district id");
        field = 2;
        goto retry;
        }
    if (w_id != EMPTY_NUM)
        warehouse = w_id;
    if (d_id != EMPTY_NUM)
        district = d_id;
    /* done */
    flush();
    return key;
    }
/*************************************************************
********
*************************************************************
*********
menu form processing
*************************************************************
********
*************************************************************
*******/
menu_setup()
    {
    /* display the menu on the iobuf -- never erased */
    position(1, 1);
    clear_screen();
    string("(1)New-Order (2)Payment (3)Order-Status ");
    string("(4)Delivery (5)StockLevel (9)Exit");
    }
int menu_read()
    {
    position(1, 1);
    trigger();
    return getkey();
    }
int next_field(current, key, max)
    int current;
    int key;
    int max;
    {
    if (key == BACKTAB)
        if (current == 1)    return max;
        else                 return current-1;
    else if (key == TAB)
        if (current == max)  return 1;
        else                 return current+1;
    else
        return 0;
    }


msgline(str)
    char *str;
```

```
    {
    position(24, 1);
    clear_screen();
    string(str);
    flush();  /* Needed? */
    }
int setup(argc, argv)
    int argc;
    char **argv;
    {
    int key;
    /* Ignore SIGPIPE, since they occur normally */
    signal(SIGPIPE, SIG_IGN);
    /* get the user, warehouse and district numbers */
    warehouse = EMPTY_NUM;
    district = EMPTY_NUM;
    key = login();
    user = warehouse*DIST_PER_WARE + district + 1;
    /* set up the forms */
    menu_setup();
    neworder_setup();
    payment_setup();
    ordstat_setup();
    delivery_setup();
    stocklev_setup();
    /* connect to the delivery queue */
    delivery_init(user);
    /* connect to the transaction processor */
    transaction_begin(user);
    return key;
    }

cleanup()
    {
    /* detach from transaction engine */
    transaction_done();

    /* detach from the delivery queue */
    delivery_done();
    /* clear the screen */
    position(1, 1);
    clear_screen();
    flush();
    }
/*************************************************************
**********
*************************************************************
**********
Screen Output Routines
*************************************************************
**********
*************************************************************
**********/
number(row, col, n, width)
    int row;
    int col;
    int n;
    int width;
    {
    char str[81];
    fmt_num(str, n, width);
    text(row, col, str);
    }
real(row, col, x, width, dec)
    int row;
    int col;
    double x;
    int width;
    int dec;
    {
    char str[81];
    fmt_flt(str, x, width, dec);
    text(row, col, str);
    }
date(row, col, date_str)
    int row;
    int col;
    char *date_str;
    {
    text(row, col, date_str);
    }
date_only(row, col, date_str)
    int row;
```

```
    int col;
    char *date_str;
    {
    date_str[10] = '\0';
    text(row, col, date_str);
    }
money(row, col, x, width)
    int row;
    int col;
    double x;
    int width;
    {
    char str[81];
    fmt_money(str, x, width);
    text(row, col, str);
    }
long_text(row, col, str, width)
    int row, col, width;
    char *str;
    {
    int pos;

    /* repeat until the entire string is written out */
    for (pos = width; *str != '\0';  str++, pos++)
        {
        /* if at end of line, position the cursor to next
line */
        if (pos >= width)
            {
            position(row, col);
            pos = 0;
            row++;
            }
        /* output the next character */
        pushc(*str);
        }
    }
text(row, col, str)
    int row;
    int col;
    char str[];
    {
    position(row, col);
    string(str);
    }
phone(row, col,str)
      int row;
      int col;
      char *str;
      {

       char temp[30];
       fmt_phone(temp,str);
       text(row,col,temp);
       }
zip(row, col, str)
    int row;
    int col;
    char *str;
    {
    char temp[30];
    fmt_zip(temp,str);
    text(row,col,temp);
    }
empty(row, col, len)
    int row;
    int col;
    int len;
    {
    position(row, col);
    while (len-- > 0)
        pushc('_');
    }
blanks(row, col, len)
    int row, col, len;
    {
    position(row, col);
    while (len-- > 0)
        pushc(' ');
    }
status(row, col, status)
```

```
/*************************************************************
**********
status displays the transaction status
  Note: must correspond to 'get_status' in
driver/keystroke.c
*************************************************************
********/
   int row, col;
   int status;
   {
   text(row, col, "Execution Status: ");

   if (status == OK)
       string("Transaction Committed");
   else if (status == E_INVALID_ITEM)
       string("Item number is not valid");
   else
       {
       string("Rollback -- ");
       number(row, col+30, status, 5);
       }
   }
/*************************************************************
*************
*************************************************************
*************
ASCII terminal control
*************************************************************
************
*************************************************************
***********/
trigger()
/*************************************************************
************
trigger sends a turnaround sequence to let the driver know
to send input
*************************************************************
************/
    {
    pushc(TRIGGER);
    }
position(row, col)
/*************************************************************
*******
position positions the cursor at the given row and column
*************************************************************
*******/
    int row;
    int col;
    {
    pushc(ESCAPE);
    pushc('[');
    if (row >= 10)
        pushc('0' + row/10);
    pushc('0'+ row%10);
    pushc(';');
    if (col >= 10)
        pushc('0' + col/10);
    pushc('0' + col%10);
    pushc('H');
    }
clear_screen()
/*************************************************************
***********
clear_screen clears the iobuf from cursor position to end
of iobuf
*************************************************************
***********/
    {
    pushc(ESCAPE);
    pushc('[');
    pushc('J');
    }
/*************************************************************
*********
*************************************************************
**********
Screen Input Routines
*************************************************************
*********
*************************************************************
*********/
#define funny(key)  (key != ENTER && key !=TAB && key !=
BACKTAB)
read_number(row, col, n, width)
```

```
/*********************************************************
*******
read_number reads an integer field
*********************************************************
******/
    int row;
    int col;
    int *n;
    int width;
    {
    char temp[81];
    int key;
    int err;
    debug("read_number: row=%d  col=%d  width=%d n=%d
\n",row, col,width,*n);
    /* generate the current characters */
    fmt_num(temp, *n, width);
    err = NO;

    /* repeat until a valid number or a funny key is
pressed */
    for (;;)
        {
        /* Let the user edit the field */
        key = getfield(row, col, temp, width, Num);
    if (funny(key)) return key;

        /* convert the field to a number */
        *n = cvt_num(temp);
        if (*n != INVALID_NUM) break;
        msgline("Invalid digit entered");
    pushc(BELL);
        err = YES;
        }
    /* display the new number */
    number(row, col, *n, width);
    if (err) msgline("");
    debug("read_number: n=%d  key=%d\n", *n, key);
    return key;
    }
int read_money(row, col, m, width)
    int row;
    int col;
    double *m;
    int width;
    {
    char temp[81];
    int key;
    int err;
    err = NO;
    fmt_money(temp, *m, width);
    /* repeat until a valid number or a funny key is
pressed */
    for (;;)
        {
        key = getfield(row, col, temp, width, Money);
    if (funny(key)) return key;
        *m = cvt_money(temp);
        if (*m != INVALID_FLT)  break;

        msgline("Please enter amount $99999.99");
        pushc(BELL);
        err = YES;
    }
    money(row, col, *m, width);
    if (err) msgline("");
    return key;
    }
int read_real(row, col, x, width, dec)
    int row, col, width;
    double *x;
    {
    char temp[81];
    int key;
    int err;

    /* generate the current characters */
    fmt_flt(temp, *x, width, dec);
    err = NO;
    /* repeat until a valid number or a funny key is
pressed */
    for (;;)
    {
        key = getfield(row, col, temp, width);
```

```
    if (funny(key)) return key;
        /* convert the field to a number */
        *x = cvt_flt(temp);
    if (*x != INVALID_FLT) break;
        msgline("Please enter a valid floating pt number");
        pushc(BELL);
        err = YES;
        }
    /* display the new number */
    real(row, col, *x, width, dec);
    if (err) msgline("");
    return key;
    }
int read_text(row, col, s, width)
    int row, col, width;
    char *s;
    {
    char temp[81];
    int key;
    int i;
    /* generate the current characters */
    fmt_text(temp, s, width);
    /* let the user edit the field */
    key = getfield(row, col, temp, width, Text);
    if (funny(key)) return key;
    /* Strip off leading and trailing space characters */
    cvt_text(temp, s);
    /* redisplay the current text */
    fmt_text(temp, s, width);
    text(row, col, temp);
    return key;
    }

int getfield(row, col, buf, width,ftype)
    int row, col, width;
    char buf[];
    FIELD_TYPE ftype;
    {
    int pos, key;
    debug("getfield: width=%d  buf=%*s\n", width, width,
buf);
    /* go to the beginning of the field */
    position(row, col);
    pos = 0;
    /* repeat until a special control character is pressed
*/
    for (;;)
        {
        /* get the next character */
        key = getkey();
        /* CASE: Add to buf if it fits and Is it a valid
character ? */
        if (pos < width  && valid_char(key, ftype))
            {
            buf[pos] = key;
            pos++;
            pushc(key);
            }
        /* CASE: char is BACKSPACE.  Erase last character.
*/
        else if (key == BACKSPACE && pos > 0)
            {
            pos--;
            buf[pos] = '_';
            pushc(BACKSPACE);
            pushc('_');
            pushc(BACKSPACE);
            }
       /* CASE: enter, tab, backtab, ^c.  Exit loop */
       else if (key==ENTER || key==TAB || key==BACKTAB ||
key==CNTRLC
                || key == EOF)
           break;
       else if (key=='\031')   /* for debugging, let ^X ==
ENTER */
            {key=ENTER; break;}
       /* Otherwise, ignore the character and beep */
       else
           pushc(BELL);
       }
    debug("getfield: final key: %d  buf=%*s\n", key, width,
buf);
    return key;
```

```
    }
int valid_char(key, ftype)
/*************************************************************
**********
valid_char is true if the key is valid for this type of
field
*************************************************************
**********/
    int key;
    FIELD_TYPE ftype;
    {
    int valid;
    switch(ftype)
     {
     case Num : valid = (isdigit(key) || key == '-' || key
== ' ');
       break;
          case Text : valid = (isprint(key) || key == ' ');
          break;
          case Money : valid = (isdigit(key) || key == '-'
|| key == '.'
       || key == '$' || key == ' ');
                  break;
          default     : valid = NO;
          break;
          }
     return valid;
     }
```

lib/tpcc.h

```
/*************************************************************
******************
 @(#) Version: A.10.10 $Date: 96/07/11 16:52:21 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights
reserved.
*************************************************************
*****************/
#ifndef TPCC_INCLUDED
#define TPCC_INCLUDED
#include <values.h>

/* The auditor can define these 20 char strings to be
anything */
#define DRIVER_AUDIT_STRING  "driver audit string"
#define CLIENT_AUDIT_STRING  "client audit string"
#ifdef DEBUG
#define debug printf
#else
#define debug (void)
#endif
#include <stdio.h>
typedef int ID;           /* All id's */
typedef double MONEY;     /* Large integer number of cents
*/
typedef char TEXT;        /* Add an extra byte for null
terminator */
typedef double TIME;      /* Elapsed seconds from start of
run (float?) */
typedef int COUNT;        /* integer numbers of things */
typedef double REAL;      /* real numbers */
typedef int LOGICAL;      /* YES or NO */
typedef struct {          /* days and seconds since Jan 1,
1900 */
    int day;              /* NULL represented by negative
day */
    int sec;
    } DATE;
/* Macro to convert time of day to TIME */
#include <time.h>
extern struct timeval start_time;
#define elapsed_time(t) ( ((t)->tv_sec - start_time.tv_sec)
+  \
                          ((t)->tv_usec -
start_time.tv_usec) / 1000000.0 )
typedef enum {Num,Money,Text,Time,Real,Date} FIELD_TYPE;
/* screen field types */
/* Various TPCC constants */
#define W_ID_LEN        4
#define D_ID_LEN        2
#define C_ID_LEN        4
#define I_ID_LEN        6
#define OL_QTY_LEN      2
#define PMT_LEN         7
#define C_ID_LEN        4
```

```
#define C_LAST_LEN      16
#define CARRIER_LEN     2
#define THRESHOLD_LEN   2
#define DIST_PER_WARE   10
#define CUST_PER_DIST   3000
#define ORD_PER_DIST    3000
#define MAXITEMS        100000
#define MAX_DIGITS      3       /* # of digits of the
NURand number selected
                                   to generate the customer
last name */
#define MAXWAREHOUSE   2000     /* maximum # of warehouses
- scaling factor */
#define LOADSEED       42 /* # of digits of the NURand
number selected
/*************************************************************
*********/
/* database identifiers and
populations                     */
/*************************************************************
*********/
  int no_warehouse;                             /*  scaling
factor    */
  int no_item;                                  /*
100000            */
  int no_dist_pw;                               /*
10            */
  int no_cust_pd;                               /*
3000            */
  int no_ord_pd;                                /*
3000            */
  int no_new_pd;                                /*
900            */
  int tpcc_load_seed;                           /*
900            */
/* fields to add to each transaction for acid testing */
#define ACID_STUFF     \
    char acid_txn[2];  \
    int  acid_timing;  \
    int  acid_action;  \
    FILE *acid_res
typedef struct {
    ID OL_SUPPLY_W_ID;
    ID OL_I_ID;
    TEXT I_NAME[24+1];
    COUNT OL_QUANTITY;
    COUNT S_QUANTITY;
    MONEY I_PRICE;
    char brand_generic;
    } neworder_item;
typedef struct {
    int status;
    LOGICAL all_local;
    ID W_ID;
    ID D_ID;
    ID C_ID;
    TEXT C_LAST[C_LAST_LEN+1];
    TEXT C_CREDIT[2+1];
    REAL C_DISCOUNT;
    COUNT O_OL_CNT;
    ID O_ID;
    TEXT O_ENTRY_D[20];  /* dates as text fields */
    REAL W_TAX;
    REAL D_TAX;
    neworder_item item[15];
    ACID_STUFF;
    } neworder_trans;
typedef struct {
    int status;
    LOGICAL byname;
    ID W_ID;
    ID D_ID;
    ID C_ID;
    ID C_D_ID;
    ID C_W_ID;
    MONEY H_AMOUNT;
    TEXT H_DATE[20];  /* date as text field */
    TEXT W_STREET_1[20+1];
    TEXT W_STREET_2[20+1];
    TEXT W_CITY[20+1];
    TEXT W_STATE[2+1];
    TEXT W_ZIP[9+1];
    TEXT D_STREET_1[20+1];
    TEXT D_STREET_2[20+1];
    TEXT D_CITY[20+1];
```

```
    TEXT D_STATE[2+1];
    TEXT D_ZIP[9+1];
    TEXT C_FIRST[16+1];
    TEXT C_MIDDLE[2+1];
    TEXT C_LAST[16+1];
    TEXT C_STREET_1[20+1];
    TEXT C_STREET_2[20+1];
    TEXT C_CITY[20+1];
    TEXT C_STATE[2+1];
    TEXT C_ZIP[9+1];
    TEXT C_PHONE[16+1];
    TEXT C_SINCE[20]; /* date as text field */
    TEXT C_CREDIT[2+1];
    MONEY C_CREDIT_LIM;
    REAL C_DISCOUNT;
    REAL C_BALANCE;
    TEXT  C_DATA[200+1];
    ACID_STUFF;
    } payment_trans;

typedef struct {
    int status;
    LOGICAL byname;
    ID W_ID;
    ID D_ID;
    ID C_ID;
    TEXT C_FIRST[16+1];
    TEXT C_MIDDLE[2+1];
    TEXT C_LAST[16+1];
    MONEY C_BALANCE;
    ID O_ID;
    TEXT O_ENTRY_DATE[20];   /* date as text field */
    ID O_CARRIER_ID;
    COUNT ol_cnt;
    struct {
        ID OL_SUPPLY_W_ID;
        ID OL_I_ID;
        COUNT OL_QUANTITY;
        MONEY OL_AMOUNT;
        TEXT OL_DELIVERY_DATE[20]; /* date as text field */
        } item[15];
    ACID_STUFF;
    } ordstat_trans;

typedef struct {
    int status;
    ID W_ID;
    ID D_ID;
    COUNT threshold;
    COUNT low_stock;
    ACID_STUFF;
    } stocklev_trans;
typedef struct {
    int status;
    ID W_ID;
    ID O_CARRIER_ID;
    struct {
        ID O_ID;
    int status;
        } order[10];
    struct timeval enque[1];
    struct timeval deque[1];
    struct timeval complete[1];
    ACID_STUFF;
    } delivery_trans;
typedef union {
    neworder_trans neworder;
    payment_trans payment;
    ordstat_trans ordstat;
    delivery_trans delivery;
    stocklev_trans stocklev;
    int status;
    } generic_trans;
/*******************************************************
Record formats for results
*******************************************************/
#ifdef NOTYET
typedef struct
    {
    float t1, t2, t3, t4, t5;
    int status           :8;
    unsigned int type    :3;
```

```
    unsigned int ol_cnt  :4;
    unsigned int remote_ol_cnt :4;
    unsigned int byname :1;
    unsigned int remote  :1;
    unsigned int skipped  :4;
    } success_t;
#endif
typedef struct
    {
    TIME t1, t2, t3, t4, t5;
    int status;
    unsigned int type    :3;
    unsigned int ol_cnt  :4;
    unsigned int remote_ol_cnt :4;
    unsigned int byname :1;
    unsigned int remote  :1;
    unsigned int skipped  :4;
    } success_t;
typedef struct
    {
    struct timeval start_time;
    } success_header_t;
/************************************************************
*************
Record formats for loading routines.  (DB's have own
internal formats
************************************************************
************/
typedef struct
    {
    ID W_ID;
    TEXT W_NAME[10+1];
    TEXT W_STREET_1[20+1];
    TEXT W_STREET_2[20+1];
    TEXT W_CITY[20+1];
    TEXT W_STATE[2+1];
    TEXT W_ZIP[9+1];
    REAL W_TAX;
    MONEY W_YTD;
    } warehouse_row;
typedef struct
    {
    ID D_ID;
    ID D_W_ID;
    TEXT D_NAME[10+1];
    TEXT D_STREET_1[20+1];
    TEXT D_STREET_2[20+1];
    TEXT D_CITY[20+1];
    TEXT D_STATE[2+1];
    TEXT D_ZIP[9+1];
    REAL D_TAX;
    MONEY D_YTD;
    ID D_NEXT_O_ID;
    } district_row;
typedef struct
    {
    ID C_ID;
    ID C_D_ID;
    ID C_W_ID;
    TEXT C_FIRST[16+1];
    TEXT C_MIDDLE[2+1];
    TEXT C_LAST[16+1];
    TEXT C_STREET_1[20+1];
    TEXT C_STREET_2[20+1];
    TEXT C_CITY[20+1];
    TEXT C_STATE[2+1];
    TEXT C_ZIP[9+1];
    TEXT C_PHONE[16+1];
    DATE C_SINCE[20];
    TEXT C_CREDIT[2+1];
    MONEY C_CREDIT_LIM;
    REAL C_DISCOUNT;
    MONEY C_BALANCE;
    MONEY C_YTD_PAYMENT;
    COUNT C_PAYMENT_CNT;
    COUNT C_DELIVERY_CNT;
    TEXT  C_DATA[500+1];
    } customer_row;
typedef struct
    {
    ID H_C_ID;
    ID H_C_D_ID;
    ID H_C_W_ID;
```

```
    ID H_D_ID;
    ID H_W_ID;
    DATE H_DATE[20];
    MONEY H_AMOUNT;
    TEXT H_DATA[24+1];
    } history_row;
typedef struct
    {
    ID NO_O_ID;
    ID NO_D_ID;
    ID NO_W_ID;
    } neworder_row;
typedef struct
    {
    ID O_ID;
    ID O_D_ID;
    ID O_W_ID;
    ID O_C_ID;
    DATE O_ENTRY_D[20];
    ID O_CARRIER_ID;
    COUNT O_OL_CNT;
    LOGICAL O_ALL_LOCAL;
    } order_row;
typedef struct
    {
    ID OL_O_ID;
    ID OL_D_ID;
    ID OL_W_ID;
    ID OL_NUMBER;
    ID OL_I_ID;
    ID OL_SUPPLY_W_ID;
    DATE OL_DELIVERY_D;
    COUNT OL_QUANTITY;
    MONEY OL_AMOUNT;
    TEXT OL_DIST_INFO[24+1];
    } orderline_row;
typedef struct
    {
    ID I_ID;
    ID I_IM_ID;
    TEXT I_NAME[24+1];
    MONEY I_PRICE;
    TEXT I_DATA[50+1];
    } item_row;
typedef struct
    {
    ID S_I_ID;
    ID S_W_ID;
    COUNT S_QUANTITY;
    TEXT S_DIST_01[24+1];
    TEXT S_DIST_02[24+1];
    TEXT S_DIST_03[24+1];
    TEXT S_DIST_04[24+1];
    TEXT S_DIST_05[24+1];
    TEXT S_DIST_06[24+1];
    TEXT S_DIST_07[24+1];
    TEXT S_DIST_08[24+1];
    TEXT S_DIST_09[24+1];
    TEXT S_DIST_10[24+1];
    COUNT S_YTD;
    COUNT S_ORDER_CNT;
    COUNT S_REMOTE_CNT;
    TEXT S_DATA[50+1];
    } stock_row;

/* Empty field values */
#define EMPTY_NUM (MAXINT-1)
#define INVALID_NUM (MAXINT)
#define EMPTY_FLT   (MAXDOUBLE)
#define INVALID_FLT (MINDOUBLE)
/* Status conditions */
#define OK 0
#define E 1
#define E_INVALID_ITEM 2
#define E_NOT_ENOUGH_ORDERS 3
#define E_DB_ERROR 4
/* Error message strings */
static char *e_mesg[]={"Transaction
complete.","Error","Invalid item number.",
                       "Not enough orders.", "Database
ERROR !!!!"};
#define YES 1
#define NO 0
```

```
double cvt_flt();
double cvt_money();
TIME getclock();
TIME getlocalclock();
#define TPC_MSG_QUE  150
/*************************************
Transaction specific stuff
*************************************/
/* types of transactions */
#define NEWORDER 1
#define PAYMENT  2
#define ORDSTAT  3
#define DELIVERY 4
#define STOCKLEV 5
#define DEFERRED 6   /* deferred portion of delivery */
/* the name of each transaction */
static char *transaction_name[] =
    {"", "New_Order", "Payment", "Order-Status",
     "Delivery", "Stock-Level", "Deferred-Delivery"};
/* size of each transaction record */
static int transaction_size[] = {0,
     sizeof(neworder_trans),
     sizeof(payment_trans),
     sizeof(ordstat_trans),
     sizeof(delivery_trans),
     sizeof(stocklev_trans),
     sizeof(delivery_trans),
     0};
/* valid response time for each transaction */
static TIME valid_response[] = {0, 5, 5, 5, 5, 20};
#endif /* TPCC_INCLUDED */
```

A.2 Transaction Source

sqlserver/transactionb.c

```
/*************************************************************
******************
 @(#) Version: A.10.10 $Date: 96/09/20 15:33:20 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights
reserved.
*************************************************************
*****************/
#include "tpcc.h"
#include "errno.h"
#define MaxTries 10
int userNo;
#include <string.h>
#include <stdlib.h>
#include <sys/time.h>
#include <time.h>
#define MSG_LNG 256
/* Maximum message length */
#define max(a,b) (a>b?a:b)
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <stdio.h>
#define FAR
#include <sql.h>
#include <sqlext.h>
#include "odbc.h"
void display_neword(char * msg, neworder_trans *t);
void display_payment(char * msg, payment_trans *t);
void display_ordstat(char * msg, ordstat_trans *t);
void display_stocklev(char * msg, stocklev_trans *t);
void display_delivery(char * msg, delivery_trans *t);
/** Global Order ID -mvn- **/
int fdel;
int o_id[10];
int xact_type;
/* Some local defines */
short commit_flag;
short d_id;
void sleep_before_retry();
/* For ODBC */
unsigned char odbc_buffer[128];
char errorName[16];
#define INVALID_DATA 0
/* For DEBUG */
FILE *fp;
```

```
int pid;
/*#define DEBUG */
#ifdef DEBUG
int debug_flag;
#endif
/*
** The datetime structures.
*/
typedef longCS_INT;
/*typedef intCS_INT;*/
typedef struct dbdatetime
{
        CS_INT          dtdays;         /* number of days
since 1/1/1900 */
        CS_INT          dttime;         /* number 300th
second since mid */
} DBDATETIME;
fmt_date(str, date)
/*************************************************************
***********
fmt_date formats the DATE into a string  MM-DD-YY HH-MM-SS
*************************************************************
*********/
    char str[20];
    TIMESTAMP_STRUCT *date;
{
    /* format the date and time */
    fmtint(str+0,  date->day,    2, ' ');
    str[2]='-';
    fmtint(str+3,  date->month,  2, '0');
    str[5]='-';
    fmtint(str+6,  date->year,   4, '0');
    str[10] = ' ';
    fmtint(str+11, date->hour,   2, ' ');
    str[13] = ':';
    fmtint(str+14, date->minute, 2, '0');
    str[16] = ':';
    fmtint(str+17, date->second,    2, '0');
    str[19] = '\0';
    }
void neworder_transaction(t)
    neworder_trans *t;
{
    int rc;
    int try;
    int i;
    xact_type = XACT_NEWO;
    /* return status in t->status; set in body, may
override here */
    /* assume local order */
    t->all_local = 1;
    for (i=0;  i<t->O_OL_CNT; i++) {
        if (t->item[i].OL_SUPPLY_W_ID != t->W_ID) t->all_local
= 0;
     }
#ifdef SORT_LINES
    sort_order_lines();
#endif
    for (try=0; try<MaxTries; try++) {
    if (try > 0) display_neword("Repeating", t);
    commit_flag = TRUE;
    o_ol_done = 0;
    o_ol_now = t->O_OL_CNT-o_ol_done;
    if ((rc=new_order_body(t)) != YES) {
                /* deal with error condition here, t-
>status is set */
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,
                            "new_order_rpc: return from
new_order_body=%d\n",
                            rc);
    if (try > 0)
    fprintf(fp,"new_order_rpc: try %d \n",try);
    fclose(fp);
#endif
    if (rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,"new_order_rpc: error\n");
    fclose(fp);
#ifdef DEBUG
    dump_neworder_params();
#endif
    display_neword("Failed", t);
```

```
    return; }
    /* else deadlock */
    else if( rc == DEADLOCK ) {
#ifdef DEBUG
    debug_flag=1;
    fp=fopen(errorName,"a");
    fprintf(fp,"new_order_rpc: deadlock\n");
    fclose(fp);
    dump_neworder_params();
#endif
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,
                                        "neworder_rpc:
SQLFreeStmt rc=%d\n",
                                        rc);
    fclose(fp);
    return;
    }
    sleep_before_retry();
    continue;
    } else {
    fp=fopen(errorName,"a");
    fprintf(fp,
                                  "neworder_rpc: SQL
Unknown Error rc=%d\n",
                                  rc);
    fclose(fp);
                                return;
    }
    }
                /* it was YES check try count for message */
    if (try > 0) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"neworder_rpc: try %d Success!!\n",try);
    dump_neworder_params();
    fclose(fp);
#endif
    }
    break;
    }  /* end of for loop on MaxTries */
    if (try >= MaxTries) {
    display_neword("Failed", t);
                t->status=E_DB_ERROR;
    return;
    }
    return;
}  /* end of neworder_transaction() */
int new_order_body (t)
    neworder_trans *t;
{
    RETCODE rc;
    int i,j,num_ol;
    TIMESTAMP_STRUCT o_entry_d;
    double ol_amount;
    char generic[4];
    t->status = E_DB_ERROR;  /* multiple returns possible
for problems */
    num_ol=t->O_OL_CNT;
    strcpy((char *) odbc_buffer, "{call
tpcc_neworder(?,?,?,?,?" );
    for (i=0;i<num_ol; i++)
      strcat((char *) odbc_buffer, ",?,?,?" );
    strcat((char *) odbc_buffer, ")}");
    /* Bind Parameters */
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: Starting
BindParameters\n");
    fclose(fp);
    }
#endif
    SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_SLONG,
    SQL_INTEGER, 0, 0, &t->W_ID, 0, NULL);
    SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_LONG,
    SQL_INTEGER, 0, 0, &t->D_ID, 0, NULL);
    SQLBindParameter(hstmt, 3, SQL_PARAM_INPUT, SQL_C_LONG,
    SQL_INTEGER, 0, 0, &t->C_ID, 0, NULL);
    SQLBindParameter(hstmt, 4, SQL_PARAM_INPUT, SQL_C_SLONG,
    SQL_INTEGER, 0, 0, &t->O_OL_CNT, 0, NULL);
    SQLBindParameter(hstmt, 5, SQL_PARAM_INPUT, SQL_C_SLONG,
```

```
    SQL_INTEGER, 0, 0, &t->all_local, 0, NULL);
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,
                  "debug: neworder_body: Finished Initial
BindParameters\n");
    fclose(fp);
    }
#endif
    /* now, deal with the order lines */
    for(i = 0; i < num_ol; i++) {
    int parm_num = 6 + 3*i;
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,
                        "debug: neworder_body: BindP Loop
i=%d parm_num=%d\n",
    i,parm_num);
    fclose(fp);
    }
#endif
    SQLBindParameter(hstmt, (UWORD)(parm_num++),
SQL_PARAM_INPUT,
                        SQL_C_SLONG, SQL_INTEGER, 0, 0,
                        &t->item[i].OL_I_ID, 0, NULL);
    SQLBindParameter(hstmt, (UWORD)(parm_num++),
SQL_PARAM_INPUT,
                        SQL_C_SLONG, SQL_INTEGER, 0, 0,
                        &t->item[i].OL_SUPPLY_W_ID,
    0, NULL);
    SQLBindParameter(hstmt, (UWORD)(parm_num),
SQL_PARAM_INPUT,
                        SQL_C_SLONG, SQL_INTEGER, 0, 0,
                        &t->item[i].OL_QUANTITY,
    0, NULL);
    }
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: SQLExecDirect\n");
    fclose(fp);
    }
#endif
    rc = SQLExecDirect(hstmt, odbc_buffer, SQL_NTS);
    if(rc != SQL_SUCCESS ) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    if(rc == SQL_SUCCESS_WITH_INFO)
    fprintf(fp,
    "neworder_bdy: SQLExDir=Success With Info\n");
    else
    fprintf(fp,"neworder_body: SQLExecDirect\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    for (i = o_ol_done; i < (int)(o_ol_done+o_ol_now); i++)
{
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: BindCol Loop
i=%d\n",i);
    fprintf(fp,"debug: BindCol Loop:
o_ol_done=%d\n",o_ol_done);
    fprintf(fp,"debug: BindCol Loop:
o_ol_now=%d\n",o_ol_now);
    fclose(fp); }
#endif
    SQLBindCol(hstmt, 1, SQL_C_CHAR,
                        &t->item[i].I_NAME,
    sizeof(t->item[i].I_NAME), NULL);
    SQLBindCol(hstmt, 2, SQL_C_SLONG,
    &t->item[i].S_QUANTITY, 0, NULL);
                SQLBindCol(hstmt, 3, SQL_C_CHAR,
                        &generic[0], sizeof(generic), NULL);
    SQLBindCol(hstmt, 4, SQL_C_DOUBLE,
    &t->item[i].I_PRICE, 0, NULL);
     SQLBindCol(hstmt, 5, SQL_C_DOUBLE,
    &ol_amount, 0, NULL);

#ifdef DEBUG
```

```
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: SQLFetch\n");
    fclose(fp);
    }
#endif
    rc = SQLFetch(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,
    "neworder_body: SQLFetch i=%d o_ol_done=%d
o_ol_now=%d\n",
    i, o_ol_done, o_ol_now);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    t->item[i].I_PRICE = t->item[i].I_PRICE * 100;
    t->item[i].brand_generic = generic[0];
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: SQLMoreResults\n");
    fclose(fp); }
#endif
    rc = SQLMoreResults(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"neworder_body: SQLMoreResults\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    }   /* end of the for loop on order lines */
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: Final Binds\n");
    fclose(fp); }
#endif
    SQLBindCol(hstmt, 1, SQL_C_DOUBLE, &t->W_TAX, 0, NULL);
    SQLBindCol(hstmt, 2, SQL_C_DOUBLE, &t->D_TAX, 0, NULL);
    SQLBindCol(hstmt, 3, SQL_C_SLONG, &t->O_ID, 0, NULL);
    SQLBindCol(hstmt, 4, SQL_C_CHAR, &t->C_LAST,
    sizeof(t->C_LAST), NULL);
    SQLBindCol(hstmt, 5, SQL_C_DOUBLE, &t->C_DISCOUNT, 0,
NULL);
    SQLBindCol(hstmt, 6, SQL_C_CHAR, &t->C_CREDIT,
    sizeof(t->C_CREDIT), NULL);
    SQLBindCol(hstmt, 7, SQL_C_TIMESTAMP, &o_entry_d, 0,
NULL);
    SQLBindCol(hstmt, 8, SQL_C_SSHORT, &commit_flag, 0,
NULL);
    rc = SQLFetch(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"neworder_body: SQLFetch2\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    fmt_date(&t->O_ENTRY_D,&o_entry_d);
#ifdef DEBUG
    if(debug_flag) {
    fp=fopen(errorName,"a");
    fprintf(fp,"debug: neworder_body: SQLFreeStmt\n");
    fclose(fp);
    }
#endif
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"neworder_body: SQLFreeStmt\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    if (commit_flag)
                t->status = OK;
```

```
    else
    t->status = E_INVALID_ITEM;
    return YES;
}  /* end of new_order body */
void payment_transaction (t)
    payment_trans *t;
{
    int rc;
    int try;
    /* move the transaction data passed from rte into the
global area */

    xact_type = XACT_PAYM;
    for (try=0; try<MaxTries; try++) {
    if (try>0) display_payment("Repeating", t);
    if ((rc=payment_body(t)) != YES) {
    if (rc == SQL_ERROR) {
    display_payment("Failed", t);
    return;
    }
    /* else deadlock */
    else if( rc == DEADLOCK ) {
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,"payment_rpc: SQLFreeStmt\n");
    fclose(fp);
                                        return;
    }
#ifdef DEALLOC
    if(pmt_dataptr_d.c_id == 0) {
    SQLExecDirect(hstmt,
                                          "deallocate
c_payment", SQL_NTS);
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,

"payment_rpc: SQLFreeStmt\n"
                                                  );
    fclose(fp);
#endif
    return;
    }
    }
#endif /* DEALLOC */
    sleep_before_retry();
    continue;
    } else {
    fp=fopen(errorName,"a");
    fprintf(fp,
                                    "payment_rpc: SQL Unknown
Error rc=%d\n",
                                    rc);
    fclose(fp);
    return;
    }
    } /* end of was not YES */
    if (try > 0) {
    fp=fopen(errorName,"a");
    fprintf(fp,"payment_rpc: try %d Success!!\n",try);
    fclose(fp);
    }
    break;
    }
    if (try >= MaxTries) {
    display_payment("Failed", t);
                t->status = E_DB_ERROR;
    return;
    }
    return;
}   /* end of payment_transaction() */
int payment_body (t)
    payment_trans *t;
{
    RETCODE rc;
    UWORD rowStatus[5];
    UDWORD rowfetched;
    TIMESTAMP_STRUCT pay_date;
    double sqlAmount;
    t->status = E_DB_ERROR;  /* multiple returns possible
for problems */
```

```
    if (t->byname)
    t->C_ID = 0;
    strcpy((char *) odbc_buffer, "{call
tpcc_payment(?,?,?,?,?,?,?)}");
    /* Bind Parameters for payment stored procedure */
    rc = SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT,
SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->W_ID, 0, NULL);
    rc = SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT,
SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->C_W_ID, 0, NULL);
        sqlAmount = t->H_AMOUNT/100.00;
    rc = SQLBindParameter(hstmt, 3, SQL_PARAM_INPUT,
SQL_C_DOUBLE,
    SQL_NUMERIC, 6, 2, &sqlAmount, 0, NULL);
    rc = SQLBindParameter(hstmt, 4, SQL_PARAM_INPUT,
SQL_C_SLONG,
    SQL_TINYINT, 0, 0, &t->D_ID, 0, NULL);
    rc = SQLBindParameter(hstmt, 5, SQL_PARAM_INPUT,
SQL_C_SLONG,
    SQL_TINYINT, 0, 0, &t->C_D_ID, 0, NULL);
    rc = SQLBindParameter(hstmt, 6,
SQL_PARAM_INPUT,SQL_C_LONG,
                        SQL_INTEGER, SQL_NTS, 0, &t->C_ID,
0, NULL);
    rc = SQLBindParameter(hstmt, 7, SQL_PARAM_INPUT,
SQL_C_CHAR,
    SQL_CHAR, SQL_NTS, 0, &t->C_LAST,
    sizeof(t->C_LAST), NULL);
    rc = SQLExecDirect(hstmt, odbc_buffer, SQL_NTS);
    if(rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"payment_body_odbc1: SQLFreeStmt\n");
                fprintf(fp, "t->H_AMOUNT: %lf \n", t-
>H_AMOUNT);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    SQLBindCol(hstmt, 1, SQL_C_LONG,
                            &t->C_ID, 0, NULL);
    SQLBindCol(hstmt, 2, SQL_C_CHAR, t->C_LAST, sizeof(t-
>C_LAST), NULL);
    SQLBindCol(hstmt, 3, SQL_C_TIMESTAMP, &pay_date, 0,
NULL);
    SQLBindCol(hstmt, 4, SQL_C_CHAR, t->W_STREET_1,
    sizeof(t->W_STREET_1), NULL);
    SQLBindCol(hstmt, 5, SQL_C_CHAR, t->W_STREET_2,
    sizeof(t->W_STREET_2), NULL);
    SQLBindCol(hstmt, 6, SQL_C_CHAR, t->W_CITY, sizeof(t-
>W_CITY), NULL);
    SQLBindCol(hstmt, 7, SQL_C_CHAR, t->W_STATE, sizeof(t-
>W_STATE), NULL);
    SQLBindCol(hstmt, 8, SQL_C_CHAR, t->W_ZIP, sizeof(t-
>W_ZIP), NULL);
    SQLBindCol(hstmt, 9, SQL_C_CHAR, t->D_STREET_1,
    sizeof(t->D_STREET_1), NULL);
    SQLBindCol(hstmt, 10, SQL_C_CHAR, t->D_STREET_2,
    sizeof(t->D_STREET_2), NULL);
    SQLBindCol(hstmt, 11, SQL_C_CHAR, t->D_CITY, sizeof(t-
>D_CITY), NULL);
    SQLBindCol(hstmt, 12, SQL_C_CHAR, t->D_STATE,
                                sizeof(t->D_STATE), NULL);
    SQLBindCol(hstmt, 13, SQL_C_CHAR, t->D_ZIP, sizeof(t-
>D_ZIP), NULL);
    SQLBindCol(hstmt, 14, SQL_C_CHAR, t->C_FIRST,
    sizeof(t->C_FIRST), NULL);
    SQLBindCol(hstmt, 15, SQL_C_CHAR, t->C_MIDDLE,
    sizeof(t->C_MIDDLE), NULL);
    SQLBindCol(hstmt, 16, SQL_C_CHAR, t->C_STREET_1,
    sizeof(t->C_STREET_1), NULL);
    SQLBindCol(hstmt, 17, SQL_C_CHAR, t->C_STREET_2,
    sizeof(t->C_STREET_2), NULL);
    SQLBindCol(hstmt, 18, SQL_C_CHAR, t->C_CITY, sizeof(t-
>C_CITY), NULL);
    SQLBindCol(hstmt, 19, SQL_C_CHAR, t->C_STATE,
    sizeof(t->C_STATE), NULL);
    SQLBindCol(hstmt, 20, SQL_C_CHAR, t->C_ZIP, sizeof(t-
>C_ZIP), NULL);
    SQLBindCol(hstmt, 21, SQL_C_CHAR, t->C_PHONE,
    sizeof(t->C_PHONE), NULL);
    SQLBindCol(hstmt, 22, SQL_C_CHAR, t->C_SINCE,
    sizeof(t->C_SINCE), NULL);
    SQLBindCol(hstmt, 23, SQL_C_CHAR, t->C_CREDIT,
```

```
    sizeof(t->C_CREDIT), NULL);
    SQLBindCol(hstmt, 24, SQL_C_DOUBLE, &t->C_CREDIT_LIM,
    sizeof(t->C_CREDIT_LIM), NULL);
    SQLBindCol(hstmt, 25, SQL_C_DOUBLE, &t->C_DISCOUNT,
    sizeof(t->C_DISCOUNT), NULL);
    SQLBindCol(hstmt, 26, SQL_C_DOUBLE, &t->C_BALANCE,
    sizeof(t->C_BALANCE), NULL);
    SQLBindCol(hstmt, 27, SQL_C_CHAR, t->C_DATA, sizeof(t-
>C_DATA), NULL);
    rc = SQLFetch(hstmt);
        /* rc = SQLExtendedFetch(hstmt, SQL_FETCH_NEXT,
(SDWORD) 0,
                              &rowfetched, &rowStatus[0] );
*/
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"payment_body_odbc2: SQLFreeStmt\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    fmt_date(&t->H_DATE,&pay_date);
    t->C_CREDIT_LIM = t->C_CREDIT_LIM * 100;
    t->C_BALANCE = t->C_BALANCE * 100;
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"payment_body_odbc3: SQLFreeStmt\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
        t->status = OK;
    return YES;
}  /* end of payment_body() */
void ordstat_transaction(t)
    ordstat_trans *t;
{
    int rc;
    int try;
    /* ords_dataptr->w_id = t->W_ID; */
    /* ords_dataptr->d_id = t->D_ID; */
    /* ords_dataptr->c_id = t->C_ID; */
    /* strcpy(ords_dataptr->c_last,t->C_LAST); */
    xact_type = XACT_ORDS;
    for (try=0; try<MaxTries; try++) {
    if (try>0) display_ordstat("Repeating", t);
    if ((rc=ordstat_body(t)) != YES) {
    if (rc == SQL_ERROR) {
    display_ordstat("Failed", t);
    return;
    } else if( rc == DEADLOCK ) {
#ifdef DEALLOC
    if(ords_dataptr_d.c_id == 0) {
    SQLExecDirect(hstmt,
                                              "deallocate
c_orderstatus", SQL_NTS);
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,

"order_status_rpc: SQLFreeStmt\n");
    fclose(fp);
    return;
    }
    }
#endif /* DEALLOC */
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,

"order_status_rpc: SQLFreeStmt\n");
    fclose(fp);
#endif
    return;
    }
    sleep_before_retry();
    continue;
```

```
    } else {
    fp=fopen(errorName,"a");
    fprintf(fp,
                                  "order_status_rpc: SQL
Unknown Error rc=%d\n",
                                   rc);
    fclose(fp);
    return;
    }
    }
    if (try > 0) {
    fp=fopen(errorName,"a");
    fprintf(fp,"order_status_rpc: try %d Success!!\n",try);
    fclose(fp);
    }
    break;
    }   /* end of the MaxTries for loop  */
    if (try >= MaxTries) {
    display_ordstat("Failed", t);
                t->status = E_DB_ERROR;
    return;
    }
    return;
}    /* end of ordstat_transaction() */
#ifdef DEBUG
void
mem_dump(char *s, char *p, int len)
{
    int i;
    fprintf(fp, "%s:\n\t", s);\
    for(i=0;i<len;i++)
    fprintf(fp, "%2.2x ", 0xff & *p++);
    fprintf(fp, "\n");

}
#endif
int ordstat_body (t)
    ordstat_trans *t;
{
    int not_done;
    int i;

    int count = 0;
    RETCODE rc;
    TIMESTAMP_STRUCT delivery_d;
    if (t->byname)
    {
    t->C_ID = 0;
    }
        t->status = E_DB_ERROR;  /* multiple returns
possible for problems */

    /* Bind Parameters */
    SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->W_ID, 0, NULL);
    SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT,
    SQL_C_SLONG, SQL_TINYINT, 0, 0, &t->D_ID, 0, NULL);
    SQLBindParameter(hstmt, 3, SQL_PARAM_INPUT,
    SQL_C_SLONG, SQL_INTEGER, 0, 0, &t->C_ID, 0, NULL);
    SQLBindParameter(hstmt, 4, SQL_PARAM_INPUT,
    SQL_C_CHAR, SQL_CHAR, SQL_NTS, 0, &t->C_LAST,
    sizeof(t->C_LAST), NULL);
    rc = SQLExecDirect(hstmt,
              (unsigned char *) "{call
tpcc_orderstatus(?,?,?,?)}", SQL_NTS);
    if(rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    not_done = TRUE; i = 0;
    while (not_done) {
    SQLBindCol(hstmt, 1, SQL_C_SSHORT,
                        &t->item[i].OL_SUPPLY_W_ID,
                        0, NULL);
    SQLBindCol(hstmt, 2, SQL_C_SLONG,
                        &t->item[i].OL_I_ID,
                        0, NULL);
    SQLBindCol(hstmt, 3, SQL_C_SSHORT,
                        &t->item[i].OL_QUANTITY,
```

```
                        0, NULL);
    SQLBindCol(hstmt, 4, SQL_C_DOUBLE,
                        &t->item[i].OL_AMOUNT,
                        0, NULL);
    SQLBindCol(hstmt, 5, SQL_C_TIMESTAMP,
                        &delivery_d, 0, NULL);

    rc = SQLFetch(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    if (rc == SQL_NO_DATA_FOUND)
    not_done = FALSE;
    fmt_date(&t->item[i].OL_DELIVERY_DATE, &delivery_d);
    t->item[i].OL_AMOUNT = t->item[i].OL_AMOUNT * 100;
    i++;
    }   /* end of the while */
        t->ol_cnt = i -1;
    rc = SQLMoreResults(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    SQLBindCol(hstmt, 1, SQL_C_LONG,
                    &t->C_ID, 0, NULL);
    SQLBindCol(hstmt, 2, SQL_C_CHAR,
                    &t->C_LAST,
                    sizeof(t->C_LAST), NULL);
    SQLBindCol(hstmt, 3, SQL_C_CHAR,
                    &t->C_FIRST,
                    sizeof(t->C_FIRST), NULL);
    SQLBindCol(hstmt, 4, SQL_C_CHAR,
                    &t->C_MIDDLE,
                    sizeof(t->C_MIDDLE), NULL);
    SQLBindCol(hstmt, 5, SQL_C_CHAR,
                    &t->O_ENTRY_DATE,
                    sizeof(t->O_ENTRY_DATE), NULL);
    SQLBindCol(hstmt, 6, SQL_C_SSHORT,
                    &t->O_CARRIER_ID,
                    0, NULL);
    SQLBindCol(hstmt, 7, SQL_C_DOUBLE,
                    &t->C_BALANCE,
                    0, NULL);
    SQLBindCol(hstmt, 8, SQL_C_SLONG,
                    &t->O_ID,
                    0, NULL);
    rc = SQLFetch(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    mem_dump("C_ID", (char *)&t->C_ID, sizeof(t->C_ID));
    mem_dump("C_LAST", (char *)&t->C_LAST, sizeof(t-
>C_LAST));
    mem_dump("C_FIRST", (char *)&t->C_FIRST, sizeof(t-
>C_FIRST));
    mem_dump("C_MIDDLE", (char *)&t->C_MIDDLE, sizeof(t-
>C_MIDDLE));
    mem_dump("O_ENTRY_DATE", (char *)&t->O_ENTRY_DATE,
    sizeof(t->O_ENTRY_DATE));
    mem_dump("O_CARRIER_ID", (char *)&t->O_CARRIER_ID,
    sizeof(t->O_CARRIER_ID));
    mem_dump("C_BALANCE", (char *)&t->C_BALANCE,
    sizeof(t->C_BALANCE));
    mem_dump("O_ID", (char *)&t->O_ID, sizeof(t->O_ID));
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
```

```
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"order_status_body: SQLFreeStmt\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
        t->status = OK;
    return YES;
}  /* end of ordstat_body()  */
void stocklev_transaction(t)
    stocklev_trans *t;
{
    int rc;
    int try;

    xact_type = XACT_STOCK;
    for (try = 0; try < MaxTries; try ++) {
    if (try > 0) display_stocklev("Repeating", t);
    if ((rc=stocklev_body(t)) != YES) {
    if (rc == SQL_ERROR) {
    display_stocklev("Failed", t);
    return;
    } else if( rc == DEADLOCK ) {
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,
                                        "stock_level_rpc:
SQLFreeStmt\n");
    fclose(fp);
    return;
    }
    sleep_before_retry();
    continue;
    } else {
    fp=fopen(errorName,"a");
    fprintf(fp,
                                  "stock_level_rpc: SQL
Unknown Error rc=%d\n",
                                  rc);
    fclose(fp);
    return;
    }
    }
    if (try > 0) {
    fp=fopen(errorName,"a");
    fprintf(fp,"stock_level_rpc: try %d Success!!\n",try);
    fclose(fp);
    }
    break;
    } /* end of the for loop */
    if (try >= MaxTries) {
    display_stocklev("Failed", t);
                t->status = E_DB_ERROR;
    return;
    }
    return;
}     /* end of stocklev_transaction() */
int stocklev_body (t)
    stocklev_trans *t;
{
    RETCODE rc;
        t->status = E_DB_ERROR;  /* multiple returns
possible for problems */
    /* Bind Parameters */
    SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT, SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->W_ID, 0, NULL);
    SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT, SQL_C_SLONG,
    SQL_TINYINT, 0, 0, &t->D_ID, 0, NULL);
    SQLBindParameter(hstmt, 3, SQL_PARAM_INPUT, SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->threshold, 0, NULL);
    rc = SQLExecDirect(hstmt,
                            (unsigned char *) "{call
tpcc_stocklevel(?,?,?)}",
    SQL_NTS);
    if(rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
```

```
    }
    SQLBindCol(hstmt, 1, SQL_C_SLONG,
                    &t->low_stock, 0, NULL);
    rc = SQLFetch(hstmt);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"stock_level_body: SQLFreeStmt\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
        t->status = OK;
    return YES;
}    /*( end of stocklev_body()  */
int delivery_transaction (t)
    delivery_trans *t;
{
    int rc;
    int try;
    xact_type = XACT_DEL;
    for (try = 0; try < MaxTries; try++) {
    if (try > 0) display_delivery("Repeating", t);
    if ((rc=delivery_body(t)) != YES) {
    if (rc == SQL_ERROR) {
    display_delivery("Failed", t);
                                return INVALID_DATA;
    }
    /* else deadlock */
    else if( rc == DEADLOCK ) {
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,
    "delivery_trans: SQLFreeStmt\n");
    fclose(fp);
    return;
    }
    sleep(1);
    continue;
    } else {
    fp=fopen(errorName,"a");
    fprintf(fp,"delivery_trans: SQL Unknown Error
rc=%d\n",rc);
    fclose(fp);
    return;
    }
    }
    if (try > 0) {
    fp=fopen(errorName,"a");
    fprintf(fp,"delivery_trans: try %d Success!!\n",try);
    fclose(fp);
    }
    break;

    }

    if (try >= MaxTries) {
    display_delivery("Failed", t);
                t->status = E_DB_ERROR;
                return;
    }
    return;
}   /* end of delivery_transaction  */
int delivery_body (t)
    delivery_trans *t;
{
    RETCODE rc;
    int dist;
    /* Bind Parameters for the delivery stored procedure */
    rc = SQLBindParameter(hstmt, 1, SQL_PARAM_INPUT,
SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->W_ID, 0, NULL);
```

```
    rc = SQLBindParameter(hstmt, 2, SQL_PARAM_INPUT,
SQL_C_SLONG,
    SQL_SMALLINT, 0, 0, &t->O_CARRIER_ID, 0, NULL);
    rc = SQLExecDirect(hstmt,
                (unsigned char *) "{call
tpcc_delivery(?,?)}", SQL_NTS);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    /* all the district info is returned with one fetch
from proc */
    for (dist=0;dist<10;dist++) {
    rc = SQLBindCol(hstmt, (UWORD)(dist+1), SQL_C_SLONG,
                &t->order[dist].O_ID, 0, NULL);
    }
    rc = SQLFetch(hstmt);
    if(rc == SQL_ERROR) {
    fp=fopen(errorName,"a");
    fprintf(fp,
                  "delivery_body: SQLFetch rc=%d,
o_id=%d\n", rc, o_id);
    fclose(fp);
    return ODBCError(henv, hdbc, hstmt);
    }
    /*
    ** Print delivery information (w_id, d_id, o_id ).
    ** If o_id == NULL, there were no new orders in that
(w_id, d_id).
    */
    rc = SQLFreeStmt(hstmt, SQL_CLOSE);
    if(rc == SQL_ERROR) {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"big_delivery_body: SQLFreeStmt\n");
    fclose(fp);
#endif
    return ODBCError(henv, hdbc, hstmt);
    }
    /* now set required t->status information  */
    for (dist=0;dist<10;dist++) {
    if (t->order[dist].O_ID == 0)
    t->order[dist].status=E_NOT_ENOUGH_ORDERS;
    else
    t->order[dist].status = OK;
    }
    return YES;
}  /* end of delivery_body()  */
/* void sleep_before_retry() { sleep(1); } */
void display_neword(msg, t)
char * msg;
neworder_trans *t;
{
    int i;
    fp=fopen(errorName,"a");
    fprintf(fp,"display_neword:%s\n",msg);
    fprintf(fp,"New Order w=%d, d=%d, c=%d, %d lines: [",
    t->W_ID, t->D_ID, t->C_ID, t->O_OL_CNT);
    for (i=0; i<(int)t->O_OL_CNT; i++)
    fprintf(fp," %d", t->item[i].OL_I_ID);
    fprintf(fp,"]\n");
    fclose(fp);
}  /* end of display_neword(msg,t) */
void display_payment(msg, t)
char * msg;
payment_trans *t;
{
    int i;
    fp=fopen(errorName,"a");
    fprintf(fp,"display_payment:%s\n",msg);
    fprintf(fp,"Payment w=%d/%d, d=%d/%d, c=%d l=%s\n", t-
>W_ID,
    t->C_W_ID, t->D_ID, t->C_D_ID, t->C_ID, t->C_LAST);
    fclose(fp);
}  /* end of display_payment(msg,t) */
void display_ordstat(msg, t)
char * msg;
ordstat_trans *t;
```

```
{
    int i;
    fp=fopen(errorName,"a");
    fprintf(fp,"display_ordstat:%s\n",msg);
    fprintf(fp,"Order Status cw=%d, cd=%d, c=%d l=%s\n", t-
>W_ID,
    t->D_ID, t->C_ID, t->C_LAST);
    fclose(fp);
}  /* end of display_ordstat(msg,t) */
void display_stocklev(msg, t)
char * msg;
stocklev_trans *t;
{
    int i;
    fp=fopen(errorName,"a");
    fprintf(fp,"display_stocklev:%s\n",msg);
    fprintf(fp,"Stock Level w=%d, d=%d, th=%d\n", t->W_ID,
    t->D_ID, t->threshold);
    fclose(fp);
}  /* end of display_stocklev(msg,t) */
void display_delivery(msg, t)
char * msg;
delivery_trans *t;
{
    int i;
    fp=fopen(errorName,"a");
    fprintf(fp,"display_delivery:%s\n",msg);
    fprintf(fp,"Delivery w=%d, carrier=%d\n", t->W_ID, t-
>O_CARRIER_ID);
    fclose(fp);
}  /* end of display_delivery(msg,t) */
#ifdef SORT_LINES
sort_order_lines () {
    /*
    ** Sort order_lines in a new_order by i_id. Reduces
possibility of deadlock.
    ** Brute force insertion sort -- works OK for <= 15
rows.
    */
    int i, j; tux_item_line temp;
    for (j=1; j<newo_dataptr_d.o_ol_cnt; j++) {
    if (newo_dataptr_d.ol_table[j-1].ol_i_id >
newo_dataptr_d.ol_table[j].ol_i_id) {
    temp = newo_dataptr_d.ol_table[j];
    newo_dataptr_d.ol_table[j] = newo_dataptr_d.ol_table[j-
1];
    for (i=j-2; i>=0 && temp.ol_i_id <
newo_dataptr_d.ol_table[i].ol_i_id; i--) {
    newo_dataptr_d.ol_table[i+1] =
newo_dataptr_d.ol_table[i];
    } newo_dataptr_d.ol_table[i+1] = temp;
    }
    }
}
#endif
/*************************************************************
********
/* Allocate environment and connection
handles                     *
/* Connect to the data
source                                      *
/* Allocate a statement
handle                                     *
/*************************************************************
********/
int connect_odbc_user() {
    RETCODE rc;
    UCHAR db[51];
    SWORD dblen;
    char del_fifo[] = DEL_FIFO;
    extern int fdel;
    pid=getpid();
    /* Initialize the error log file Name */
    sprintf(errorName,"errorlog.%d",pid);
    /* Done with initialization */
    rc = SQLAllocEnv(&henv);
    if (rc != SQL_SUCCESS & rc != SQL_SUCCESS_WITH_INFO)
    {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
```

```
    return(ODBCError(SQL_NULL_HENV, SQL_NULL_HDBC,
SQL_NULL_HSTMT));
    }
    rc = SQLAllocConnect(henv, &hdbc);
    if (rc != SQL_SUCCESS & rc != SQL_SUCCESS_WITH_INFO)
    {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return(ODBCError(henv, SQL_NULL_HDBC, SQL_NULL_HSTMT));
    }
    rc = SQLConnect(hdbc, dsn, SQL_NTS, user, SQL_NTS,
passwd, SQL_NTS);
    if (rc != SQL_SUCCESS & rc != SQL_SUCCESS_WITH_INFO)
    {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return(ODBCError(henv, hdbc, SQL_NULL_HSTMT));
    }
    rc = SQLGetInfo(hdbc, SQL_DBMS_NAME, &db, (SWORD)
sizeof(db), &dblen);
    if (rc != SQL_SUCCESS & rc != SQL_SUCCESS_WITH_INFO)
    {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return(ODBCError(henv, hdbc, SQL_NULL_HSTMT));
    }
    /* printf("\nODBC connection to %s
successful.\n\n",db); */
    rc = SQLAllocStmt(hdbc, &hstmt);
    if (rc != SQL_SUCCESS & rc != SQL_SUCCESS_WITH_INFO)
    {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return(ODBCError(henv, hdbc, SQL_NULL_HSTMT));
    }
    rc = SQLSetStmtOption(hstmt, SQL_QUERY_TIMEOUT, 300L);
    if (rc != SQL_SUCCESS & rc != SQL_SUCCESS_WITH_INFO)
    {
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"calling ODBCError from line %d, file %s\n",
    __LINE__, __FILE__);
    fclose(fp);
#endif
    return(ODBCError(henv, hdbc, SQL_NULL_HSTMT));
    }
/*  if( (fdel=open(del_fifo,O_RDWR)) < 0 ) {
    fprintf(stderr,"\nError in opening FIFO: %s,
Errno=%d\n", del_fifo, errno);
    return(-1); } */
    return 0;
} /* end of connect_odbc_user  */
#ifdef DEBUG
dump_neworder_params(t)
neworder_trans *t;
{
    fp=fopen(errorName,"a");
    fprintf(fp," t->W_ID %d\n", t->W_ID);
    fprintf(fp," newo_dataptr_d.d_id %d\n", t->D_ID);
    fprintf(fp," newo_dataptr_d.c_id %d\n", t->C_ID);
    fprintf(fp," newo_dataptr_d.o_ol_cnt %d\n", t-
>O_OL_CNT);
    fprintf(fp," newo_dataptr_d.o_all_local %d\n", t-
>all_local);
    fclose(fp);
}
#endif
```

```
/*********************************************************
**********
/* ODBCError - Use SQLError to get error data, then print
it. *
/*********************************************************
**********/
int ODBCError(henv, hdbc, hstmt) HENV henv; HDBC hdbc;
HSTMT hstmt; {
    struct timeval now;
    time_t timenow;
    FILE *fp; RETCODE rc;
    /* general return code for API */
    UCHAR szSqlState[MSG_LNG];
    /* SQL state string */
    SDWORD pfNativeError;
    /* Native error code */
    UCHAR szErrorMsg[MSG_LNG];
    /* Error msg text buffer pointer*/
    SWORD pcbErrorMsg;
    /* Error msg text Available bytes*/
    char msgtext[MSG_LNG];
    /* message text work area */
    int retcode = SQL_ERROR;
    rc = SQLError(henv, hdbc, hstmt, szSqlState,
    &pfNativeError, szErrorMsg, MSG_LNG, &pcbErrorMsg);
    if (rc != SQL_SUCCESS && rc != SQL_SUCCESS_WITH_INFO) {
    switch (rc) {
    case SQL_NO_DATA_FOUND:
    fp=fopen(errorName,"a");
    fprintf(fp,"SQLERROR() couldn't find text, RC=%d\n",
rc);
    fclose(fp);
    break;
    case SQL_ERROR:
    fp=fopen(errorName,"a");
    fprintf(fp,"SQLERROR() couldn't access text, RC=%d\n",
rc);
    fclose(fp);
    break;
    case SQL_INVALID_HANDLE:
    fp=fopen(errorName,"a");
    fprintf(fp,"SQLERROR() had invalid handle, RC=%d\n",
rc);
    fclose(fp);
    break;
    default:
    fp=fopen(errorName,"a");
    fprintf(fp,"SQLERROR() unknown return code, RC=%d\n",
rc);
    fclose(fp);
    break;
    }
    } else if (pfNativeError == 1205) {
    retcode = DEADLOCK;
#ifdef DEBUG
    fp=fopen(errorName,"a");
    fprintf(fp,"ODBCError: %d:Deadlock detected\n",pid);
    fprintf(fp,"ODBCError: STATE=%s, CODE=%ld, MSG=%s\n",
    szSqlState, pfNativeError, szErrorMsg); fclose(fp);
#endif
    } else {
    fp=fopen(errorName,"a");
    gettimeofday(&now, NULL);
    timenow = now.tv_sec;
    fprintf(fp,"ODBCError: %d: %s",pid,ctime(&timenow));
    retcode = SQL_ERROR;
    fprintf(fp,"ODBCError: STATE=%s, CODE=%ld, MSG=%s\n",
    szSqlState, pfNativeError, szErrorMsg);
    fclose(fp);
    }
return retcode;
} /* end ODBC_error function */
/*********************************************************
**********
/* The following function is included for completeness, but
is not *
/* relevant for understanding the function of ODBC. *
/*********************************************************
**********/
#define MAX_NUM_PRECISION 15
/*********************************************************
**********
/* Define max length of char string representation of
number as: *
/* = max(precision) + leading sign + E + exp sign + max exp
leng *
```

```
/* = 15 + 1 + 1 + 1 + 2 * /* = 15 + 5 *
/************************************************************
**********/
#define MAX_NUM_STRING_SIZE (MAX_NUM_PRECISION + 5)
UDWORD display_size (coltype, collen, colname) SWORD
coltype;
UDWORD collen; UCHAR *colname;
{ FILE *fp; fp=fopen(errorName,"a");
switch (coltype) {
    case SQL_CHAR:
    case SQL_VARCHAR:
    case SQL_DATE:
    case SQL_TIMESTAMP:
    case SQL_BIT:
    return(max((int) collen, (int) strlen((char *)
colname)));
    case SQL_SMALLINT:
    case SQL_INTEGER:
    case SQL_TINYINT:
    return(max((int) collen+1, (int) strlen((char *)
colname)));
    case SQL_DECIMAL:
    case SQL_NUMERIC:
    return(max((int) collen+2, (int) strlen((char *)
colname)));
    case SQL_REAL:
    case SQL_FLOAT:
    case SQL_DOUBLE:
    return(max((int) MAX_NUM_STRING_SIZE, (int)strlen((char
*) colname)));
    case SQL_BINARY:
    case SQL_VARBINARY:
    return(max((int) 2*collen, (int) strlen((char *)
colname)));
    case SQL_LONGVARBINARY:
    case SQL_LONGVARCHAR: fprintf(fp,"Unsupported datatype,
%d\n", coltype);
    return (0);
    default: fprintf(fp,"Unknown datatype, %d\n", coltype);
    return (0);
    }
/* end switch (coltype) */
    fclose(fp);
} /* end display_size function */
/************************************************************
**********
/* Use K&R getline function to get an input line from
stdin. *
/************************************************************
**********/
int getline (char s[], int lim) {
    int c, i;
    for (i=0; i < lim-1 && (c=getchar()) != EOF && c!= '\n'
; ++i)
    s[i] = c;
    s[i] = '\0' ;
    return i;
}
/*==========================================================
=============
** Function name: ODBCExit **
** Description:
**
**==========================================================
=============*/
void ODBCExit(HDBC hdbc, HSTMT hstmt) {
    SQLFreeStmt(hstmt, SQL_DROP);
    SQLDisconnect(hdbc);
    SQLFreeConnect(hdbc);
}
transaction_begin(u)
    int u;
{
    char *packet;
    userNo = u;
    connect_odbc_user();
}
transaction_done()
{
    ODBCExit(hdbc,hstmt);
}
#define INT2(p) ((short *)(p)+1)
#define INT1(p) ((char *)(p)+3)
void sleep_before_retry()
{
```

```
        delay(.1);
    }
```

client/Makefile

```
    #************************************************************
    ********************
    #@(#) Version: A.10.10 $Date: 97/02/13 18:22:47 $
    #
    #(c) Copyright 1996, Hewlett-Packard Company, all rights
    reserved.
    #************************************************************
    ********************
    #
    # Makefile for compiling the client, batch-tpcc, and
    service code
    #
    OH      = ${ORACLE_HOME}
    P       = ${WORK_DIR}/src
    I       = $(P)/lib
    L       = $(P)/lib
    D       = $(P)/driver
    Q       = $(P)/que
    S       = $(P)/client
    OPT        = -Wl,-a,archive_shared +O4 +Ofastaccess
    +Onolimit +Oentrysched
    #LDOPTS     = -a archive +Oprocelim +Ofastaccess
    LDOPTS    = -ldld -a archive_shared +Oprocelim +Ofastaccess
    TUXEDO     = -D_HPUX_SOURCE ${ROOTDIR}/include ${OPT}
    # ORA_LOAD = -L${OH}/lib ${OH}/lib/osntab.o -lbench -locic -
    lsqlnet -lnetv2 -lnetwork -lora -lsqlnet -lora -lnlsrtl3 -
    lnlsrtl -lc3v6 -lcore3 -lcore -lm -lnlsrtl3 -lnlsrtl -lnsg -
    lpls -lcore3 -lnlsrtl3 -lnlsrtl -lstublm -lc -lm
    ORA_LOAD =  -L${OH}/lib-lbench -lsqlnet -lclient -lserver -
    lcommon -lgeneric -lsqlnet -lclient -lserver -lcommon -
    lgeneric -lnlsrtl3 -lc3v6 -lcore3 -lnlsrtl3 -lcore3
    /oracle/v7/lib/epcni.o -lcl -lm
    LDFLAGS_SYB= ${OPT} ${L}/tpc_lib.a -L${SYBASE}/lib -lsybdb -
    lm
    LDFLAGS_ORA= ${OPT} ${L}/tpc_lib.a ${ORA_LOAD}
    LDFLAGS_SQL= ${OPT} ${L}/tpc_lib.a -L/opt/odbc/lib -lodbc -
    lm
    ORA_INCLUDE= -I${OH}/rdbms/demo
    SYB_INCLUDE= -I${SYBASE}/include
    VIS_INCLUDE= -I ${VISIGENIC}/include
    TUX_INCLUDE= -I${ROOTDIR}/include
    INCLUDE    = -I${S}/oracle  -I. -I$L
    CFLAGS   = ${OPT} ${INCLUDE} ${TUX_INCLUDE}
    CFLAGS_SYB = ${OPT} ${INCLUDE} ${TUX_INCLUDE} ${SYB_INCLUDE}
    CFLAGS_ORA = -Aa -D_HPUX_SOURCE ${OPT} ${INCLUDE}
    ${ORA_INCLUDE} ${TUX_INCLUDE}
    CFLAGS_SQL = -Aa -Dunix -D_HPUX_SOURCE -DVG_UNIX ${OPT}
    ${INCLUDE} ${TUX_INCLUDE} ${SQL_INCLUDE} ${VIS_INCLUDE}
    PROGRAMS     = client service startup client_batch
    msg_server raw
    tpcc_client: client
        mv client ${WORK_DIR}/bin/
    others_sybase: raw startup client_batch_syb msg_server_syb
        mv raw startup client_batch msg_server ${WORK_DIR}/bin
    others_oracle: raw startup client_batch_ora msg_server_ora
        mv raw startup client_batch msg_server ${WORK_DIR}/bin
    others_sqlserver: raw startup client_batch_sql
    msg_server_sql
        mv raw startup client_batch msg_server ${WORK_DIR}/bin
    service_oracle: service_ora
        mv service ${WORK_DIR}/bin/
    service_sybase: service_syb
        mv service ${WORK_DIR}/bin/
    service_sqlserver: service_sql
        mv service ${WORK_DIR}/bin/
    ${S}/sybase/transaction.o: ${S}/sybase/transaction.c
        $(CC) ${CFLAGS_SYB} $(L)/tpc_lib.a -c
    ${S}/sybase/transaction.c;
    ${S}/sqlserver/transactionb.o: ${S}/sqlserver/transactionb.c
        $(CC) ${CFLAGS_SQL} $(L)/tpc_lib.a -c
    ${S}/sqlserver/transactionb.c;
    ORA_OBJS=plnew.o plord.o plpay.o pldel.o plsto.o tpccpl.o
    transaction.o: ${S}/oracle/transaction.c
        $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
    ${S}/oracle/transaction.c;
    plnew.o: ${S}/oracle/plnew.c
        $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
    ${S}/oracle/plnew.c;
    plord.o: ${S}/oracle/plord.c
        $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
    ${S}/oracle/plord.c;
```

```
plpay.o: ${S}/oracle/plpay.c
    $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
${S}/oracle/plpay.c;
pldel.o: ${S}/oracle/pldel.c
    $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
${S}/oracle/pldel.c;
plsto.o: ${S}/oracle/plsto.c
    $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
${S}/oracle/plsto.c;
tpccpl.o: ${S}/oracle/tpccpl.c
    $(CC) ${CFLAGS_ORA} $(L)/tpc_lib.a -c
${S}/oracle/tpccpl.c;
raw: raw.o
    cc ${CFLAGS} raw.o $(L)/tpc_lib.a -o raw
startup: startup.o $(L)/tpc_lib.a
    cc ${CFLAGS} startup.o $(L)/tpc_lib.a -o startup
    chmod a+rw startup
client: client.o  tux_transaction.o $(L)/tpc_lib.a
    ${ROOTDIR}/bin/buildclient -v -f \
        "client.o tux_transaction.o $(L)/tpc_lib.a -lm" -o
client
service_syb: service.o ${S}/sybase/transaction.o
$(L)/tpc_lib.a
    ${ROOTDIR}/bin/buildserver -v -b shm \
                  -s NEWO_SVC -s PMT_SVC -s ORDS_SVC -s
STKL_SVC -s DVRY_SVC \
                  -o service \
                  -f "service.o transaction.o $L/tpc_lib.a \
                      ${SYBASE}/lib/libsybdb.a -lm";
service_ora: service.o transaction.o $(ORA_OBJS)
$(L)/tpc_lib.a
    ${ROOTDIR}/bin/buildserver -v -b shm \
                  -s NEWO_SVC -s PMT_SVC -s ORDS_SVC -s
STKL_SVC -s DVRY_SVC \
                  -o service \
                  -f 'service.o transaction.o $(ORA_OBJS)
$L/tpc_lib.a \
                  ${LDFLAGS_ORA}
service_sql: service.o ${S}/sqlserver/transactionb.o
$(L)/tpc_lib.a
    ${ROOTDIR}/bin/buildserver -v -b shm \
                  -s NEWO_SVC -s PMT_SVC -s ORDS_SVC -s
STKL_SVC -s DVRY_SVC \
                  -o service \
                  -f "service.o transactionb.o $L/tpc_lib.a
\

/vsbuild/v1.10/build/com/obj/inst/libodbc.sl"
client_batch_ora: $(D)/driver.o $(D)/generate.o
transaction.o $(ORA_OBJS) $(Q)/dummy_que.o $(L)/tpc_lib.a  \
            $(L)/server_default.o
    $(CC) $(D)/driver.o $(D)/generate.o transaction.o
$(ORA_OBJS) $(Q)/dummy_que.o $(L)/server_default.o
$(L)/tpc_lib.a ${LDFLAGS_ORA} -o client_batch;
client_batch_syb: $(D)/driver.o $(D)/generate.o
transaction.o $(Q)/dummy_que.o $(L)/tpc_lib.a  \
            $(L)/server_default.o
    $(CC) $(D)/driver.o $(D)/generate.o transaction.o
$(Q)/dummy_que.o $(L)/server_default.o $(L)/tpc_lib.a
${LDFLAGS_SYB} -o client_batch;
client_batch_sql: $(D)/driver.o $(D)/generate.o
transactionb.o $(Q)/dummy_que.o $(L)/tpc_lib.a \
    $(L)/server_default.o
    $(CC) $(D)/driver.o $(D)/generate.o transactionb.o
$(Q)/dummy_que.o $(L)/server_default.o $(L)/tpc_lib.a
${LDFLAGS_SQL} -o client_batch;
msg_server_ora: $(Q)/msg_server.o  transaction.o
$(ORA_OBJS) $(L)/tpc_lib.a
    $(CC) $(Q)/msg_server.o transaction.o $(ORA_OBJS)
${LDFLAGS_ORA} -o msg_server;
msg_server_syb: $(Q)/msg_server.o  transaction.o
$(L)/tpc_lib.a
    $(CC) $(Q)/msg_server.o transaction.o ${LDFLAGS_SYB} -o
msg_server;
msg_server_sql: $(Q)/msg_server.o  transactionb.o
$(L)/tpc_lib.a
    $(CC) $(Q)/msg_server.o transactionb.o ${LDFLAGS_SQL} -
o msg_server;

clean:
    rm -f *.o
clobber: clean
    rm -f ${PROGRAMS}
```

client/service.c

```
/*************************************************************
*******************
```

```
 @(#) Version: A.10.10 $Date: 96/06/10 14:46:59 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights
reserved.
************************************************************
*****************/
#include <unistd.h>
#include <sys/types.h>
#include "tpcc.h"
#include "atmi.h"
extern int userid;
char *cmd           = NULL;
int tpsvrinit(argc, argv)
int    argc;
char **argv;
{
    char c;
    int ret;
    /*
     * search for the options
     *    "-n" server number
     *    "-S" server program
     * purpose: to get svr_id & progname for DVRY_LOG files
     *
     */
    while ((c = getopt(argc, argv, "n:S:h:")) != EOF) {
        switch(c) {
        case 'n':
            userid = atoi(optarg);
            break;
        case 'S':
            cmd  = optarg;
            break;
       }
    }
    message("TUXEDO service %s has started\n", cmd);
    ret = transaction_begin(userid);
    results_open(userid);
    return 0;
}
void NEWO_SVC(svcinfo)
TPSVCINFO *svcinfo;
{
    neworder_transaction((neworder_trans *)svcinfo->data);
    tpreturn(TPSUCCESS, 0, svcinfo->data, svcinfo->len, 0);
}
void PMT_SVC(svcinfo)
TPSVCINFO *svcinfo;
{
    payment_transaction((payment_trans *)svcinfo->data);
    tpreturn(TPSUCCESS, 0, svcinfo->data, svcinfo->len, 0);
}
void ORDS_SVC(svcinfo)
TPSVCINFO *svcinfo;
{
    ordstat_transaction((ordstat_trans *)svcinfo->data);
    tpreturn(TPSUCCESS, 0, svcinfo->data, svcinfo->len, 0);
}
void STKL_SVC(svcinfo)
TPSVCINFO *svcinfo;
{
    stocklev_transaction((stocklev_trans *)svcinfo->data);
    tpreturn(TPSUCCESS, 0, svcinfo->data, svcinfo->len, 0);
}
void DVRY_SVC(svcinfo)
TPSVCINFO *svcinfo;
{
    delivery_trans *t = (delivery_trans *)svcinfo->data;
    gettimeofday(t->deque, NULL);
    delivery_transaction(t);
    gettimeofday(t->complete, NULL);
    results(t);
    /* Why do we return things ? */
    tpreturn(TPSUCCESS, 0, svcinfo->data, svcinfo->len, 0);
}
/************************************************************
****
tpsrvdone cleans up after the TPC transaction service
************************************************************
****/
void tpsvrdone()
{
    transaction_done();
    results_close();
    /* Log a message saying we are done */
```

```
        message("TUXEDO service %s has shutdown \n", cmd);
    }
```

client/tux_transaction.c

```
    /*******************************************************************************
     @(#) Version: A.10.10 $Date: 96/04/15 15:16:17 $
     (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
    *******************************************************************************/
    #include <varargs.h>
    #include <errno.h>
    extern int errno;
    #include "atmi.h"
    #include "Uunix.h"
    #include "tpcc.h"
    int user;
    neworder_trans *neworder_ptr;
    payment_trans  *payment_ptr;
    ordstat_trans *ordstat_ptr;
    stocklev_trans *stocklev_ptr;
    delivery_trans *delivery_ptr;
    int result;
    transaction_begin(u)
       int u;
       {
       /* keep track of which user we are (for error messages only) */
       user = u;
       /* attach to Tuxedo */
       if (tpinit( (TPINIT *)NULL) == -1)
          tux_error("Failed to attach to Tuxedo\n");
       /* allocate structures for each transaction */
       neworder_ptr = tpalloc("CARRAY", NULL, sizeof(neworder_trans));
       payment_ptr = tpalloc("CARRAY", NULL, sizeof(payment_trans));
       ordstat_ptr = tpalloc("CARRAY", NULL, sizeof(ordstat_trans));
       stocklev_ptr = tpalloc("CARRAY", NULL, sizeof(stocklev_trans));
       delivery_ptr = tpalloc("CARRAY", NULL, sizeof(delivery_trans));
       if (neworder_ptr == NULL || payment_ptr == NULL || ordstat_ptr == NULL
          || stocklev_ptr == NULL || delivery_ptr == NULL)
          tux_error("Unable to allocate Tuxedo memory\n");
       }
    transaction_done()
       {
       if (tpterm() == -1)
          tux_error("Unable to detach from Tuxedo\n");
       }
    void neworder_transaction(t)
       neworder_trans *t;
       {
       *neworder_ptr = *t;
       if (tpcall("NEWO_SVC", neworder_ptr, sizeof(neworder_trans),
             &neworder_ptr, &result, TPSIGRSTRT|TPNOTIME) == -1)
          tux_error("Tuxedo failed for neworder transaction\n");
       *t = *neworder_ptr;
       }
    void payment_transaction(t)
       payment_trans *t;
       {
       *payment_ptr = *t;
       if (tpcall("PMT_SVC", payment_ptr, sizeof(payment_trans),
                   &payment_ptr, &result, TPSIGRSTRT|TPNOTIME) == -1)
          tux_error("Tuxedo failed for payment transaction\n");
       *t = *payment_ptr;
       }
    void ordstat_transaction(t)
       ordstat_trans *t;
       {
       *ordstat_ptr = *t;
       if (tpcall("ORDS_SVC", ordstat_ptr, sizeof(ordstat_trans),
                    &ordstat_ptr, &result, TPSIGRSTRT|TPNOTIME) == -1)
          tux_error("Tuxedo failed for ordstat transaction\n");
       *t = *ordstat_ptr;
       }
    stocklev_transaction(t)
       stocklev_trans *t;
       {
       *stocklev_ptr = *t;
       if (tpcall("STKL_SVC", stocklev_ptr, sizeof(stocklev_trans),
                    &stocklev_ptr, &result, TPSIGRSTRT|TPNOTIME) == -1)
          tux_error("Tuxedo failed for stocklev transaction\n");
       *t = *stocklev_ptr;
       }
    delivery_init(u)
```

```
    int u;
    {
    }
delivery_enque(t)
    delivery_trans *t;
    {
    gettimeofday(&t->enque, NULL);
    t->status = OK;
    *delivery_ptr = *t;
    if (tpacall("DVRY_SVC", delivery_ptr, sizeof(delivery_trans),
            TPNOREPLY) == -1)
        tux_error("Tuxedo failed enqueing delivery transaction\n");
    }
delivery_done()
    {
    }
static tux_error(format, va_alist)
    char *format;
    va_dcl
    {
    va_list argptr;
    va_start(argptr);
    vmessage(format, argptr);
    message("Tuxedo error %d\n", tperrno);
    errno = Uunixerr;
    if (tperrno == TPEOS)
        syserror("Tuxedo encountered O/S error\n");
    exit(1);
    }
```

A.3 Driver

driver/generate.c

```
/*******************************************************************************
 @(#) Version: A.10.10 $Date: 97/02/20 11:45:59 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
*******************************************************************************/
#include <stdio.h>
#include <values.h>
#include <unistd.h>
#include <time.h>
#include <sys/types.h>
#include <sys/ipc.h>
#include <fcntl.h>
#include <signal.h>
#include <math.h>
#include "shm_lookup.h"
#include "random.h"
#include <time.h>
int CLAST_CONST_C = 208;
int CID_CONST_C =  37;
int IID_CONST_C = 75;
int trans_type = 0;   /* type of transaction 0 == all */
extern ID warehouse;
extern ID district;
extern int no_warehouse;
extern int no_item;
extern int no_dist_pw;
extern int no_cust_pd;
extern int no_ord_pd;
extern int no_new_pd;
extern int tpcc_load_seed;
neworder_gen(t)
    neworder_trans *t;
    {
    int i;
    t->W_ID = warehouse;
    t->D_ID = RandomNumber(1, no_dist_pw);
    t->C_ID = NURandomNumber( 1023, 1, no_cust_pd, CID_CONST_C);
    t->O_OL_CNT = RandomNumber(5, 15);
    for (i=0; i<t->O_OL_CNT; i++)
        {
        t->item[i].OL_I_ID = NURandomNumber(8191, 1, no_item, IID_CONST_C);
        t->item[i].OL_SUPPLY_W_ID = RandomWarehouse(warehouse, scale, 1);
        t->item[i].OL_QUANTITY = RandomNumber(1, 10);
        }
    /* 1% of transactions roll back. Give the last order line a bad item */
    if (RandomNumber(1, 100) == 1)
        t->item[t->O_OL_CNT - 1].OL_I_ID = -1;
    }
```

```
payment_gen(t)
   payment_trans *t;
   {
   /* home warehouse is fixed */
   t->W_ID = warehouse;
   /* Random district */
   t->D_ID = RandomNumber(1, no_dist_pw);
   /* Customer is from remote warehouse and district 15% of the time */
   t->C_W_ID = RandomWarehouse(warehouse, scale, 15);
   if (t->C_W_ID == t->W_ID)
      t->C_D_ID = t->D_ID;
   else
      t->C_D_ID = RandomNumber(1, no_dist_pw);
   /* by name 60% of the time */
   t->byname = RandomNumber(1, 100) <= 60;
   if (t->byname)
      LastName(NURandomNumber(255, 0, no_cust_pd/3 - 1,
CLAST_CONST_C),
         t->C_LAST);
   else
      t->C_ID = NURandomNumber(1023, 1, no_cust_pd, CID_CONST_C);
   /* amount is random from [1.00..5,000.00] */
   t->H_AMOUNT = RandomNumber(100, 500000);
   }
ordstat_gen(t)
   ordstat_trans *t;
   {
   /* home warehouse is fixed */
   t->W_ID = warehouse;
   /* district is randomly selected from warehouse */
   t->D_ID = RandomNumber(1, no_dist_pw);

   /* by name 60% of the time */
   t->byname = RandomNumber(1, 100) <= 60;
   if (t->byname)
      LastName(NURandomNumber(255, 0, no_cust_pd/3 - 1,
CLAST_CONST_C),
         t->C_LAST);
   else
      t->C_ID = NURandomNumber(1023, 1, no_cust_pd, CID_CONST_C);
   }
delivery_gen(t)
   delivery_trans *t;
   {
   t->W_ID = warehouse;
   t->O_CARRIER_ID = RandomNumber(1,10);
   }
stocklev_gen(t)
   stocklev_trans *t;
   {
   t->W_ID = warehouse;
   t->D_ID = district;
   t->threshold = RandomNumber(10, 20);
   }
int get_trans_type()
/*****************************************************************************
 * get_trans_type selects a transaction according to the weighted average
 * For TPC-C rev 3.0 and less and TPC-C rev 3.2 this is:
 *      new-order :  ???
 *      payment   : 43.0%
 *      order stat:  4.0%
 *      delivery  :  4.0%
 *      stock     :  4.0%
 *****************************************************************************/
   {
   static double weight[] = { 0.0,  0.0, .4305, .0405, .0405, .0405};
   double drand48();
   int type;
   double r;
   /* choose a random number between 0.0 and 1.0 */
   if (trans_type == 0) {
      r = drand48();

      /*
       * select one of STOCKLEV, DELIVERY, ORDSTAT and PAYMENT
       * based on weight
       */
      for (type = STOCKLEV;  type > NEWORDER;  type--) {
         r -= weight[type];
         if (r < 0) break;
      }
   } else {
      /* user wants only a certain type (say all stocklevel) so do that
```

```
            instead */
        type = trans_type;
    }
    /* return the value of the selected card, or NEWORDER if none selected */
    return type;
    }
```

lib/date.c

```
    /*******************************************************************************
     @(#) Version: A.10.10 $Date: 96/04/02 16:26:09 $
     (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
    *******************************************************************************/
    #include "tpcc.h"
    #include <time.h>
    /* macro to get starting day of a particular year (1901 thru 2100) */
    #define YEAR(yr)  ( (yr-1900)*365 + (yr-1900-1)/4 )
    CurrentDate(date)
    /*******************************************************************
    CurrentDate fetches the current date and time
    *******************************************************************/
        DATE *date;
        {
        struct timeval time;
        struct timezone tz;
        /* get the current time of day */
        if (gettimeofday(&time, &tz) < 0)
            syserror("Can't get time of day\n");
        /* adjust the time of day by the timezone */
        time.tv_sec -= tz.tz_minuteswest * 60;
        /* convert seconds and days since EPOCH (Jan 1, 1970) */
        date->day = time.tv_sec / (24*60*60);
        date->sec = time.tv_sec - date->day * (24*60*60);
        /* convert to days since Jan 1, 1900 */
        date->day += YEAR(1970);
        }
    EmptyDate(date)
    /*********************************************
    Get a NULL date and time
    *********************************************/
        DATE *date;
        {
        date->day = 0;   /* Use EMPTYNUM instead */
        date->sec = 0;
        }
    int IsEmptyDate(date)
        DATE *date;
        {
        return (date->day == 0 & date->sec == 0);
        }
    #define Feb29 (31+29-1)
    fmt_date(str, date)
    /*************************************************************************
    fmt_date formats the DATE into a string  MM-DD-YY HH-MM-SS
    *************************************************************************/
        char str[20];
        DATE *date;
        {
        /* Note: should probably do date and time separately */
        int quad, year, month, day;
        int hour, minute, sec;
        static int dur[] = {31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31};
        static int first = YES;
        day = date->day;
        sec = date->sec;
        /* if NULL date, then return empty string */
        if (day == EMPTY_NUM || sec == EMPTY_NUM)
            {str[0] = '\0';  return;}
        /* 2100, 1900 are NOT leap years.  If we are Feb 29 or later, add a day */
        if (day >= Feb29 + YEAR(2100))  day++;
        if (day >= Feb29)               day++;
        /* figure out which quad and day within quad we are in */
        quad = day / (4*365+1);
        day = day - quad * (4*365+1);
        /* get our year within quad and day within the year */
        if      (day < 1*365+1)    {year = 0;}
        else if (day < 2*365+1)    {year = 1; day -= 1*365+1;}
        else if (day < 3*365+1)    {year = 2; day -= 2*365+1;}
        else                       {year = 3; day -= 3*365+1;}
        /* if this is a leap year, february has 29 days */
        if (year == 0)          dur[1] = 29;
        else                    dur[1] = 28;
```

```
    /* decide which day and month we are */
    for (month = 0; day >= dur[month]; month++)
        day -= dur[month];
    /* decide what time of day it is */
    minute = sec / 60;
    sec = sec - minute * 60;
    hour = minute / 60;
    minute = minute - hour * 60;
    /* format the date and time */
    fmtint(str+0,  day+1, 2, ' ');
    str[2]='-';
    fmtint(str+3, month+1, 2, '0');
    str[5]='-';
    fmtint(str+6, 1900+quad*4+year, 4, '0');
    str[10] = ' ';
    fmtint(str+11, hour, 2, ' ');
    str[13] = ':';
    fmtint(str+14, minute, 2, '0');
    str[16] = ':';
    fmtint(str+17, sec, 2, '0');
    str[19] = '\0';
    }
```

lib/errlog.c

```
/*******************************************************************************
 @(#) Version: A.10.10 $Date: 96/06/11 10:46:41 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
*******************************************************************************/
#include<fcntl.h>
#include<stdio.h>
#include<unistd.h>
#include<errno.h>
#include <stdarg.h>
#include <stdlib.h>
#include <stdio.h>
#include <errno.h>
extern int errno;
int userid;
error(format, args)
/*****************************************************************************
error formats a message and outputs it to a standard location (stderr for now)
*****************************************************************************/
    char *format;
    int args;
    {
    va_list argptr;
    /* point to the list of arguments */
    va_start(argptr, args);
    /* format and print to stderr */
    vmessage(format, argptr);
    /* done */
    va_end(argptr);
    /* take an error exit */
    exit(1);
    }
syserror( format, args )
/*****************************************************************************
syserror logs a message with the system error code
*****************************************************************************/
    char *format;
    int args;
    {
    va_list argptr;
    int save_errno = errno;
    /* point to the list of arguments */
    va_start(argptr, args);
    /* format and print to stderr */
    vmessage(format, argptr);
    /* done */
    va_end(argptr);
    /* display the system error message */
    message("    System error message: %s\n", strerror(save_errno));
    /* take an error exit */
    exit(1);
    }
message(format, args)
/*****************************************************************************
message formats a message and outputs it to a standard location (stderr for now)
*****************************************************************************/
    char *format;
    int args;
```

```
    {
    va_list argptr;
    /* point to the list of arguments */
    va_start(argptr, args);
    /* format and print to stderr */
    vmessage(format, argptr);
    /* done */
    va_end(argptr);
    }
vmessage(format, argptr)
/*****************************************************
*****************************************************/
    char *format;
    va_list argptr;
{
  char buf[3*1024];
  /* format a message id */
  sprintf(buf, "User %-6d Pid %-6d ", userid, getpid());
  /* format the string and print it */
  vsprintf(buf+strlen(buf), format, argptr);
  if (getenv("NO_ERROR_LOG") == NULL)
      msg_buf(buf, strlen(buf));
  if (getenv("NO_STDERR") == NULL)
      write(2, buf, strlen(buf));
}

static msg_buf(buf, size)
  char *buf;
  int size;
  {
  int  fd;
  char  *fname;
  /* get the file name to use */
  fname = getenv("ERROR_LOG");
  if (fname == NULL)
    fname = "/tmp/ERROR_LOG";
  /* get exclusive access to the error log file */
  fd= open(fname, O_WRONLY | O_CREAT, 0666);
  if (fd < 0)
    console_error("Can't open tpc error log file 'ERROR_LOG'\n");
  lockf(fd, F_LOCK, 0);
  /* write the new text at the end of the file */
  lseek(fd, 0, SEEK_END);
  write(fd, buf, size);
  /* release the file */
  /* fsync(fd); */
  lockf(fd, F_ULOCK, 0);
  close(fd);
  }
console_error(str)
  char *str;
  {
  int fd = open("/dev/tty", O_WRONLY);
  write(fd, str, strlen(str));
  close(fd);
  exit(1);
  }
```

lib/fmt.c

```
/*****************************************************************************
 @(#) Version: A.10.10 $Date: 96/04/02 16:26:25 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
*****************************************************************************/
#include "tpcc.h"
#include "iobuf.h"
#include <math.h>    /* needed for ceil (VM) */
#include <strings.h>
/* formatting routines.  */
/* Note: Currently use integer routines to format and convert.  Need to
   modify the code for cases when integers don't work.  */
fmt_money(str, m, width)
    char *str;
    MONEY m;
    int width;
    {
    if (m == EMPTY_FLT)
        {
        memset(str, '_', width);
        str[width] = '\0';
        return;
        }
```

```
    /* format it as a number with a leading blank */
    *str = ' ';
    fmt_flt(str+1, m/100, width-1, 2);
    /* fill in a leading dollar */
    while (*(str+1) == ' ')
        str++;
    *str = '$';
    }
double cvt_money(str)
    char *str;
    {
    char temp[81], *t, *s;
    double cvt_flt(), f;
    /* skip leading and trailing blanks */
    cvt_text(str, temp);
    /* remove leading $ */
    if (*temp == '$')   t = temp + 1;
    else                t = temp;
    /* start scan at current character */
    s = t;
    /* allow leading minus sign */
    if (*s == '-')
        s++;
    /* allow leading digits */
    while (isdigit(*s))
        s++;
    /* allow decimal pt and two decimal digits */
    if (*s == '.')    s++;
    if (isdigit(*s))  s++;
    if (isdigit(*s))  s++;
    /* There should be no more characters */
    if (*s != '\0') return INVALID_FLT;
    /* convert the floating pt number */
    f = cvt_flt(t);
    if (f == EMPTY_FLT)        return EMPTY_FLT;
    else if (f == INVALID_FLT) return INVALID_FLT;
    else                       return rint(f*100);
    }
fmt_num(str, n, width)
    char str[];
    int n;
    int width;
    {
    /* mark the end of the string */
    str[width] = '\0';
    /* if empty number, return the empty field */
    if (n == EMPTY_NUM)
        memset(str, '_', width);
    /* otherwise, convert the integer */
    else
        fmtint(str, n, width, ' ');
    debug("fmt_num:  n=%d  str=%s\n", n, str);
    }
cvt_num(str)
    char str[];
    {
    char text[81];
    cvt_text(str, text);
    if (*text == '\0')
        return EMPTY_NUM;
    else
        return cvtint(text);
    }

fmt_flt(str, x, width, dec)
/*****************************************************************************
fmt_flt converts a floating pt number to a string   "999999.9999"
*****************************************************************************/
    char *str;
    double x;
    int width;
    int dec;
    {
    int negative;
    int integer, fract;
    double absolute;
    static double pow10[] =
    {1., 10., 100., 1000., 10000., 100000., 1000000., 10000000., 100000000.};
    /* mark the end of string */
    str[width] = '\0';
    /* if empty value, make it be an empty field */
    if (x == EMPTY_FLT)
```

```
        {
        memset(str, '_', width);
        return;
        }
    absolute = (x < 0)? -x: x;
    /* separate into integer and fractional parts */
    integer = (int) absolute;
    fract   = (absolute - integer) * pow10[dec] + .5;

    /* let the integer portion contain the sign */
    if (x < 0) integer = -integer;

    /* Format integer and fraction separately */
    fmtint(str, integer, width-dec-1, ' ');
    str[width-dec-1] = '.';
    fmtint(str+width-dec, fract, dec, '0');
    }
double cvt_flt(str)
    char str[];
    {
    char text[81];
    char *t;
    double value;
    int div;
    int fract;
    int negative;
    int i;
    /* normalize the text */
    cvt_text(str, text);
    if (*text == '\0')
        return EMPTY_FLT;
    negative = NO;
    fract = NO;
    value = 0;
    div = 1.0;
    negative = (text[0] == '-');
    if (negative)    t = text+1;
    else             t = text;
    for (;  *t !=  '\0' ; t++)
        {
        if (*t == '.')
            if (fract)  return INVALID_FLT;
            else        fract = YES;
        else if (isdigit(*t))
            {
            value = value*10 + (int)*t - (int)'0';
            if (fract) div *= 10;
            }
        else
            return INVALID_FLT;
        }
    if (fract)
        value /= div;
    if (negative)
        value = -value;
    return value;
    }
fmt_text(s, text, width)
    char *s, *text;
    int width;
    {
    /* if an empty string, then all underscores */
    if (*text == '\0')
        for (; width > 0; width--)
            *s++  = '_';
    /* otherwise, blank fill it */
    else
        {
        /* copy the text into the new buffer */
        for ( ; *text != '\0';  width--)
            *s++ = *text++;
        /* fill in the rest with blanks */
        for (;  width > 0;  width--)
            *s++ = ' ';
        }
    /* and finally, terminate the string */
    *s = '\0';
    }
cvt_text(s, text)
    char *s;
    char *text;
    {
```

```
    char *lastnb;

    /* skip leading blanks and underscores */
    for (; *s == ' ' || *s == '_'; s++)
        ;
    /* copy the characters, keeping track of last blank or underscore */
    lastnb = text-1;
    for (; *s != '\0'; *text++ = *s++)
        if (*s != ' ' && *s != '_')
            lastnb = text;
    /* truncate the text string to last nonblank character */
    *(lastnb+1) = '\0';
    }

fmtint(field, value, size, fill)
/*********************************************************************
fmtint formats an integer value into a character field to make the integer
right-justified within the character field, padded with leading fill
characters (e.g. leading blanks if a blank is passed in for the fill argument
*********************************************************************/
    int value;
    char *field;
    int size;
    char fill;
    {
    int negative;
    int dividend;
    int remainder;
    char *p;
    /* create characters from right to left */
    p = field + size - 1;
    /* make note if this is a negative number */
    negative = value < 0;
    if (negative)
        value = -value;
    /* Case: Null field.  Can't do anything */
    if (p < field)
        ;
    /* Case: value is zero.  Print a leading '0' */
    else if (value == 0)
        *p-- = '0';
    /* Otherwise, convert each digit in turn */
    else do
        {
        dividend = value / 10;
        remainder = value - dividend * 10;
        value = dividend;
        *p-- = (char) (  (int)'0'  +  remainder  );
        } while (p >= field && value > 0);
    /* insert a minus sign if appropriate */
    if (negative && p >= field)
        *p-- = '-';
    /* fill in leading characters */
    while (p >= field)
        *p-- = fill;
    }
int cvtint(str)
/*********************************************************************
getint extracts an integer value from the given character field
(ex: turns the string "123" into the integer 123)
*********************************************************************/
    char *str;
    {
    int value;
    char c;
    int negative;
    debug("cvtint: str=%s\n", str);
    negative = (*str == '-');
    if (negative)  str++;
    /* convert the integer */
    for (value = 0; isdigit(*str); str++)
        value = value*10 + (int)(*str) - (int)'0';
    /* if any non-digit characters, error */
    if (*str != '\0')
        return INVALID_NUM;
    /* make negative if there was a minus sign */
    if (negative)
        value = -value;
    debug("cvtint: value=%d\n", value);
    return value;
    }
fmt_phone(str, phone)
```

```
    char str[20];
    char *phone;
    {
    /* copy phone number and insert dashes  999999-999-999-9999 */
    str[0] = phone[0];  str[1] = phone[1]; str[2] = phone[2];
    str[3] = phone[3];  str[4] = phone[4]; str[5] = phone[5];
    str[6] = '-';
    str[7] = phone[6];  str[8] = phone[7]; str[9] = phone[8];
    str[10] = '-';
    str[11] = phone[9]; str[12] = phone[10]; str[13] = phone[11];
    str[14] = '-';
    str[15] = phone[12]; str[16] = phone[13]; str[17] = phone[14];
    str[18] = phone[15];
    str[19] = '\0';
    }
fmt_zip(str,zip)
    char str[20];
    char *zip;
    {
    /* copy zip code and insert dashes 99999-9999 */
    str[0] = zip[0];  str[1] = zip[1];  str[2] = zip[2];
    str[3] = zip[3];  str[4] = zip[4];
    str[5] = '-';
    str[6] = zip[5]; str[7] = zip[6]; str[8] = zip[7];  str[9] = zip[8];
    str[10] = '\0';
    }
```

lib/iobuf.c

```
/*******************************************************************************
 @(#) Version: A.10.10 $Date: 96/04/02 16:26:25 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
 *******************************************************************************/
#define DECLARE_IO_BUFFERS
#include "iobuf.h"
#undef DECLARE_IO_BUFFERS
#include "tpcc.h"
#include <sys/errno.h>
extern int errno;
string(str)
    char str[];
    {
    for (; *str != '\0'; str++)
        pushc(*str);
    }
push(str, len)
    char *str;
    int len;
    {
    for (; len > 0; len --)
        pushc(*str++);
    }
display(scr)
    iobuf *scr;
    {
/* Note: if problems doing output, let the input routine detect it */
    char *p;
    int len;
    for (p = scr->beg; p < scr->end; p+=len)
        {
        len = write(1, p, scr->end - p);
        if (len <= 0) break;
        }
    }
input(scr)
    iobuf *scr;
    {
    int len;
    /* read in as many characters as are available */
    len = read(0, scr->end, scr->max - scr->end);
    /* if end of input, then pretend we read an END character */
    if (len == 0 || (len == -1 && errno == ECONNRESET))
        {
        *scr->end = EOF;
        len = 1;
        }
    /* Check for errors */
    else if (len == -1)
        syserror("input(scr): unable to read stdin\n");
    /* update the pointers to reflect the new data */
    scr->end += len;
    *scr->end='\0';  /* for debugging */
```

```
    }
getkey()
    {
    if (in_buf->cur == in_buf->end)
        {
        flush();
        reset(in_buf);
        input(in_buf);
        }
    return popc();
    }
```

lib/iobuf.h

```
/*******************************************************************************
 @(#) Version: A.10.10 $Date: 96/08/06 19:33:00 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
*******************************************************************************/
/*****************************************************************
History
941220 LAN Added definition and initialization of the line_col[] array.
       This was needed for modifications made of client program to do
       block I/O using a WYSE terminal.
*****************************************************************/
/* structure for screen emulation */
typedef struct
    {
    int row;
    int col;
    char buf[25][81];
    } screen_t;
typedef struct {
    char *beg;
    char *end;   /* for output buffers */
    char *max;
    char *cur;   /* for input buffers */
    } iobuf;
/* Macro do define an I/O buffer of x characters, initialized to empty */
#define define_iobuf(name, size)                    \
char name/**/_data[size];                           \
iobuf name[1] = {{name/**/_data, name/**/_data,     \
                  name/**/_data+size, name/**/_data}}
#define reset(buf)  if (1) { \
    (buf)->cur = (buf)->end = (buf)->beg;           \
    *(buf)->beg = '\0';                             \
    } else (void)0
#define flush()  if(1) { \
        display(out_buf);    \
        reset(out_buf);     \
     } else (void)0
/* Standard I/O to and from in_buf and out_buf */
#ifdef DECLARE_IO_BUFFERS
define_iobuf(output_stuff, 4*1024);
define_iobuf(input_stuff, 1024);
iobuf *in_buf = input_stuff;
iobuf *out_buf = output_stuff;
#else
iobuf *in_buf;
iobuf *out_buf;
#endif
#define pushc(c) if (1) { \
    if (out_buf->end >= out_buf->max)   \
        error("out_buf overflow:  beg=0x%x end=%d  max=%d\n",  \
         out_buf->beg, out_buf->end-out_buf->beg,out_buf->max-out_buf->beg); \
    *(out_buf->end++) = (c);  \
    *(out_buf->end) = '\0';  /* debug */ \
    } else (void)0
#define popc()  \
    (*in_buf->cur++)

/* Standard characters used for screen control */
#define ENTER '\015'
#define TAB   '\t'
#define BACKTAB '\02'  /*  ^B  */
#define CNTRLC '\03'
#define BACKSPACE '\010'
#define BELL '\07'
#define BLANK ' '
#define UNDERLINE '_'
#define ESCAPE '\033'
/*#define EOF    ((char)-1) */
#define TRIGGER '\021'  /* dc1 */
```

lib/random.c

```
/*****************************************************************************
 @(#) Version: A.10.10 $Date: 97/02/20 11:47:10 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights reserved.
 *****************************************************************************/
#include "tpcc.h"
#include "string.h"
#include "random.h"
double drand48();
char lastNames[1000][16];
char customerData1[10][301];
char customerData2[10][201];
char stockData1[10][27];
char stockData2[10][25];
char historyData1[10][13];
char historyData2[10][13];
char citystreetData1[10][11];
char citystreetData2[10][11];
char firstNameData1[10][9];
char firstNameData2[10][9];
char StockDistrict[10][25];
char phoneData[10][17];
void GenerateLastNames()
{
   int      i;
   char *name;
   static char *n[] = {"BAR", "OUGHT", "ABLE", "PRI", "PRES",
                       "ESE", "ANTI", "CALLY", "ATION", "EING"};
   for(i = 0; i < 1000; i++) {
      name = &lastNames[i];
      strcpy(name, n[(i/100)%10]);
      strcat(name, n[(i/10) %10]);
      strcat(name, n[(i/1)  %10]);
   }
}
int MakeNumberString(min, max, num)
   int min;
   int max;
   TEXT num[];
   {
   static char digit[]="0123456789";
   int length;
   int i;
   length = RandomNumber(min, max);

   for (i=0;  i<length;  i++)
      num[i] = digit[RandomNumber(0,9)];
   num[length] = '\0';
   return length;
   }
ID RandomWarehouse(local, scale, percent)
   ID local;
   ID scale;
   int percent;   /* percent of remote transactions */
   {
   ID w_id;
   /* For the given percent of the time, pick the local warehouse */
   if (RandomNumber(1, 100) > percent || scale == 1)
      w_id = local;
   /* Otherwise, pick a non-local warehouse */
   else
      {
      w_id = RandomNumber(2, scale);
      if (w_id == local)
         w_id = 1;
      }
   return w_id;
   }
/* Initialize a table of Random strings for the stock-district
   field in the stock table.  We can use a table of 10 elements
   and select randomly from this table via rule 4.3.2.2 in
   the TPC-C spec */
void InitRandomStrings()
{
   int i;
   for (i=0; i < 10; i++) {
         MakeAlphaString(24,24,&StockDistrict[i]);
         MakeAlphaString(300,300,&customerData1[i]);
         MakeAlphaString(0,200,&customerData2[i]);
         MakeAlphaString(26,26,&stockData1[i]);
```

```
            MakeAlphaString(0,24,&stockData2[i]);
            MakeAlphaString(12,12,&historyData1[i]);
            MakeAlphaString(0,12, &historyData2[i]);
            MakeAlphaString(10,10,&citystreetData1[i]);
            MakeAlphaString(0 ,10,&citystreetData2[i]);
            MakeAlphaString(8,8,&firstNameData1[i]);
            MakeAlphaString(0,8,&firstNameData2[i]);
            MakeNumberString(16,16,&phoneData[i]);
        }
        GenerateLastNames();
}
int MakeAlphaString(min, max, str)
    int min;
    int max;
    TEXT str[];
    {
    static char character[] = "abcdefghijklmnopqrstuvwxyz";
    int length;
    int i;
    length = RandomNumber(min, max);
    for (i=0;  i<length;  i++) {
        /* NOTE:  we use sizeof(character)-2 because of the following:
           subtract 1 because we are numbering from 0 instead of 1 and
           subtract 1 because the sizeof(character) is 1 greater than
           the data in character because of the inivisible C string
           terminator at the end. */
        str[i] = character[RandomNumber(0, sizeof(character)-2)];
    }
    str[length] = '\0';
    return length;
    }
void RandomPermutation(perm, n)
    int perm[];
    int n;
    {
    int i, r, t;
    /* generate the identity permutation to start with */
    for (i=1; i<=n; i++)
        perm[i] = i;
    /* randomly shuffle the permutation */
    for (i=1; i<=n; i++)
        {
        r = RandomNumber(i, n);
        t = perm[i]; perm[i] = perm[r]; perm[r] = t;
        }
    }
void RandomDelay(mean, adjust)
/*****************************************************************
random_sleep sleeps according to the TPC specification
*****************************************************************/
    double mean;
    double adjust;
    {
    double secs;
    double exponential();
    secs = exponential(mean);

    delay(secs+adjust);
    }
double exponential(mean)
/*****************************************************************
exponential generates a reverse exponential distribution
*****************************************************************/
    double mean;
    {
    double x;
    double log();
    x = -log(1.0-drand48()) * mean;
    return x;
    }
void Randomize()
    {
    srand48(time(0)+getpid());
    }
```

lib/random.h

```
/*************************************************************
*******************
 @(#) Version: A.10.10 $Date: 97/02/20 11:47:20 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights
reserved.
```

```
************************************************************
*****************/
#ifndef TPCC_RANDOM
#define TPCC_RANDOM
double drand48();
extern int    MakeNumberString();
extern ID     RandomWarehouse();
extern int    MakeAlphaString();
extern void   RandomPermutation();
extern void   RandomDelay();
extern double exponential();
extern void   Randomize();
extern char lastNames[1000][16];
extern char customerData1[10][301];
extern char customerData2[10][201];
extern char stockData1[10][27];
extern char stockData2[10][25];
extern char historyData1[10][13];
extern char historyData2[10][13];
extern char citystreetData1[10][11];
extern char citystreetData2[10][11];
extern char firstNameData1[10][9];
extern char firstNameData2[10][9];
extern char StockDistrict[10][25];
extern char phoneData[10][17];
/************************************************************
**************
RandomNumber selects a uniform random number from min to
max inclusive
************************************************************
**************/
#define RandomNumber(min,max)  \
    ((int)(drand48() * ((int)(max) - (int)(min) + 1)) +
(int)(min))
/************************************************************
************
NURandomNumber selects a non-uniform random number
************************************************************
***********/
#define NURandomNumber(a, min, max, c) \
    ((RandomNumber(0, a) | RandomNumber(min, max)) + (c)) %
\
    ((max) - (min) + 1) + (min)
#define SelectHistoryData(data) \
{ \
    strcpy(data,historyData1[RandomNumber(0,9)]);\
    strcat(data,historyData2[RandomNumber(0,9)]);\
}
#define SelectCityStreetData(data) \
{ \
    strcpy(data,citystreetData1[RandomNumber(0,9)]); \
    strcat(data,citystreetData2[RandomNumber(0,9)]); \
}
#define SelectFirstName(data) \
{ \
    strcpy(data,firstNameData1[RandomNumber(0,9)]); \
    strcat(data,firstNameData2[RandomNumber(0,9)]); \
}
#define SelectHistoryData(data) \
{ \
    strcpy(data,historyData1[RandomNumber(0,9)]); \
    strcat(data,historyData2[RandomNumber(0,9)]); \
}
#define SelectStockData(data) \
{ \
    strcpy(data,stockData1[RandomNumber(0,9)]); \
    strcat(data,stockData2[RandomNumber(0,9)]); \
}
#define SelectClientData(data) \
{ \
    strcpy(data,customerData1[RandomNumber(0,9)]); \
    strcat(data,customerData2[RandomNumber(0,9)]); \
}
#define SelectPhoneData(data)
strcpy(data,phoneData[RandomNumber(0,9)])
#define SelectStockDistrict(data)
strcpy(data,StockDistrict[RandomNumber(0,9)])
#define MakeZip(zip) \
{ \
   MakeNumberString(4, 4, zip); \
   zip[4] = '1'; \
   zip[5] = '1'; \
   zip[6] = '1'; \
   zip[7] = '1'; \
   zip[8] = '1'; \
```

```
   zip[9] = '\0'; \
}
#define MakeAddress(str1, str2, city, state, zip) \
{ \
    SelectCityStreetData(str1); \
    SelectCityStreetData(str2); \
    SelectCityStreetData(city); \
    MakeAlphaString(2,2,state); \
    MakeZip(zip); \
}
#define LastName(num, name) strcpy(name, lastNames[(num)])
#define Original(str) \
{ \
    int len = strlen(str); \
    if (len >= 8) { \
        int pos = RandomNumber(0,(len-8)); \
        str[pos+0] = 'O'; \
        str[pos+1] = 'R'; \
        str[pos+2] = 'I'; \
        str[pos+3] = 'G'; \
        str[pos+4] = 'I'; \
        str[pos+5] = 'N'; \
        str[pos+6] = 'A'; \
        str[pos+7] = 'L'; \
    } \
}
#endif

lib/results_file.c
/*************************************************************
******************
 @(#) Version: A.10.10 $Date: 96/08/06 11:56:24 $
 (c) Copyright 1996, Hewlett-Packard Company, all rights
reserved.
*************************************************************
******************/
#include <unistd.h>
#include <stdio.h>
#include "tpcc.h"
static FILE *rfile;
results_open(id)
    int id;
    {
    char fullname[128];
    char *basename;
    /* get the base file name for the deferred results */
    /*
     * Make it a directory under /tmp so at least we can
set it to a
     * symbolic link in case /tmp doesn't have enough room.
     */
    basename = getenv("TPCC_RESULTS_FILE");
    if (basename == NULL)
        basename = "/tmp/TPCC_RESULTS_FILE";
    /* create the full file name */
    sprintf(fullname, "%s.%d", basename, id);
    /* open the file */
    unlink(fullname);
    rfile = fopen(fullname, "wb");
    if (rfile == NULL)
        syserror("Delivery server %d can't open file %s\n",
id, fullname);
    /* allocate a larger buffer */
    }
results(t)
    delivery_trans *t;
    {
    if (fwrite(t, sizeof(*t), 1, rfile) != 1)
        syserror("Delivery server: Can't post results\n");
    }
results_close()
    {
    if (fclose(rfile) < 0)
        syserror("Delivery server can't close file\n");
    }
```

Appendix B – Database Design

Build

diskinit.sql

```
    /*  TPC-C Benchmark Kit                                 */
    /*                                                      */
    /*  DISKINIT.SQL                                        */
    /*                                                      */
    /*  This script is used create the database devices     */
    use master
    go
    disk init name = "c_log1_dev",
        physname = "u:",
        vdevno   = 14,
        size     = 2048000
    go
    disk init name = "c_log2_dev",
        physname = "v:",
        vdevno   = 15,
        size     = 2048000
    go
    disk init name = "c_ordln1_dev",
        physname = "e:",
        vdevno   = 16,
        size     = 1730560
    go
    disk init name = "c_ordln2_dev",
        physname = "f:",
        vdevno   = 17,
        size     = 1730560
    go
    disk init name = "c_ordln3_dev",
        physname = "h:",
        vdevno   = 18,
        size     = 1730560
    go
    disk init name = "c_ordln4_dev",
        physname = "i:",
        vdevno   = 19,
        size     = 1730560
    go
    disk init name = "c_ordln5_dev",
        physname = "j:",
        vdevno   = 20,
        size     = 1730560
    go
    disk init name = "c_cs1_dev",
        physname = "k:",
        vdevno   = 21,
        size     = 3883008
    go
    disk init name = "c_cs2_dev",
        physname = "l:",
        vdevno   = 22,
        size     = 3883008
    go
    disk init name = "c_cs3_dev",
        physname = "m:",
        vdevno   = 23,
        size     = 3883008
    go
    disk init name = "c_cs4_dev",
        physname = "n:",
        vdevno   = 24,
        size     = 3883008
    go
    disk init name = "c_cs5_dev",
        physname = "o:",
        vdevno   = 25,
        size     = 3883008
    go
    disk init name = "c_misc1_dev",
        physname = "p:",
        vdevno   = 26,
        size     = 647168
    go
```

```
    disk init name = "c_misc2_dev",
        physname = "q:",
        vdevno   = 27,
        size     = 647168
    go
    disk init name = "c_misc3_dev",
        physname = "r:",
        vdevno   = 28,
        size     = 647168
    go
    disk init name = "c_misc4_dev",
        physname = "s:",
        vdevno   = 29,
        size     = 647168
    go
    disk init name = "c_misc5_dev",
        physname = "t:",
        vdevno   = 30,
        size     = 647168
    go
```

createdb.sql

```
    /*  TPC-C Benchmark Kit                                 */
    /*                                                      */
    /*  CREATEDB.SQL                                        */
    /*                                                      */
    /*  This script is used to create the database          */
    use master
    go
    if exists ( select name from sysdatabases where name =
    "tpcc" )
        drop database tpcc
    go
    create database tpcc on
        c_ordln1_dev   = 1690,
        c_ordln2_dev   = 1690,
        c_ordln3_dev   = 1690,
        c_ordln4_dev   = 1690,
        c_ordln5_dev   = 1690,
        c_ordln1_dev   = 1690,
        c_ordln2_dev   = 1690,
        c_ordln3_dev   = 1690,
        c_ordln4_dev   = 1690,
        c_ordln5_dev   = 1690,
        c_cs1_dev    = 2528,
        c_cs2_dev    = 2528,
        c_cs3_dev    = 2528,
        c_cs4_dev    = 2528,
        c_cs5_dev    = 2528,
        c_cs1_dev    = 2528,
        c_cs2_dev    = 2528,
        c_cs3_dev    = 2528,
        c_cs4_dev    = 2528,
        c_cs5_dev    = 2528,
        c_cs1_dev    = 2528,
        c_cs2_dev    = 2528,
        c_cs3_dev    = 2528,
        c_cs4_dev    = 2528,
        c_cs5_dev    = 2528,
        c_misc1_dev  = 1264,
        c_misc2_dev  = 1264,
        c_misc3_dev  = 1264,
        c_misc4_dev  = 1264,
        c_misc5_dev  = 1264
        log on c_log1_dev =  4000,
        c_log2_dev =  4000
        FOR LOAD
    go
```

segment.sql

```
    /*  TPC-C Benchmark Kit                                 */
    /*                                                      */
    /*  SEGMENT.SQL                                         */
    /*                                                      */
    /*  This script is used to create the database segments */
    use tpcc
    go
    exec sp_addsegment misc_seg, c_misc1_dev
```

```
exec sp_extendsegment misc_seg, c_misc2_dev
exec sp_extendsegment misc_seg, c_misc3_dev
exec sp_extendsegment misc_seg, c_misc4_dev
exec sp_extendsegment misc_seg, c_misc5_dev
exec sp_addsegment ordln_seg, c_ordln1_dev
exec sp_extendsegment ordln_seg, c_ordln2_dev
exec sp_extendsegment ordln_seg, c_ordln3_dev
exec sp_extendsegment ordln_seg, c_ordln4_dev
exec sp_extendsegment ordln_seg, c_ordln5_dev
exec sp_addsegment cs_seg, c_cs1_dev
exec sp_extendsegment cs_seg, c_cs2_dev
exec sp_extendsegment cs_seg, c_cs3_dev
exec sp_extendsegment cs_seg, c_cs4_dev
exec sp_extendsegment cs_seg, c_cs5_dev
go
```

tables.sql

```
/*  TPC-C Benchmark
Kit                                                 */
/*
             */
/*
TABLES.SQL
         */
/*
             */
/*  Creates TPC-C tables
(seg)                                               */
use tpcc
go
checkpoint
go
if exists ( select name from sysobjects where name =
'warehouse' )
    drop table warehouse
go
create table warehouse
(
    w_idsmallint,
    w_namechar(10),
    w_street_1char(20),
    w_street_2char(20),
    w_citychar(20),
    w_statechar(2),
    w_zipchar(9),
    w_taxnumeric(4,4),
    w_ytdnumeric(12,2)
) on misc_seg
go
if exists ( select name from sysobjects where name =
'district' )
    drop table district
go
create table district
(
    d_idtinyint,
    d_w_idsmallint,
    d_namechar(10),
    d_street_1char(20),
    d_street_2char(20),
    d_citychar(20),
    d_statechar(2),
    d_zipchar(9),
    d_taxnumeric(4,4),
    d_ytdnumeric(12,2),
    d_next_o_idint
) on misc_seg
go
if exists ( select name from sysobjects where name =
'customer' )
    drop table customer
go
create table customer
(
    c_idint,
    c_d_idtinyint,
    c_w_idsmallint,
    c_firstchar(16),
    c_middlechar(2),
    c_lastchar(16),
    c_street_1char(20),
    c_street_2char(20),
```

```
    c_citychar(20),
    c_statechar(2),
    c_zipchar(9),
    c_phonechar(16),
    c_sincedatetime,
    c_creditchar(2),
    c_credit_limnumeric(12,2),
    c_discountnumeric(4,4),
    c_balancenumeric(12,2),
    c_ytd_paymentnumeric(12,2),
    c_payment_cntsmallint,
    c_delivery_cntsmallint,
    c_data_1char(250),
    c_data_2char(250)
) on cs_seg
go
if exists ( select name from sysobjects where name =
'history' )
    drop table history
go
create table history
(
    h_c_idint,
    h_c_d_idtinyint,
    h_c_w_idsmallint,
    h_d_idtinyint,
    h_w_idsmallint,
    h_datedatetime,
    h_amountnumeric(6,2),
    h_datachar(24)
) on misc_seg
go
if exists ( select name from sysobjects where name =
'new_order' )
    drop table new_order
go
create table new_order
(
    no_o_idint,
    no_d_idtinyint,
    no_w_idsmallint
) on misc_seg
go
if exists ( select name from sysobjects where name =
'orders' )
    drop table orders
go
create table orders
(
    o_idint,
    o_d_idtinyint,
    o_w_idsmallint,
    o_c_idint,
    o_entry_ddatetime,
    o_carrier_idtinyint,
    o_ol_cnttinyint,
    o_all_localtinyint
) on misc_seg
go
if exists ( select name from sysobjects where name =
'order_line' )
    drop table order_line
go
create table order_line
(
    ol_o_idint,
    ol_d_idtinyint,
    ol_w_idsmallint,
    ol_numbertinyint,
    ol_i_idint,
    ol_supply_w_idsmallint,
    ol_delivery_ddatetime,
    ol_quantitysmallint,
    ol_amountnumeric(6,2),
    ol_dist_infochar(24)
) on ordln_seg
go
if exists ( select name from sysobjects where name = 'item'
)
    drop table item
go
create table item
(
    i_idint,
```

```
    i_im_idint,
    i_namechar(24),
    i_pricenumeric(5,2),
    i_datachar(50)
) on misc_seg
go
if exists ( select name from sysobjects where name =
'stock' )
    drop table stock
go
create table stock
(
    s_i_idint,
    s_w_idsmallint,
    s_quantitysmallint,
    s_dist_01char(24),
    s_dist_02char(24),
    s_dist_03char(24),
    s_dist_04char(24),
    s_dist_05char(24),
    s_dist_06char(24),
    s_dist_07char(24),
    s_dist_08char(24),
    s_dist_09char(24),
    s_dist_10char(24),
    s_ytdint,
    s_order_cntsmallint,
    s_remote_cntsmallint,
    s_datachar(50)
) on cs_seg
go
```

idxwarcl.sql

```
/*  TPC-C Benchmark
Kit                                                 */
/*
            */
/*
IDXWARCL.SQL
         */
/*
            */
/*  Creates clustered index on warehouse
(seg)                           */
use tpcc
go
if exists ( select name from sysindexes where name =
'warehouse_c1' )
    drop index warehouse.warehouse_c1
go
select getdate()
go
create unique clustered index warehouse_c1 on
warehouse(w_id)
    with fillfactor=1 on misc_seg
go
select getdate()
go
```

idxdiscl.sql

```
/*  TPC-C Benchmark
Kit                                                 */
/*
            */
/*
IDXDISCL.SQL
         */
/*
            */
/*  Creates clustered index on district
(seg)                           */
use tpcc
go
if exists ( select name from sysindexes where name =
'district_c1' )
    drop index district.district_c1
go
select getdate()
go
create unique clustered index  district_c1 on
district(d_w_id, d_id)
    with fillfactor=1 on misc_seg
```

```
go
select getdate()
go
```

idxcuscl.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXCUSCL.SQL
         */
/*
             */
/*  Creates clustered index on customer
(seg)                              */
use tpcc
go
if exists ( select name from sysindexes where name =
'customer_c1' )
    drop index customer.customer_c1
go
select getdate()
go
create unique clustered index customer_c1 on
customer(c_w_id, c_d_id, c_id)
    with sorted_data on cs_seg
go
select getdate()
go
```

idxodlcl.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXODLCL.SQL
         */
/*
             */
/*  Creates clustered index on order-line
(seg)                              */
use tpcc
go
if exists ( select name from sysindexes where  name =
'order_line_c1' )
    drop index order_line.order_line_c1
go
select getdate()
go
create unique clustered index order_line_c1 on
order_line(ol_w_id, ol_d_id, ol_o_id, ol_number)
    with sorted_data on ordln_seg
go
select getdate()
go
```

idxordcl.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXORDCL.SQL
         */
/*
             */
/*  Creates clustered index on orders
(seg)                                */
use tpcc
go
if exists ( select name from sysindexes where  name =
'orders_c1' )
    drop index orders.orders_c1
go
select getdate()
go
create unique clustered index orders_c1 on orders(o_w_id,
o_d_id, o_id)
    with sorted_data on misc_seg
```

```
go
select getdate()
go
```

idxnodcl.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXNODCL.SQL
          */
/*
             */
/*  Creates clustered index on new-order
(seg)                          */
use tpcc
go
if exists ( select name from sysindexes where  name =
'new_order_c1' )
    drop index new_order.new_order_c1
go
select getdate()
go
create unique clustered index new_order_c1 on
new_order(no_w_id, no_d_id, no_o_id)
    with sorted_data on misc_seg
go
select getdate()
go
```

idxstkcl.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXSTKCL.SQL
          */
/*
             */
/*  Creates clustered index on stock
(seg)                                */
use tpcc
go
if exists ( select name from sysindexes where  name =
'stock_c1' )
    drop index stock.stock_c1
go
select getdate()
go
create unique clustered index stock_c1 on stock(s_i_id,
s_w_id)
    with sorted_data on cs_seg
go
select getdate()
go
```

idxitmcl.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXITMCL.SQL
          */
/*
             */
/*  Creates clustered index on item
(seg)                                */
use tpcc
go
if exists ( select name from sysindexes where  name =
'item_c1' )
    drop index item.item_c1
go
select getdate()
go
create unique clustered index item_c1 on item(i_id)
    with sorted_data on misc_seg
go
select getdate()
go
```

idxcusnc.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
IDXCUSNC.SQL
         */
/*
             */
/*  Creates non-clustered index on customer
(seg)                          */
use tpcc
go
if exists ( select name from sysindexes where  name =
'customer_nc1' )
    drop index customer.customer_nc1
go
select getdate()
go
create unique nonclustered index customer_nc1 on
customer(c_w_id, c_d_id, c_last, c_first, c_id)
    on cs_seg
go
select getdate()
go
```

dbopt1.sql

```
/*  TPC-C Benchmark
Kit                                                    */
/*
             */
/*
DBOPT1.SQL
          */
/*
             */
/*  Set database options for database
load                                */
use master
go
sp_dboption tpcc,'select into/bulkcopy',true
go
sp_dboption tpcc,'trunc. log on chkpt.',true
go
use tpcc
go
checkpoint
go
use tpcc_admin
go
sp_dboption tpcc,'trunc. log on chkpt.',true
go
```

tpccirl.sql

```
/*  TPC-C Benchmark
Kit                                                          */
/*
                 */
/*
TPCCIRL.SQL
              */
/*
                 */
/*  This script file sets the insert row lock option on
selected tables       */
use tpcc
go
exec sp_tableoption "history","insert row lock",true
exec sp_tableoption "new_order","insert row lock",true
exec sp_tableoption "orders","insert row lock",true
exec sp_tableoption "order_line","insert row lock",true
go
```

neword.sql

```
/*  File:
NEWORD.SQL
*/
```

```
/*              Microsoft TPC-C Kit Ver.
3.00.000                            */
/*              Audited 08/23/96, By Francois
Raab                           */
/*
               */
/*              Copyright Microsoft,
1996                                */
/*
               */
/*  Purpose:    New-Order transaction for Microsoft TPC-C
Benchmark Kit    */
/*  Author:     Damien
Lindauer                                            */
/*
damienl@Microsoft.com
*/
use tpcc
go
/* new-order transaction stored procedure */
if exists ( select name from sysobjects where name =
"tpcc_neworder" )
    drop procedure tpcc_neworder
go
/*  Modified by rick vicik, 2/4/97  */
/*  Combined initialization of local variables into
district update statement  */
/*  Combined 3 huge case select statements into a single
one  */
create proc tpcc_neworder
    @w_id           smallint,
    @d_id           tinyint,
    @c_id           int,
    @o_ol_cnt       tinyint,
    @o_all_local    tinyint,
    @i_id1  int = 0, @s_w_id1 smallint = 0, @ol_qty1
smallint = 0,
    @i_id2  int = 0, @s_w_id2 smallint = 0, @ol_qty2
smallint = 0,
    @i_id3  int = 0, @s_w_id3 smallint = 0, @ol_qty3
smallint = 0,
    @i_id4  int = 0, @s_w_id4 smallint = 0, @ol_qty4
smallint = 0,
    @i_id5  int = 0, @s_w_id5 smallint = 0, @ol_qty5
smallint = 0,
    @i_id6  int = 0, @s_w_id6 smallint = 0, @ol_qty6
smallint = 0,
    @i_id7  int = 0, @s_w_id7 smallint = 0, @ol_qty7
smallint = 0,
    @i_id8  int = 0, @s_w_id8 smallint = 0, @ol_qty8
smallint = 0,
    @i_id9  int = 0, @s_w_id9 smallint = 0, @ol_qty9
smallint = 0,
    @i_id10 int = 0, @s_w_id10 smallint = 0, @ol_qty10
smallint = 0,
    @i_id11 int = 0, @s_w_id11 smallint = 0, @ol_qty11
smallint = 0,
    @i_id12 int = 0, @s_w_id12 smallint = 0, @ol_qty12
smallint = 0,
    @i_id13 int = 0, @s_w_id13 smallint = 0, @ol_qty13
smallint = 0,
    @i_id14 int = 0, @s_w_id14 smallint = 0, @ol_qty14
smallint = 0,
    @i_id15 int = 0, @s_w_id15 smallint = 0, @ol_qty15
smallint = 0

as
declare @w_tax          numeric(4,4),
        @d_tax          numeric(4,4),
        @c_last         char(16),
        @c_credit       char(2),
        @c_discount     numeric(4,4),
        @i_price        numeric(5,2),
        @i_name         char(24),
        @i_data         char(50),
        @o_entry_d      datetime,
        @remote_flag    int,
        @s_quantity     smallint,
        @s_data         char(50),
        @s_dist         char(24),
    @li_no          int,
    @o_idint,
    @commit_flag    int,
        @li_id          int,
        @li_s_w_id      smallint,
        @li_qty         smallint,
    @ol_numberint,
    @c_id_localint
```

```
begin
begin transaction n
/*  get district tax and next availible order id and update
*/
/*  plus initialize local variables  */
    update district
    set @d_tax      = d_tax,
        @o_id       = d_next_o_id,
    d_next_o_id = d_next_o_id + 1,
        @o_entry_d = getdate(),
        @li_no=0,
        @commit_flag = 1
        where d_w_id = @w_id and
              d_id   = @d_id
    /*  process orderlines */
    while (@li_no < @o_ol_cnt)
    begin
        select @li_no = @li_no + 1
        /*  Set i_id, s_w_id, and qty for this lineitem */
        select @li_id = case @li_no
                when 1 then @i_id1
        when 2 then @i_id2
        when 3 then @i_id3
        when 4 then @i_id4
        when 5 then @i_id5
        when 6 then @i_id6
        when 7 then @i_id7
        when 8 then @i_id8
        when 9 then @i_id9
        when 10 then @i_id10
        when 11 then @i_id11
        when 12 then @i_id12
        when 13 then @i_id13
        when 14 then @i_id14
        when 15 then @i_id15
        end,
        @li_s_w_id = case @li_no
        when 1 then @s_w_id1
        when 2 then @s_w_id2
        when 3 then @s_w_id3
        when 4 then @s_w_id4
        when 5 then @s_w_id5
        when 6 then @s_w_id6
        when 7 then @s_w_id7
        when 8 then @s_w_id8
        when 9 then @s_w_id9
        when 10 then @s_w_id10
        when 11 then @s_w_id11
        when 12 then @s_w_id12
        when 13 then @s_w_id13
        when 14 then @s_w_id14
        when 15 then @s_w_id15
        end,
         @li_qty = case  @li_no
        when 1 then @ol_qty1
        when 2 then @ol_qty2
        when 3 then @ol_qty3
        when 4 then @ol_qty4
        when 5 then @ol_qty5
        when 6 then @ol_qty6
        when 7 then @ol_qty7
        when 8 then @ol_qty8
        when 9 then @ol_qty9
        when 10 then @ol_qty10
        when 11 then @ol_qty11
        when 12 then @ol_qty12
        when 13 then @ol_qty13
        when 14 then @ol_qty14
        when 15 then @ol_qty15
        end
         /* get item data (no one updates item) */
         select @i_price = i_price,
                @i_name  = i_name,
                @i_data  = i_data
         from item (tablock holdlock)
         where i_id = @li_id
        /* if there actually is an item with this id, go to
work */

      if (@@rowcount > 0)
       begin
            update stock set s_ytd        = s_ytd + @li_qty,
```

```
                                @s_quantity  = s_quantity,
                                s_quantity   = s_quantity -
@li_qty +
                                    case when (s_quantity -
@li_qty < 10) then 91 else 0 end,
                                s_order_cnt  = s_order_cnt + 1,
                                s_remote_cnt = s_remote_cnt +
case
                                    when (@li_s_w_id = @w_id)
then 0 else 1 end,
                                @s_data      = s_data,
                                @s_dist      = case @d_id
                            when 1  then s_dist_01
                                when 2  then s_dist_02
                                when 3  then s_dist_03
                                when 4  then s_dist_04
                                when 5  then s_dist_05
                                when 6  then s_dist_06
                                when 7  then s_dist_07
                                when 8  then s_dist_08
                                when 9  then s_dist_09
                                when 10 then s_dist_10
                                        end
              where s_i_id = @li_id and
            s_w_id = @li_s_w_id
       /* insert order_line data (using data from item and
stock) */
              insert into order_line
values(@o_id,                /* from district update */
                                            @d_id,      /*
input param          */

@w_id,               /* input param          */

@li_no,              /* orderline number     */

@li_id,              /* lineitem id          */

@li_s_w_id,          /* lineitem warehouse   */
                                           "jan 1,
1900",      /* constant             */

@li_qty,             /* lineitem qty         */
                                                 @i_price *
@li_qty, /* ol_amount            */

@s_dist)             /* from stock           */

              /* send line-item data to client */

           select @i_name,
                       @s_quantity,
                       b_g = case when (
(patindex("%ORIGINAL%",@i_data) > 0) and

(patindex("%ORIGINAL%",@s_data) > 0) )
                              then "B" else "G" end,
                       @i_price,
                       @i_price * @li_qty

           end
           else
       begin

           /*  no item found - triggers rollback condition
*/

       select "",0,"",0,0
       select @commit_flag = 0

       end
       end
       /* get customer last name, discount, and credit rating
*/
       select @c_last     = c_last,
              @c_discount = c_discount,
              @c_credit   = c_credit,
          @c_id_local = c_id
       from customer holdlock
       where c_id   = @c_id and
             c_w_id = @w_id and
             c_d_id = @d_id
       /* insert fresh row into orders table */
       insert into orders values (@o_id,
                             @d_id,
```

```
                    @w_id,
                @c_id_local,
                @o_entry_d,
                0,
                @o_ol_cnt,
                @o_all_local)
    /* insert corresponding row into new-order table */
    insert into new_order values (@o_id,
      @d_id,
      @w_id)
    /*  select warehouse tax */
    select @w_tax = w_tax
    from warehouse holdlock
    where w_id = @w_id
    if (@commit_flag = 1)
    commit transaction n
    else
    /* all that work for nuthin!!! */
    rollback transaction n
    /* return order data to client */
    select @w_tax,
           @d_tax,
       @o_id,
       @c_last,
       @c_discount,
       @c_credit,
       @o_entry_d,
       @commit_flag
end
go
```

payment.sql

```
/*  File:
PAYMENT.SQL
*/
/*              Microsoft TPC-C Kit Ver.
3.00.000                          */
/*              Audited 08/23/96, By Francois
Raab                         */
/*
              */
/*              Copyright Microsoft,
1996                                  */
/*
             */
/*  Purpose:    Payment transaction for Microsoft TPC-C
Benchmark Kit      */
/*  Author:     Damien
Lindauer                                              */
/*
damienl@Microsoft.com
*/
use tpcc
go
if exists (select name from sysobjects where name =
"tpcc_payment" )
   drop procedure tpcc_payment
go
create proc tpcc_payment @w_id           smallint,
     @c_w_id         smallint,
     @h_amount       numeric(6,2),
     @d_id           tinyint,
     @c_d_id         tinyint,
     @c_id           int,
     @c_last         char(16) = ""


as
declare  @w_street_1     char(20),
         @w_street_2     char(20),
         @w_city         char(20),
         @w_state        char(2),
         @w_zip          char(9),
         @w_name         char(10),
         @d_street_1     char(20),
         @d_street_2     char(20),
         @d_city         char(20),
         @d_state        char(2),
         @d_zip          char(9),
         @d_name         char(10),
         @c_first        char(16),
         @c_middle       char(2),
         @c_street_1     char(20),
         @c_street_2     char(20),
```

```
        @c_city         char(20),
        @c_state        char(2),
        @c_zip          char(9),
        @c_phone        char(16),
        @c_since        datetime,
        @c_credit       char(2),
        @c_credit_lim   numeric(12,2),
        @c_balance      numeric(12,2),
        @c_discount     numeric(4,4),
        @data1          char(250),
        @data2          char(250),
        @c_data_1       char(250),
        @c_data_2       char(250),
        @datetime       datetime,
        @w_ytd          numeric(12,2),
        @d_ytd          numeric(12,2),
        @cnt            smallint,
        @val            smallint,
        @screen_data char(200),
    @d_id_local tinyint,
    @w_id_local smallint,
    @c_id_local int
select @screen_data = ""
begin tran p

    /* get payment date */
    select @datetime = getdate()

    if (@c_id = 0)
    begin
    /* get customer id and info using last name */
    select @cnt = count(*)
    from customer holdlock
    where c_last = @c_last and
          c_w_id = @c_w_id and
          c_d_id = @c_d_id

    select @val = (@cnt + 1) / 2
    set rowcount @val
    select @c_id = c_id
    from customer holdlock
    where c_last = @c_last and
          c_w_id = @c_w_id and
          c_d_id = @c_d_id
    order by c_w_id, c_d_id, c_last, c_first
    set rowcount 0
    end

    /* get customer info and update balances */

    update customer set
    @c_balance     = c_balance = c_balance - @h_amount,
    c_payment_cnt  = c_payment_cnt + 1,
    c_ytd_payment  = c_ytd_payment + @h_amount,
    @c_first       = c_first,
    @c_middle      = c_middle,
        @c_last        = c_last,
        @c_street_1    = c_street_1,
    @c_street_2    = c_street_2,
    @c_city        = c_city,
    @c_state       = c_state,
    @c_zip         = c_zip,
    @c_phone       = c_phone,
    @c_credit      = c_credit,
    @c_credit_lim  = c_credit_lim,
    @c_discount    = c_discount,
    @c_since       = c_since,
    @data1         = c_data_1,
    @data2         = c_data_2,
    @c_id_local    = c_id
    where c_id   = @c_id and
          c_w_id = @c_w_id and
          c_d_id = @c_d_id

    /* if customer has bad credit get some more info */
    if (@c_credit = "BC")
    begin
    /* compute new info */
    select @c_data_2 = substring(@data1,209,42) +
       substring(@data2, 1, 208)
    select @c_data_1 = convert(char(5),@c_id) +
       convert(char(4),@c_d_id) +
```

```
            convert(char(5),@c_w_id) +
            convert(char(4),@d_id) +
            convert(char(5),@w_id) +
            convert(char(19),@h_amount) +
            substring(@data1, 1, 208)
/* update customer info */
update customer set
       c_data_1 = @c_data_1,
   c_data_2 = @c_data_2
where c_id   = @c_id and
  c_w_id = @c_w_id and
      c_d_id = @c_d_id
select @screen_data = substring (@c_data_1,1,200)
end



/* get district data and update year-to-date */

update district
set d_ytd       = d_ytd + @h_amount,
@d_street_1 = d_street_1,
@d_street_2 = d_street_2,
@d_city     = d_city,
@d_state    = d_state,
@d_zip      = d_zip,
@d_name     = d_name,
@d_id_local = d_id
where d_w_id = @w_id and
      d_id   = @d_id
/* get warehouse data and update year-to-date */
update warehouse
set w_ytd       = w_ytd + @h_amount,
@w_street_1 = w_street_1,
    @w_street_2 = w_street_2,
    @w_city     = w_city,
    @w_state    = w_state,
    @w_zip      = w_zip,
    @w_name     = w_name,
@w_id_local = w_id
where w_id = @w_id


    /* create history record */

    insert into history values  (@c_id_local,
         @c_d_id,
     @c_w_id,
     @d_id_local,
     @w_id_local,
     @datetime,
     @h_amount,
     @w_name + "    " + @d_name)
commit tran p
/* return data to client */
select  @c_id,
    @c_last,
    @datetime,
    @w_street_1,
    @w_street_2,
    @w_city,
    @w_state,
    @w_zip,
    @d_street_1,
    @d_street_2,
    @d_city,
    @d_state,
    @d_zip,
    @c_first,
    @c_middle,
    @c_street_1,
    @c_street_2,
    @c_city,
    @c_state,
    @c_zip,
    @c_phone,
    @c_since,
    @c_credit,
    @c_credit_lim,
    @c_discount,
    @c_balance,
    @screen_data
go
```

ordstat.sql

```
    /*  File:
    ORDSTAT.SQL
    */
    /*              Microsoft TPC-C Kit Ver.
    3.00.000                            */
    /*              Audited 08/23/96, By Francois
    Raab                            */
    /*
                    */
    /*              Copyright Microsoft,
    1996                                    */
    /*
                    */
    /*  Purpose:    Order-Status transaction for Microsoft TPC-
    C Benchmark Kit  */
    /*  Author:     Damien
    Lindauer                                                */
    /*
    damienl@Microsoft.com
    */
    use tpcc
    go
    if exists ( select name from sysobjects where name =
    "tpcc_orderstatus" )
        drop procedure   tpcc_orderstatus
    go
    /*  Modified by rick vicik, 2/4/97  */
    /*  Eliminated @val local variable  */
    create proc tpcc_orderstatus @w_idsmallint,
         @d_idtinyint,
         @c_idint,
         @c_lastchar(16) = ""

    as
    declare @c_balancenumeric(12,2),
            @c_firstchar(16),
            @c_middlechar(2),
            @o_idint,
            @o_entry_ddatetime,
            @o_carrier_idsmallint,
            @cntsmallint
    begin tran o
        if (@c_id = 0)
        begin
        /* get customer id and info using last name */
        select @cnt = (count(*)+1)/2
        from customer holdlock
        where c_last = @c_last and
              c_w_id = @w_id and
                c_d_id = @d_id
        set rowcount @cnt
        select @c_id = c_id,
           @c_balance = c_balance,
           @c_first   = c_first,
           @c_last    = c_last,
           @c_middle  = c_middle
        from customer holdlock
        where c_last = @c_last and
              c_w_id = @w_id and
                c_d_id = @d_id
        order by c_w_id, c_d_id, c_last, c_first
        set rowcount 0
        end

        else
        begin
        /*  get customer info if by id*/
        select @c_balance = c_balance,
               @c_first   = c_first,
               @c_middle  = c_middle,
               @c_last    = c_last
        from customer holdlock
        where c_id   = @c_id and
              c_d_id = @d_id and
              c_w_id = @w_id
        select @cnt = @@rowcount
        end

        /* if no such customer */
        if (@cnt = 0)
        begin
```

```
    raiserror("Customer not found",18,1)
    goto custnotfound
    end

    /*  get order info */
    select @o_id = o_id,
       @o_entry_d    = o_entry_d,
          @o_carrier_id = o_carrier_id
    from orders holdlock
    where o_w_id = @w_id and
          o_d_id = @d_id and
           o_c_id = @c_id
    /*  select order lines for the current order */
    select ol_supply_w_id,
          ol_i_id,
           ol_quantity,
           ol_amount,
           ol_delivery_d
    from order_line holdlock
    where ol_o_id = @o_id and
          ol_d_id = @d_id and
          ol_w_id = @w_id
custnotfound:

commit tran o
/*  return data to client  */
select @c_id,
       @c_last,
       @c_first,
       @c_middle,
       @o_entry_d,
       @o_carrier_id,
       @c_balance,
       @o_id
go
```

delivery.sql

```
    /*  File:
    DELIVERY.SQL
    */
    /*              Microsoft TPC-C Kit Ver.
    3.00.000                          */
    /*              Audited 08/23/96, By Francois
    Raab                          */
    /*
                  */
    /*              Copyright Microsoft,
    1996                                */
    /*
                  */
    /*  Purpose:    Delivery transaction for Microsoft TPC-C
    Benchmark Kit     */
    /*  Author:     Damien
    Lindauer                                          */
    /*
    damienl@Microsoft.com
    */
    use tpcc
    go
    /* delivery transaction */
    if exists (select name from sysobjects where name =
    "tpcc_delivery" )
        drop procedure tpcc_delivery
    go
    create proc tpcc_delivery@w_id           smallint,
        @o_carrier_id   smallint
    as
    declare @d_id tinyint,
            @o_id int,
            @c_id int,
            @total numeric(12,2),
            @oid1 int,
            @oid2 int,
            @oid3 int,
            @oid4 int,
            @oid5 int,
            @oid6 int,
            @oid7 int,
            @oid8 int,
            @oid9 int,
            @oid10 int
    select @d_id = 0
    begin tran d
```

```
    while (@d_id < 10)
    begin
        select @d_id  = @d_id + 1,
               @total = 0,
               @o_id  = 0
        select @o_id = min(no_o_id)
        from new_order holdlock
        where no_w_id = @w_id and
          no_d_id = @d_id
        if (@@rowcount <> 0)
        begin
            /* claim the order for this district */
            delete new_order
            where no_w_id = @w_id and
              no_d_id = @d_id and
          no_o_id = @o_id
            /* set carrier_id on this order (and get
customer id) */
            update orders
        set o_carrier_id = @o_carrier_id,
                @c_id        = o_c_id
            where o_w_id = @w_id and
              o_d_id = @d_id and
          o_id   = @o_id
            /* set date in all lineitems for this order
(and sum amounts) */
            update order_line
        set ol_delivery_d = getdate(),
                @total       = @total + ol_amount
            where ol_w_id = @w_id and
                  ol_d_id = @d_id and
          ol_o_id = @o_id
            /* accummulate lineitem amounts for this order
into customer */

        update customer
    set c_balance      = c_balance + @total,
        c_delivery_cnt = c_delivery_cnt + 1
            where c_w_id = @w_id and
              c_d_id = @d_id and
          c_id   = @c_id
        end
```

```
        select @oid1 = case @d_id when  1  then @o_id else
    @oid1 end,
                   @oid2 = case @d_id when  2  then @o_id else
    @oid2 end,
                   @oid3 = case @d_id when  3  then @o_id else
    @oid3 end,
                   @oid4 = case @d_id when  4  then @o_id else
    @oid4 end,
                   @oid5 = case @d_id when  5  then @o_id else
    @oid5 end,
                   @oid6 = case @d_id when  6  then @o_id else
    @oid6 end,
                   @oid7 = case @d_id when  7  then @o_id else
    @oid7 end,
                   @oid8 = case @d_id when  8  then @o_id else
    @oid8 end,
                   @oid9 = case @d_id when  9  then @o_id else
    @oid9 end,
                   @oid10 = case @d_id when 10 then @o_id else
    @oid10 end
        end
    commit tran d

    select @oid1,
           @oid2,
           @oid3,
           @oid4,
           @oid5,
           @oid6,
           @oid7,
           @oid8,
           @oid9,
           @oid10
    go
```

stocklev.sql

```
    /*  File:
    STOCKLEV.SQL
    */
    /*              Microsoft TPC-C Kit Ver.
    3.00.000                              */
    /*              Audited 08/23/96, By Francois
    Raab                          */
```

```
/*
              */
/*              Copyright Microsoft,
1996                                  */
/*
              */
/*  Purpose:    Stock-Level transaction for Microsoft TPC-C
Benchmark Kit  */
/*  Author:     Damien
Lindauer                                          */
/*
damienl@Microsoft.com
*/
use tpcc
go
/* stock-level transaction stored procedure */
if exists (select name from sysobjects where name =
"tpcc_stocklevel" )
    drop procedure tpcc_stocklevel
go
/* Modified by rick vicik, 2/4/97 */
/* Eliminate 1 local variable, use derived table to
eliminate duplicate item#'s */
create proc tpcc_stocklevel@w_id        smallint,
    @d_id        tinyint,
    @threshhold smallint
as
declare @o_id int
select @o_id = d_next_o_id
from district
where d_w_id = @w_id and
      d_id   = @d_id
select count(*) from stock,
    (select distinct(ol_i_id) from order_line
     where ol_w_id    =  @w_id and
           ol_d_id    =  @d_id and
           ol_o_id between (@o_id-20) and (@o_id-1)) OL
where s_w_id     =  @w_id and
      s_i_id     =  OL.ol_i_id and
      s_quantity <  @threshhold
go
```

dbopt2.sql

```
    /*  TPC-C Benchmark
    Kit                                                  */
    /*
                */
    /*
    DBOPT2.SQL
             */
    /*
                */
    /*  Reset database options after database
    load                            */
    use master
    go
    sp_dboption tpcc,'select ',false
    go
    sp_dboption tpcc,'trunc. ',false
    go
    use tpcc
    go
    checkpoint
    go
```

pintable.sql

```
    /*  TPC-C Benchmark
    Kit                                                  */
    /*
                    */
    /*
    PINTABLE.SQL
                 */
    /*
                    */
    /*  This script file is used to 'pin' certain tables in the
    data cache        */
    use tpcc
    go
    exec sp_tableoption "district","pintable",true
    exec sp_tableoption "warehouse","pintable",true
    exec sp_tableoption "new_order","pintable",true
    exec sp_tableoption "item","pintable",true
```

```
    go
```

tmakefile.x86

```
    !include $(TPC_DIR)\build\ntintel\tpc.inc

    CUR_DIR = $(TPC_DIR)\src

    CLIENT_EXE     = $(EXE_DIR)\client.exe
    MASTER_EXE     = $(EXE_DIR)\master.exe
    TPCCLDR_EXE    = $(EXE_DIR)\tpccldr.exe
    DELIVERY_EXE   = $(EXE_DIR)\delivery.exe
    sqlstat_EXE    = $(EXE_DIR)\sqlstat.exe

    all : $(CLIENT_EXE) $(MASTER_EXE) $(TPCCLDR_EXE)
    $(DELIVERY_EXE) $(sqlstat_EXE)

    $(OBJ_DIR)\client.obj : $(CUR_DIR)\client.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\client.obj
    $(CUR_DIR)\client.c

    $(OBJ_DIR)\master.obj : $(CUR_DIR)\master.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\master.obj
    $(CUR_DIR)\master.c

    $(OBJ_DIR)\tpccldr.obj : $(CUR_DIR)\tpccldr.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\tpccldr.obj
    $(CUR_DIR)\tpccldr.c

    $(OBJ_DIR)\stats.obj : $(CUR_DIR)\stats.c $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\stats.obj
    $(CUR_DIR)\stats.c

    $(OBJ_DIR)\getargs.obj : $(CUR_DIR)\getargs.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\getargs.obj
    $(CUR_DIR)\getargs.c

    $(OBJ_DIR)\util.obj : $(CUR_DIR)\util.c  $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\util.obj $(CUR_DIR)\util.c

    $(OBJ_DIR)\time.obj : $(CUR_DIR)\time.c $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\time.obj $(CUR_DIR)\time.c

    $(OBJ_DIR)\random.obj : $(CUR_DIR)\random.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\random.obj
    $(CUR_DIR)\random.c

    $(OBJ_DIR)\strings.obj : $(CUR_DIR)\strings.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\strings.obj
    $(CUR_DIR)\strings.c

    $(OBJ_DIR)\sqlfuncs.obj : $(CUR_DIR)\sqlfuncs.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\sqlfuncs.obj
    $(CUR_DIR)\sqlfuncs.c

    $(OBJ_DIR)\tran.obj : $(CUR_DIR)\tran.c  $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\tran.obj $(CUR_DIR)\tran.c

    $(OBJ_DIR)\data.obj : $(CUR_DIR)\data.c  $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\data.obj $(CUR_DIR)\data.c

    $(OBJ_DIR)\delivery.obj : $(CUR_DIR)\delivery.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\delivery.obj
    $(CUR_DIR)\delivery.c

    $(OBJ_DIR)\sqlstat.obj : $(CUR_DIR)\sqlstat.c
    $(INC_DIR)\tpcc.h
        $(CC) $(CFLAGS) /Fo$(OBJ_DIR)\sqlstat.obj
    $(CUR_DIR)\sqlstat.c

    $(EXE_DIR)\client.exe : $(OBJ_DIR)\client.obj
    $(OBJ_DIR)\tran.obj $(OBJ_DIR)\sqlfuncs.obj
    $(OBJ_DIR)\random.obj $(OBJ_DIR)\util.obj
    $(OBJ_DIR)\data.obj $(OBJ_DIR)\getargs.obj
    $(OBJ_DIR)\time.obj $(OBJ_DIR)\stats.obj
    $(OBJ_DIR)\strings.obj
        $(LL) -entry:mainCRTStartup -
    out:$(EXE_DIR)\client.exe                \
        $(OBJ_DIR)\client.obj $(OBJ_DIR)\tran.obj
    $(OBJ_DIR)\sqlfuncs.obj   \
```

```
    $(OBJ_DIR)\random.obj $(OBJ_DIR)\util.obj
$(OBJ_DIR)\data.obj       \
    $(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj      \

$(OBJ_DIR)\strings.obj
          \
    $(DB_LIB)\ntwdblib.lib $(NTLIBS)


$(EXE_DIR)\master.exe : $(OBJ_DIR)\master.obj
$(OBJ_DIR)\sqlfuncs.obj $(OBJ_DIR)\util.obj
$(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj
    $(LL) -entry:mainCRTStartup -
out:$(EXE_DIR)\master.exe              \
    $(OBJ_DIR)\master.obj $(OBJ_DIR)\sqlfuncs.obj
$(OBJ_DIR)\util.obj   \
    $(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj   \
    $(DB_LIB)\ntwdblib.lib $(NTLIBS)


$(EXE_DIR)\tpccldr.exe : $(OBJ_DIR)\tpccldr.obj
$(OBJ_DIR)\getargs.obj $(OBJ_DIR)\util.obj
$(OBJ_DIR)\time.obj $(OBJ_DIR)\random.obj
$(OBJ_DIR)\strings.obj
    $(LL) -entry:mainCRTStartup -
out:$(EXE_DIR)\tpccldr.exe             \
    $(OBJ_DIR)\tpccldr.obj $(OBJ_DIR)\getargs.obj
$(OBJ_DIR)\strings.obj \
    $(OBJ_DIR)\util.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\random.obj        \
    $(DB_LIB)\ntwdblib.lib $(NTLIBS)


$(EXE_DIR)\delivery.exe : $(OBJ_DIR)\delivery.obj
$(OBJ_DIR)\sqlfuncs.obj $(OBJ_DIR)\util.obj
$(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj
    $(LL) -entry:mainCRTStartup -
out:$(EXE_DIR)\delivery.exe                \
    $(OBJ_DIR)\delivery.obj $(OBJ_DIR)\sqlfuncs.obj
$(OBJ_DIR)\util.obj      \
    $(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj      \
    $(DB_LIB)\ntwdblib.lib $(NTLIBS)


$(EXE_DIR)\sqlstat.exe : $(OBJ_DIR)\sqlstat.obj
$(OBJ_DIR)\sqlfuncs.obj $(OBJ_DIR)\util.obj
$(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj
    $(LL) -entry:mainCRTStartup -
out:$(EXE_DIR)\sqlstat.exe                \
    $(OBJ_DIR)\sqlstat.obj $(OBJ_DIR)\sqlfuncs.obj
$(OBJ_DIR)\util.obj      \
    $(OBJ_DIR)\getargs.obj $(OBJ_DIR)\time.obj
$(OBJ_DIR)\stats.obj      \
    $(DB_LIB)\ntwdblib.lib $(NTLIBS)
```

random.c

```
    /*  FILE:RANDOM.C
     *  Microsoft TPC-C Kit Ver. 3.00.000
     *  Audited 08/23/96, By Francois Raab
     *
     *  Copyright Microsoft, 1996
     *
     *  PURPOSE:Random number generation functions for
    Microsoft TPC-C Benchmark Kit
     *  Author:Damien Lindauer
     *  damienl@Microsoft.com
     */
    // Includes
    #include "tpcc.h"
    #include "math.h"
    // Defines
    #define A            16807
    #define M       2147483647
    #define Q           127773      /* M div A */
    #define R             2836      /* M mod A */
    #define Thread __declspec(thread)
    // Globals
    long Thread Seed = 0;       /* thread local seed */
    /************************************************************
    ******************
    *
                    *
    * random
    -
             *
```

```
*       Implements a GOOD pseudo random number generator.
This generator     *
*       will/should? run the complete period before
repeating.                *
*
                  *
* Copied
from:
        *
*       Random Numbers Generators: Good Ones Are Hard to
Find.                *
*       Communications of the ACM - October 1988 Volume 31
Number 10          *
*
                  *
* Machine
Dependencies:
        *
*       long must be 2 ^ 31 - 1 or
greater.                                  *
*
                  *
************************************************************
*****************/
/************************************************************
******************
* seed - load the Seed value used in irand and drand.
Should be used before  *
*       first call to irand or
drand.                                              *
************************************************************
*****************/
void seed(long val)
{

#ifdef DEBUG
    printf("[%ld]DBG: Entering seed()...\n", (int)
GetCurrentThreadId());
    printf("Old Seed %ld New Seed %ld\n",Seed, val);
#endif
    if ( val < 0 )
        val = abs(val);
    Seed = val;
}
```

```
/************************************************************
*****************
*
                  *
* irand - returns a 32 bit integer pseudo random number
with a period of     *
*       1 to 2 ^ 32 -
1.                                                    *
*
                  *
*
parameters:
                *
*
none.
         *
*
                  *
*
returns:
                *
*       32 bit integer - defined as long ( see above
).                        *
*
                  *
* side
effects:
           *
*       seed get
recomputed.
*
************************************************************
*****************/
long irand()
{
    register long    s;      /* copy of seed */
    register long    test;   /* test flag */
    register long    hi;     /* tmp value for speed */
    register long    lo;     /* tmp value for speed */
#ifdef DEBUG
    printf("[%ld]DBG: Entering irand()...\n", (int)
GetCurrentThreadId());
#endif
    s = Seed;
    hi = s / Q;
```

```
    lo = s % Q;
    test = A * lo - R * hi;
    if ( test > 0 )
    Seed = test;
    else
    Seed = test + M;
    return( Seed );
}
/*************************************************************
*****************
*                                                            *
* drand - returns a double pseudo random number between 0.0
and 1.0.          *
*       See
irand.
     *
*************************************************************
****************/
double drand()
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering drand()...\n", (int)
GetCurrentThreadId());
#endif
    return( (double)irand() / 2147483647.0);
}
//=========================================================
=============
// Function   : RandomNumber
//
// Description:
//=========================================================
=============
long RandomNumber(long lower, long upper)
{
    long rand_num;
#ifdef DEBUG
    printf("[%ld]DBG: Entering RandomNumber()...\n", (int)
GetCurrentThreadId());
#endif
    if ( upper == lower )/* pgd 08-13-96 perf enhancement */
    return lower;
    upper++;
    if ( upper <= lower )
    rand_num = upper;
    else
    rand_num = lower + irand() % (upper - lower); /* pgd 08-
13-96 perf enhancement */
#ifdef DEBUG
    printf("[%ld]DBG: RandomNumber between %ld & %ld ==>
%ld\n",
    (int) GetCurrentThreadId(), lower, upper, rand_num);
#endif
    return rand_num;
}
#if 0
//Orginal code pgd 08/13/96
long RandomNumber(long lower,
     long upper)
{
    long rand_num;
#ifdef DEBUG
    printf("[%ld]DBG: Entering RandomNumber()...\n", (int)
GetCurrentThreadId());
#endif
    upper++;
    if ((upper <= lower))
    rand_num = upper;
    else
    rand_num = lower + irand() % ((upper > lower) ? upper -
lower : upper);
#ifdef DEBUG
    printf("[%ld]DBG: RandomNumber between %ld & %ld ==>
%ld\n",
    (int) GetCurrentThreadId(), lower, upper, rand_num);
#endif
    return rand_num;
}
#endif
//=========================================================
=============
// Function   : NURand
//
// Description:
```

```
//=============================================================
=============
long NURand(int iConst,
        long x,
        long y,
        long C)
{
    long rand_num;
#ifdef DEBUG
    printf("[%ld]DBG: Entering NURand()...\n", (int)
GetCurrentThreadId());
#endif

    rand_num = (((RandomNumber(0,iConst) |
RandomNumber(x,y)) + C) % (y-x+1))+x;
#ifdef DEBUG
    printf("[%ld]DBG: NURand: num = %d\n", (int)
GetCurrentThreadId(), rand_num);
#endif
    return rand_num;
}
```

strings.c

```
/*  FILE:STRINGS.C
 *  Microsoft TPC-C Kit Ver. 3.00.000
 *  Audited 08/23/96, By Francois Raab
 *
 *  Copyright Microsoft, 1996
 *
 *  PURPOSE:String generation functions for Microsoft TPC-C
Benchmark Kit
 *  Author:Damien Lindauer
 *  damienl@Microsoft.com
 */
// Includes
#include "tpcc.h"
#include <string.h>
#include <ctype.h>
//=============================================================
=============
//
// Function name: MakeAddress
//
//=============================================================
=============
void MakeAddress(char *street_1,
     char *street_2,
     char *city,
      char *state,
      char *zip)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering MakeAddress()\n", (int)
GetCurrentThreadId());
#endif
    MakeAlphaString (10, 20, ADDRESS_LEN, street_1);
    MakeAlphaString (10, 20, ADDRESS_LEN, street_2);
    MakeAlphaString (10, 20, ADDRESS_LEN, city);
    MakeAlphaString ( 2,  2, STATE_LEN, state);
    MakeZipNumberString( 9,  9, ZIP_LEN, zip);
#ifdef DEBUG
    printf("[%ld]DBG: MakeAddress: street_1: %s, street_2:
%s, city: %s, state: %s, zip: %s\n",
    (int) GetCurrentThreadId(), street_1, street_2, city,
state, zip);
#endif
    return;
}
//=============================================================
=============
//
// Function name: LastName
//
//=============================================================
=============
void LastName(int  num,
          char *name)
{
    inti;
    intlen;
    static char *n[] =
    {
    "BAR" , "OUGHT", "ABLE" , "PRI"  , "PRES",
```

```
    "ESE" , "ANTI" , "CALLY", "ATION", "EING"
    };
#ifdef DEBUG
    printf("[%ld]DBG: Entering LastName()\n", (int)
GetCurrentThreadId());
#endif
    if ((num >= 0) && (num < 1000))
    {
    strcpy(name, n[(num/100)%10]);
    strcat(name, n[(num/10)%10]);
    strcat(name, n[(num/1)%10]);

    if (strlen(name) < LAST_NAME_LEN)
    {
    PaddString(LAST_NAME_LEN, name);
    }
    }
    else
    {
    printf("\nError in LastName()... num <%ld> out of range
(0,999)\n", num);
    exit(-1);
    }

#ifdef DEBUG
    printf("[%ld]DBG: LastName: num = [%d] ==>
[%d][%d][%d]\n",
    (int) GetCurrentThreadId(), num, num/100, (num/10)%10,
num%10);
    printf("[%ld]DBG: LastName: String = %s\n", (int)
GetCurrentThreadId(), name);
#endif
    return;
}
//============================================================
=============
//
// Function name: MakeAlphaString
//
//============================================================
=============
//philipdu 08/13/96 Changed MakeAlphaString to use A-Z, a-
z, and 0-9 in
//accordance with spec see below:
//The spec says:
//4.3.2.2The notation random a-string [x .. y]
//(respectively, n-string [x .. y]) represents a string of
random alphanumeric
//(respectively, numeric) characters of a random length of
minimum x, maximum y,
//and mean (y+x)/2. Alphanumerics are A..Z, a..z, and
0..9.  The only other
//requirement is that the character set used "must be able
to represent a minimum
//of 128 different characters".  We are using 8-bit chars,
so this is a non issue.
//It is completely unreasonable to stuff non-printing chars
into the text fields.
//-CLevine 08/13/96
int MakeAlphaString( int  x, int  y, int  z, char *str)
{
    intlen;
    inti;
    staticchar chArray[] =
"0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvw
xyz";
    staticintchArrayMax = 61;
#ifdef DEBUG
    printf("[%ld]DBG: Entering MakeAlphaString()\n", (int)
GetCurrentThreadId());
#endif
    len= RandomNumber(x, y);
    for (i=0; i<len; i++)
    str[i] = chArray[RandomNumber(0, chArrayMax)];
    if ( len < z )
    memset(str+len, ' ', z - len);
    str[len] = 0;

    return len;
}
#if 0
//philipdu 08/13/96 Orginal MakeAlphaString
int MakeAlphaString( int  x,
         int  y,
     int  z,
         char *str)
```

```
{

    intlen;
    inti;
#ifdef DEBUG
    printf("[%ld]DBG: Entering MakeAlphaString()\n", (int)
GetCurrentThreadId());
#endif
    len= RandomNumber(x, y);
    for (i=0; i<len; i++)
    {
    str[i] = RandomNumber(MINPRINTASCII, MAXPRINTASCII);
    }
    str[len] = '\0';

    if (len < z)
    {
    PaddString(z, str);
    }
    return (len);
}
#endif
//============================================================
=============
//
// Function name: MakeOriginalAlphaString
//
//============================================================
=============
int MakeOriginalAlphaString(int  x,
        int  y,
    int  z,
        char *str,
        int  percent)
{
    intlen;
    intval;
    intstart;
#ifdef DEBUG
    printf("[%ld]DBG: Entering
MakeOriginalAlphaString()\n", (int) GetCurrentThreadId());
#endif
    // verify prercentage is valid
    if ((percent < 0) || (percent > 100))
    {
    printf("MakeOrigianlAlphaString: Invalid percentage:
%d\n", percent);
    exit(-1);
    }
    // verify string is at least 8 chars in length
    if ((x + y) <= 8)
    {
    printf("MakeOriginalAlphaString: string length must be
>= 8\n");
    exit(-1);
    }
    // Make Alpha String
    len = MakeAlphaString(x,y, z, str);
    val = RandomNumber(1,100);
    if (val <= percent)
    {
    start = RandomNumber(0, len - 8);
    strncpy(str + start, "ORIGINAL", 8);
    }

#ifdef DEBUG
    printf("[%ld]DBG: MakeOriginalAlphaString: : %s\n",
    (int) GetCurrentThreadId(), str);
#endif
    return strlen(str);
}
//============================================================
=============
//
// Function name: MakeNumberString
//
//============================================================
=============
int MakeNumberString(int  x, int  y, int  z, char *str)
{
    char tmp[16];
    //MakeNumberString is always called
MakeZipNumberString(16, 16, 16, string)
    memset(str, '0', 16);
```

```
    itoa(RandomNumber(0, 99999999), tmp, 10);
    memcpy(str, tmp, strlen(tmp));
    itoa(RandomNumber(0, 99999999), tmp, 10);
    memcpy(str+8, tmp, strlen(tmp));
    str[16] = 0;
    return 16;
}
#if 0
int MakeNumberString(int  x,
         int  y,
     int  z,
         char *str)
{
    intlen;
    inti;
#ifdef DEBUG
    printf("[%ld]DBG: Entering MakeNumberString()\n", (int)
GetCurrentThreadId());
#endif
    len = RandomNumber(x,y);
    for (i=0; i < len; i++)
    {
    str[i] = (char) (RandomNumber(48,57));
    }

    str[len] = '\0';
    PaddString(z, str);
    return strlen(str);
}
#endif
//============================================================
=============
//
// Function name: MakeZipNumberString
//
//============================================================
=============
int MakeZipNumberString(int  x, int  y, int  z, char *str)
{
    char tmp[16];
    //MakeZipNumberString is always called
MakeZipNumberString(9, 9, 9, string)
    strcpy(str, "000011111");
    itoa(RandomNumber(0, 9999), tmp, 10);
    memcpy(str, tmp, strlen(tmp));
    return 9;
}
#if 0
//pgd 08/14/96 Orginal Code Below
int MakeZipNumberString(int  x,
        int  y,
     int  z,
         char *str)
{
    intlen;
    inti;
#ifdef DEBUG
    printf("[%ld]DBG: Entering MakeZipNumberString()\n",
(int) GetCurrentThreadId());
#endif
    len = RandomNumber(x-5,y-5);
    for (i=0; i < len; i++)
    {
    str[i] = (char) (RandomNumber(48,57));
    }

    str[len] = '\0';
    strcat(str, "11111");
    PaddString(z, str);
    return strlen(str);
}
#endif
//============================================================
=============
//
// Function name: InitString
//
//============================================================
=============
void InitString(char *str, int len)
{
    int i;
#ifdef DEBUG
```

```
    printf("[%ld]DBG: Entering InitString()\n", (int)
GetCurrentThreadId());
#endif
    memset(str, ' ', len);
    str[len] = 0;
}
#if 0
//Orginal pgd 08/14/96
void InitString(char *str, int len)
{
    int i;
#ifdef DEBUG
    printf("[%ld]DBG: Entering InitString()\n", (int)
GetCurrentThreadId());
#endif
    for (i=0; i< len; i++)
    str[i] = ' ';
    str[len] = '\0';
}
#endif
//============================================================
=============
// Function name: InitAddress
//
// Description:
//
//============================================================
=============
void InitAddress(char *street_1, char *street_2, char
*city, char *state, char *zip)
{
    int i;
    memset(street_1, ' ', ADDRESS_LEN+1);
    memset(street_2, ' ', ADDRESS_LEN+1);
    memset(city, ' ', ADDRESS_LEN+1);
    street_1[ADDRESS_LEN+1] = 0;
    street_2[ADDRESS_LEN+1] = 0;
    city[ADDRESS_LEN+1]     = 0;
    memset(state, ' ', STATE_LEN+1);
    state[STATE_LEN+1] = 0;
    memset(zip, ' ', ZIP_LEN+1);
    zip[ZIP_LEN+1] = 0;
}
#if 0
//Orginal pgd 08/14/96
void InitAddress(char *street_1,
     char *street_2,
      char *city,
      char *state,
      char *zip)
{
    int i;
#ifdef DEBUG
    printf("[%ld]DBG: Entering InitAddress()\n", (int)
GetCurrentThreadId());
#endif
    for (i=0; i< ADDRESS_LEN+1; i++)
    {
    street_1[i] = ' ';
    street_2[i] = ' ';
    city[i]     = ' ';
    }
    street_1[ADDRESS_LEN+1] = '\0';
    street_2[ADDRESS_LEN+1] = '\0';
    city[ADDRESS_LEN+1]     = '\0';
    for (i=0; i< STATE_LEN+1; i++)
    state[i] = ' ';
    state[STATE_LEN+1] = '\0';
    for (i=0; i< ZIP_LEN+1; i++)
    zip[i] = ' ';
    zip[ZIP_LEN+1] = '\0';
}
#endif
//============================================================
=============
//
// Function name: PaddString
//
//============================================================
=============
void PaddString(int max, char *name)
{
    inti;
    intlen;
```

```
        len = strlen(name);
        if ( len < max )
        memset(name+len, ' ', max - len);
        name[max] = 0;
        return;
    }
    #if 0
        //pgd 08/14/96 Orginal code below
        void PaddString(intmax,
        char*name)
        {
        inti;
        intlen;
        #ifdef DEBUG
        printf("[%ld]DBG: Entering PaddString()\n", (int)
    GetCurrentThreadId());
        #endif
        len = strlen(name);
        for (i=1;i<=(max - len);i++)
        {
        strcat(name, " ");
        }
        }
    #endif
```

time.c

```
    // TPC-C Benchmark Kit
    //
    // Module:  TIME.C
    // Author:  DamienL
    // Includes
    #include "tpcc.h"
    // Globals
    static long start_sec;
    //=============================================================
    =============
    //
    // Function name: TimeNow
    //
    //=============================================================
    =============
    long TimeNow()
    {
       longtime_now;
       struct_timeb el_time;
    #ifdef DEBUG
        printf("[%ld]DBG: Entering TimeNow()\n", (int)
    GetCurrentThreadId());
    #endif
       _ftime(&el_time);
       time_now = ((el_time.time - start_sec) * 1000) +
    el_time.millitm;
       return time_now;
    }
    //=============================================================
    =============
    //
    // Function name: TimeInit
    //
    // This function is used to normalize the seconds component
    of
    // elapsed time so that it will not overflow, when
    converted to milli seconds
    //
    //=============================================================
    =============
    void TimeInit()
    {
        struct  _timeb  norm_time;
    #ifdef DEBUG
        printf("[%ld]DBG: Entering TimeInit()\n", (int)
    GetCurrentThreadId());
    #endif
        _ftime(&norm_time);
        start_sec = norm_time.time;
    }
    //=============================================================
    =============
    //
    // Function name: TimeKeying
    //
    //=============================================================
    =============
    void TimeKeying(intTranType,
```

```
    doubleload_multiplier)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering TimeKeying()\n", (int)
GetCurrentThreadId());
#endif
    switch (TranType)
    {
        case NEW_ORDER_TRAN:
    UtilSleepMs( (long) ((load_multiplier * 18)*1000) );
    break;
        case PAYMENT_TRAN:
    UtilSleepMs( (long) ((load_multiplier * 3)*1000) );
    break;
        case ORDER_STATUS_TRAN:
        case DELIVERY_TRAN:
        case STOCK_LEVEL_TRAN:
    UtilSleepMs( (long) ((load_multiplier * 2)*1000) );
    break;
        default:
    printf("TimeKeying: Error - default reached!\n");
    }
}
//=============================================================
=============
//
// Function name: TimeThink
//
//=============================================================
=============
void TimeThink(intTranType,
       doubleload_multiplier)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering TimeThink()\n", (int)
GetCurrentThreadId());
#endif
    switch (TranType)
    {
        case NEW_ORDER_TRAN:
        case PAYMENT_TRAN:
    UtilSleepMs( (long) ((load_multiplier * 12)*1000) );
    break;
        case ORDER_STATUS_TRAN:
    UtilSleepMs( (long) ((load_multiplier * 10)*1000) );
    break;
        case DELIVERY_TRAN:
        case STOCK_LEVEL_TRAN:
    UtilSleepMs( (long) ((load_multiplier * 5)*1000) );
    break;
        default:
    printf("TimeThink: Error - default reached!\n");
    }
}
```

tpcc.h

```
/*  FILE:TPCC.H
 *  Microsoft TPC-C Kit Ver. 3.00.000
 *  Audited 08/23/96, By Francois Raab
 *
 *  Copyright Microsoft, 1996
 *
 *  PURPOSE:Header file for Microsoft TPC-C Benchmark Kit
 *  Author:Damien Lindauer
 *  damienl@Microsoft.com
 */
// Build number of TPC Benchmark Kit
#define TPCKIT_VER "3.00.00"
// General headers
#include <windows.h>
#include <winbase.h>
#include <stdlib.h>
#include <stdio.h>
#include <process.h>
#include <stddef.h>
#include <stdarg.h>
#include <string.h>
#include <signal.h>
#include <time.h>
#include <timeb.h>
#include <types.h>
#include <wincon.h>
```

```
#ifdef USE_ODBC
// ODBC headers
#include <sql.h>
#include <sqlext.h>
HENV henv;
#endif
// DB-Library headers
#include <sqlfront.h>
#include <sqldb.h>
#include "trans.h"//pgd 5-6-96 split transaction structs
defination s into own header
    //for tpcform.c i.e. telnet application
// Critical section declarations
CRITICAL_SECTIONConsoleCritSec;
CRITICAL_SECTIONQueuedDeliveryCritSec;
CRITICAL_SECTIONWriteDeliveryCritSec;
CRITICAL_SECTIONDroppedConnectionsCritSec;
CRITICAL_SECTIONClientErrorLogCritSec;
// General constants
#define SQLCONN DBPROCESS
#define DUMB_MESSAGE     5701
#define ABORT_ERROR      6104
#define INVALID_ITEM_ID 0
#define MILLI            1000
#define MAX_THREADS      2510
#define STATS_MSG_LOW   3600
#define STATS_MSG_HIGH  3700
#define SHOWPLAN_MSG_LOW   6200
#define SHOWPLAN_MSG_HIGH  6300
#define FALSE           0
#define TRUE            1
#define UNDEF   -1
#define MINPRINTASCII   32
#define MAXPRINTASCII  126
// Default environment constants
#define SERVER          ""
#define DATABASE        "tpcc"
#define USER            "sa"
#define PASSWORD            ""
#define SYNCH_SERVERNAME""
// Statistic constants
#define INTERVAL          20  // Total interval of buckets, in
sec
#define UNIT               .1    // Time period of each bucket
#define HIST_MAX          200    // Num of histogram buckets =
INTERVAL/UNIT
#define BUCKET          100 //Division factor for response time
// Default master arguments
#define ADMIN_DATABASE        "tpcc_admin"
#define RAMP_UP               600
#define STEADY_STATE         1200
#define RAMP_DOWN             120
#define NUM_USERS              10
#define NUM_WAREHOUSES      1
#define THINK_TIMES0
#define DISPLAY_DATA        0
#define DEFMSPACKSIZE     4096
#define TRANSACTION        0
#define CLIENT_MODE          1
#define DEF_WW_T  120
#define DEF_WW_a1
#define DEADLOCK_RETRY         4
#define DELIVERY_BACKOFF2
#define DELIVERY_MODE0
#define NEWORDER_MODE0
#define DEF_LOAD_MULTIPLIER   1.0
#define DEF_CHECKPOINT_INTERVAL   960
#define DEF_FIRST_CHECKPOINT  240
#define DISABLE_90TH0
#defineRESFILENAME"results.txt"
#define SQLSTAT_FILENAME"sqlstats.txt"
#define ENABLE_SQLSTAT0
#define SQLSTAT_PERIOD  100
#define SHUTDOWN_SERVER0
#define AUTO_RUN0
#define DISABLE_SQLPERF0
// Default client arguments
#define NUM_THREADS       10
#define X_FLAG                      0
#define Y_FLAG                      1
#define NUM_DELIVERIES2
#define CLIENT_NURAND      223
#define DISABLE_DELIVERY_RESFILES   1
```

```
#define ENABLE_QJ0
// Globals for queued delivery handling
typedef struct delivery_node *DELIVERY_PTR;
DELIVERY_PTRdelivery_head, delivery_tail;
shortqueued_delivery_cnt;
HANDLEhDeliveryMonPipe;
struct delivery_node
{
    shortw_id;
    shorto_carrier_id;
    SYSTEMTIMEqueue_time;
    longtran_start_time;
    structdelivery_node *next_delivery;
};
// Default loader arguments
#define BATCH           10000
#define DEFLDPACKSIZE 4096
#define ORDERS_PER_DIST  3000
#define LOADER_RES_FILE     "load.out"
#define LOADER_NURAND_C  123
#define DEF_STARTING_WAREHOUSE1
#define BUILD_INDEX1
#define INDEX_SCRIPT_PATH"scripts"
// Transaction types
#define EMPTY               0
#define NEW_ORDER_TRAN      1
#define PAYMENT_TRAN        2
#define ORDER_STATUS_TRAN   3
#define DELIVERY_TRAN       4
#define STOCK_LEVEL_TRAN    5
// Statistic structures
typedef struct
{
    long   tran_count;
    long   total_time;
    long   resp_time;
    long   resp_min;
    long   resp_max;
    long   rolled_back;
    long   tran_2sec;
    long   tran_5sec;
    long   tran_sqr;
    long   num_deadlocks;
    long   resp_hist[HIST_MAX];
} TRAN_STATS;
typedef struct
{
    TRAN_STATS NewOrderStats;
    TRAN_STATS PaymentStats;
    TRAN_STATS OrderStatusStats;
    TRAN_STATS QueuedDeliveryStats;
    TRAN_STATSDeliveryStats;
    TRAN_STATS StockLevelStats;
} CLIENT_STATS;
// driver structures
typedef struct
{
    char  *server;
    char  *database;
    char  *user;
    char  *password;
    char  *table;
    long   num_warehouses;
    long   batch;
    long   verbose;
    long   pack_size;
    char*loader_res_file;
    char*synch_servername;
    longcase_sensitivity;
    longstarting_warehouse;
    longbuild_index;
    char*index_script_path;
} TPCCLDR_ARGS;
typedef struct
{
    char  *server;
    char  *user;
    char  *password;
    char  *admin_database;
    char  *sqlstat_filename;
    longrun_id;
} SQLSTAT_ARGS;
```

```
typedef struct
{
    SQLCONN  *sqlconn;
    char    *server;
    char     *database;
    char*admin_database;
    char     *user;
    char     *password;
    long      ramp_up;
    long      steady_state;
    long      ramp_down;
    long      num_users;
    long      num_warehouses;
    long      think_times;
    long      display_data;
    long     client_mode;
    long     tran;
    longdeadlock_retry;
    longdelivery_backoff;
    longnum_deliveries;
    char *comment;
    doubleload_multiplier;
    longcheckpoint_interval;
    longfirst_checkpoint;
    longdisable_90th;
    char*resfilename;
    char*sqlstat_filename;
    longenable_sqlstat;
    longsqlstat_period;
    longshutdown_server;
    longauto_run;
    longdropped_connections;
    short     spid;
    longdisable_sqlperf;
} MASTER_DATA;
typedef struct
{
    long  num_threads;
    char      *server;
    char      *database;
    char*admin_database;
    char      *user;
    char      *password;
    long      pack_size;
    shortx_flag;
    char*synch_servername;
    longdisable_delivery_resfiles;
    longenable_qj;
#ifdef USE_CONMON
    HANDLE  hConMon;
    short  con_id;
    short  con_x;
    short  con_y;
#endif
} GLOBAL_CLIENT_DATA;
typedef struct
{
#ifdef USE_ODBC
    HDBChdbc;
    HSTMThstmt;
#else
    SQLCONN   *sqlconn;
#endif
    short  threadid;
    char      *server;
    char      *database;
    char*admin_database;
    char      *user;
    char      *password;
    long      ramp_up;
    long      steady_state;
    long      ramp_down;
    long     num_warehouses;
    long     client_mode;
    long     tran;
    longdeadlock_retry;
    long      think_times;
    long      pack_size;
    long      tran_start_time;
    long      tran_end_time;
    long      display_data;
    long     id;
```

```
    short     w_id;
    short     spid;
    longdisable_90th;
    doubleload_multiplier;
    longnum_deliveries;
    longenable_qj;
#ifdef USE_CONMON
    HANDLE  hConMon;
    short  con_id;
    short  con_x;
    short  con_y;
    shortfTimerStat;
#endif
} CLIENT_DATA;
typedef struct
{
#ifdef USE_ODBC
    HDBChdbc;
    HSTMThstmt;
#else
    SQLCONN   *sqlconn;
#endif
    SYSTEMTIMEqueue_time;
    SYSTEMTIMEcompletion_time;
    long      tran_start_time;
    long      tran_end_time;
    short  threadid;
    FILE      *fDelivery;
    short     spid;
    short     w_id;
    shortd_id;
    short     o_carrier_id;
    DEL_ITEM  DelItems[10];
    char      *server;
    char      *database;
    char*admin_database;
    char      *user;
    char      *password;
    long      ramp_up;
    long      steady_state;
    long      ramp_down;
    long      pack_size;
    long     id;
    longdisable_90th;
    longdelivery_backoff;
    longdisable_delivery_resfiles;
    longenable_qj;
} DELIVERY;
typedef struct
{
    longpipe_num;
} DELIVERY_ARGS;
// For client synchronization
#define LINE_LEN   80
#define NAME_SIZE  25
#define IN_BUF_SIZE        1000
#define OUT_BUF_SIZE       1000
#define TIME_OUT           0
#define PLEASE_READ        1000
#define PLEASE_WRITE       1000
typedef struct _WRTHANDLE
{   HANDLEhPipe;
    DWORDthreadID;
    CHARName[NAME_SIZE];
    struct _WRTHANDLE *next;
}WRTHANDLE;
// For client console monitor
#ifdef USE_CONMON
#defineCON_LINE_SIZE40
#defineDEADLOCK_X17
#define DEADLOCK_Y4
#define CUR_STATE_X15
#define CUR_STATE_Y3
#defineYELLOW0
#defineRED1
#defineGREEN2
int total_deadlocks;
#endif
// Functions in random.c
void   seed();
long   irand();
doubledrand();
```

```
voidWUCreate();
shortWURand();
// Functions in getargs.c;
void GetArgsLoader();
void GetArgsLoaderUsage();
void GetArgsMaster();
void GetArgsMasterUsage();
void GetArgsClient();
void GetArgsClientUsage();
void GetArgsDelivery();
void GetArgsDeliveryUsage();
void GetArgsSQLStat();
void GetArgsSQLStatUsage();
// Functions in master.c
void ReadClientDone();
BOOL    CtrlHandler();
// Functions in client.c
void  ClientMain();
voidDeliveryMain();
voidDelivery();
void  ClientEmulate();
short ClientSelectTransaction();
void  ClientShuffleDeck();
//Functions in tran.c
BOOL TranNewOrder();
BOOL TranPayment();
BOOL TranOrderStatus();
BOOL TranDelivery();
BOOL TranStockLevel();
// Functions in data.c
void DataNewOrder();
void DataPayment();
void DataOrderStatus();
void DataDelivery();
void DataStockLevel();
short DataRemoteWarehouse();
// Functions in time.c
long TimeNow();
void TimeInit();
void TimeKeying();
void TimeThink();
// Functions in stats.c
void StatsInit();
void StatsInitTran();
void StatsGeneral();
void StatsDelivery();
// Functions in sqlfuncs.c
BOOL  SQLExec();
BOOL  SQLExecCmd();
BOOL  SQLOpenConnection();
void  SQLClientInit();
int   SQLMasterInit();
voidSQLDeliveryInit();
int   SQLClientStats();
int   SQLDeliveryStats();
void  SQLTranStats();
void  SQLMasterStats();
void  SQLMasterTranStats();
void  SQLIOStats();
void  SQLCheckpointStats();
voidSQLInitResFile();
void  SQLGetRunId();
BOOL  SQLNewOrder();
BOOL  SQLPayment();
BOOL  SQLOrderStatus();
BOOLSQLStockLevel();
void    SQLDelivery();
int   SQLGetCustId();
void   SQLExit();
void  SQLInit();
void  SQLInitPrivate();
void  SQLClientInitPrivate();
void  SQLDeliveryInitPrivate();
int   SQLMsgHandler();
int   SQLErrHandler();
int   SQLClientMsgHandler();
int   SQLClientErrHandler();
int   SQLDeliveryMsgHandler();
int   SQLDeliveryErrHandler();
void  SQLInitDate();
voidSQLShutdown();
#ifdef USE_ODBC
```

```
    void ODBCOpenConnection();
    void ODBCOpenDeliveryConnection();
    BOOLODBCError();
    voidODBCExit();
    #endif
    // Functions in util.c
    void UtilSleep();
    void UtilPrintNewOrder();
    void UtilPrintPayment();
    void UtilPrintOrderStatus();
    void UtilPrintDelivery();
    void UtilPrintStockLevel();
    void UtilPrintOlTable();
    void UtilError();
    void UtilFatalError();
    void UtilStrCpy();
    #ifdef USE_CONMON
    void WriteConsoleString();
    #endif
    voidWriteDeliveryString();
    BOOLAddDeliveryQueueNode();
    BOOLGetDeliveryQueueNode();
    // Functions in strings.c
    void MakeAddress();
    void LastName();
    int  MakeAlphaString();
    int  MakeOriginalAlphaString();
    int  MakeNumberString();
    int  MakeZipNumberString();
    void InitString();
    void InitAddress();
    void PaddString();
    // Functions in delivery.c
    void  DeliveryHMain();
    void DeliveryH();
```

tpccldr.c

```
    /*  FILE:TPCCLDR.C
     *  Microsoft TPC-C Kit Ver. 3.00.000
     *  Audited 08/23/96, By Francois Raab
     *
     *  Copyright Microsoft, 1996
     *
     *  PURPOSE:Database loader for Microsoft TPC-C Benchmark
    Kit
     *  Author:Damien Lindauer
     *  damienl@Microsoft.com
     */
    // Includes
    #include "tpcc.h"
    #include "search.h"
    // Defines
    #define MAXITEMS                100000
    #define CUSTOMERS_PER_DISTRICT  3000
    #define DISTRICT_PER_WAREHOUSE  10
    #define ORDERS_PER_DISTRICT     3000
    #define MAX_CUSTOMER_THREADS    2
    #define MAX_ORDER_THREADS       3
    #define MAX_MAIN_THREADS        4
    // Functions declarations
    long NURand();
    void LoadItem();
    void LoadWarehouse();
    void Stock();
    void District();
    void LoadCustomer();
    void CustomerBufInit();
    void CustomerBufLoad();
    void LoadCustomerTable();
    void LoadHistoryTable();
    void LoadOrders();
    void OrdersBufInit();
    void OrdersBufLoad();
    void LoadOrdersTable();
    void LoadNewOrderTable();
    void LoadOrderLineTable();
    void GetPermutation();
    void CheckForCommit();
    void OpenConnections();
    void BuildIndex();
    void CurrentDate();
```

```
// Shared memory structures
typedef struct
{
    long                ol;
    long                ol_i_id;
    short               ol_supply_w_id;
    short               ol_quantity;
    double              ol_amount;
    char                ol_dist_info[DIST_INFO_LEN+1];
    // Added to insure ol_delivery_d set properly during
load
    charol_delivery_d[30];
} ORDER_LINE_STRUCT;
typedef struct
{
    long               o_id;
    short               o_d_id;
    short               o_w_id;
    long                o_c_id;
    short               o_carrier_id;
    short               o_ol_cnt;
    short               o_all_local;
    ORDER_LINE_STRUCT   o_ol[15];
} ORDERS_STRUCT;
typedef struct
{
    longc_id;
    shortc_d_id;
    shortc_w_id;
    charc_first[FIRST_NAME_LEN+1];
    charc_middle[MIDDLE_NAME_LEN+1];
    charc_last[LAST_NAME_LEN+1];
    charc_street_1[ADDRESS_LEN+1];
    charc_street_2[ADDRESS_LEN+1];
    charc_city[ADDRESS_LEN+1];
    charc_state[STATE_LEN+1];
    charc_zip[ZIP_LEN+1];
    charc_phone[PHONE_LEN+1];
    charc_credit[CREDIT_LEN+1];
    doublec_credit_lim;
    doublec_discount;
    doublec_balance;
    doublec_ytd_payment;
    shortc_payment_cnt;
    shortc_delivery_cnt;
    charc_data_1[C_DATA_LEN+1];
    charc_data_2[C_DATA_LEN+1];
    doubleh_amount;
    charh_data[H_DATA_LEN+1];
} CUSTOMER_STRUCT;
typedef struct
{
    charc_last[LAST_NAME_LEN+1];
    charc_first[FIRST_NAME_LEN+1];
    longc_id;
} CUSTOMER_SORT_STRUCT;
typedef struct
{
   long             time_start;
} LOADER_TIME_STRUCT;

// Global variables
char             errfile[20];
DBPROCESS        *i_dbproc1;
DBPROCESS        *w_dbproc1, *w_dbproc2;
DBPROCESS        *c_dbproc1, *c_dbproc2;
DBPROCESS        *o_dbproc1, *o_dbproc2, *o_dbproc3;
ORDERS_STRUCT    orders_buf[ORDERS_PER_DISTRICT];
CUSTOMER_STRUCT  customer_buf[CUSTOMERS_PER_DISTRICT];
long             main_threads_completed;
long             customer_threads_completed;
long             order_threads_completed;
long             orders_rows_loaded;
long             new_order_rows_loaded;
long             order_line_rows_loaded;
long             history_rows_loaded;
long             customer_rows_loaded;
long             stock_rows_loaded;
long             district_rows_loaded;
long             item_rows_loaded;
long             warehouse_rows_loaded;
long             main_time_start;
```

```
long            main_time_end;
TPCCLDR_ARGS    *aptr, args;
//============================================================
=============
//
// Function name: main
//
//============================================================
=============
int main(int  argc, char **argv)
{
    DWORD           dwThreadID[MAX_MAIN_THREADS];
    HANDLE          hThread[MAX_MAIN_THREADS];
    FILE            *fLoader;
    char            buffer[255];
    int             main_threads_started;
    RETCODEretcode;
    LOGINREC *login;

printf("\n*************************************************
*");

printf("\n*
*");
    printf("\n*  Microsoft SQL Server
6.5                        *");

printf("\n*
*");
    printf("\n*  TPC-C BENCHMARK KIT:  Database
loader          *");
    printf("\n*  Version %s
*", TPCKIT_VER);

printf("\n*
*");

printf("\n*************************************************
*\n\n");

    // process command line arguments

    aptr = &args;
    GetArgsLoader(argc, argv, aptr);
    if (aptr->build_index = 0)
    printf("data load only\n");
    if (aptr->build_index = 1)
    printf("data load and index creation\n");
    // install dblib error handlers
    dbmsghandle((DBMSGHANDLE_PROC)SQLMsgHandler);
    dberrhandle((DBERRHANDLE_PROC)SQLErrHandler);
    // open connections to SQL Server
    OpenConnections();

    // open file for loader results
    fLoader = fopen(aptr->loader_res_file, "a");
    if (fLoader == NULL)
    {
    printf("Error, loader result file open failed.");
    exit(-1);
    }
    // start loading data

    sprintf(buffer,"TPC-C load started for %ld warehouses:
", aptr->num_warehouses);
    if(aptr->build_index = 0)
    strcat(buffer, "data load only\n");
    if (aptr->build_index = 1)
    strcat(buffer, "data load and index creation\n");
    printf("%s",buffer);
    fprintf(fLoader,"%s",buffer);
    main_time_start = (TimeNow() / MILLI);
    // start parallel load threads
    main_threads_completed = 0;
    main_threads_started = 0;
    if ((aptr->table == NULL) || !(strcmp(aptr-
>table,"item")))
    {
    fprintf(fLoader, "\nStarting loader threads for:
item\n");

    hThread[0] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadItem,
      NULL,
      0,
```

```
      &dwThreadID[0]);
    if (hThread[0] == NULL)
    {
    printf("Error, failed in creating creating thread =
0.\n");
    exit(-1);
    }
    main_threads_started++;

    }
    if ((aptr->table == NULL) || !(strcmp(aptr-
>table,"warehouse")))
    {
    fprintf(fLoader, "Starting loader threads for:
warehouse\n");
    hThread[1] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadWarehouse,
      NULL,
      0,
      &dwThreadID[1]);
    if (hThread[1] == NULL)
    {
    printf("Error, failed in creating creating thread =
1.\n");
    exit(-1);
    }
    main_threads_started++;
    }
    if ((aptr->table == NULL) || !(strcmp(aptr-
>table,"customer")))
    {
    fprintf(fLoader, "Starting loader threads for:
customer\n");
    hThread[2] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadCustomer,
      NULL,
      0,
      &dwThreadID[2]);
    if (hThread[2] == NULL)
    {
    printf("Error, failed in creating creating main thread
= 2.\n");
    exit(-1);
    }
    main_threads_started++;
    }

    if ((aptr->table == NULL) || !(strcmp(aptr-
>table,"orders")))
    {
    fprintf(fLoader, "Starting loader threads for:
orders\n");
    hThread[3] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadOrders,
      NULL,
      0,
      &dwThreadID[3]);
    if (hThread[3] == NULL)
    {
    printf("Error, failed in creating creating main thread
= 3.\n");
    exit(-1);
    }

    main_threads_started++;

    }
    while (main_threads_completed != main_threads_started)
    Sleep(1000L);

    main_time_end = (TimeNow() / MILLI);
    sprintf(buffer,"\nTPC-C load completed successfully in
%ld minutes.\n",
    (main_time_end - main_time_start)/60);
    printf("%s",buffer);
    fprintf(fLoader, "%s", buffer);
    fclose(fLoader);
    dbexit();
    exit(0);
}
```

```
//=============================================================
=============
//
// Function name: LoadItem
//
//=============================================================
=============
void LoadItem()
{
    long   i_id;
    long   i_im_id;
    char   i_name[I_NAME_LEN+1];
    double i_price;
    char   i_data[I_DATA_LEN+1];
    char   name[20];
    long   time_start;
    printf("\nLoading item table...\n");
    // Seed with unique number
    seed(1);
    InitString(i_name, I_NAME_LEN+1);
    InitString(i_data, I_DATA_LEN+1);
    sprintf(name, "%s..%s", aptr->database, "item");
    bcp_init(i_dbproc1, name, NULL, "logs\\item.err",
DB_IN);
    bcp_bind(i_dbproc1, (BYTE *) &i_id,      0, -1,
NULL, 0, 0, 1);
    bcp_bind(i_dbproc1, (BYTE *) &i_im_id,   0, -1,
NULL, 0, 0, 2);
    bcp_bind(i_dbproc1, (BYTE *) i_name,     0, I_NAME_LEN,
NULL, 0, 0, 3);
    bcp_bind(i_dbproc1, (BYTE *) &i_price,   0, -1,
NULL, 0, SQLFLT8, 4);
    bcp_bind(i_dbproc1, (BYTE *) i_data,     0, I_DATA_LEN,
NULL, 0, 0, 5);
    time_start = (TimeNow() / MILLI);
    item_rows_loaded = 0;
    for (i_id = 1; i_id <= MAXITEMS; i_id++)
    {
    i_im_id = RandomNumber(1L, 10000L);

    MakeAlphaString(14, 24, I_NAME_LEN, i_name);

    i_price = ((float) RandomNumber(100L, 10000L))/100.0;

    MakeOriginalAlphaString(26, 50, I_DATA_LEN, i_data, 10);
    if (!bcp_sendrow(i_dbproc1))
    printf("Error, LoadItem() failed calling
bcp_sendrow().  Check error file.\n");
    item_rows_loaded++;
    CheckForCommit(i_dbproc1, item_rows_loaded, "item",
&time_start);
    }

    bcp_done(i_dbproc1);
    dbclose(i_dbproc1);
    printf("Finished loading item table.\n");
    if (aptr->build_index == 1)
    BuildIndex("idxitmcl");
    InterlockedIncrement(&main_threads_completed);
}
//=============================================================
=============
//
// Function   : LoadWarehouse
//
// Loads WAREHOUSE table and loads Stock and District as
Warehouses are created
//
//=============================================================
=============
void LoadWarehouse()
{
    short  w_id;
    char   w_name[W_NAME_LEN+1];
    char   w_street_1[ADDRESS_LEN+1];
    char   w_street_2[ADDRESS_LEN+1];
    char   w_city[ADDRESS_LEN+1];
    char   w_state[STATE_LEN+1];
    char   w_zip[ZIP_LEN+1];
    double w_tax;
    double w_ytd;
    char   name[20];
    long   time_start;

    printf("\nLoading warehouse table...\n");
```

```
    // Seed with unique number
    seed(2);

    InitString(w_name, W_NAME_LEN+1);
    InitAddress(w_street_1, w_street_2, w_city, w_state,
w_zip);

    sprintf(name, "%s..%s", aptr->database, "warehouse");
    bcp_init(w_dbproc1, name, NULL, "logs\\whouse.err",
DB_IN);

    bcp_bind(w_dbproc1, (BYTE *) &w_id,         0, -
1,           NULL, 0, 0, 1);
    bcp_bind(w_dbproc1, (BYTE *) w_name,        0,
W_NAME_LEN,   NULL, 0, 0, 2);
    bcp_bind(w_dbproc1, (BYTE *) w_street_1,    0,
ADDRESS_LEN,  NULL, 0, 0, 3);
    bcp_bind(w_dbproc1, (BYTE *) w_street_2,    0,
ADDRESS_LEN,  NULL, 0, 0, 4);
    bcp_bind(w_dbproc1, (BYTE *) w_city,        0,
ADDRESS_LEN,  NULL, 0, 0, 5);
    bcp_bind(w_dbproc1, (BYTE *) w_state,       0,
STATE_LEN,    NULL, 0, 0, 6);
    bcp_bind(w_dbproc1, (BYTE *) w_zip,         0,
ZIP_LEN,      NULL, 0, 0, 7);
    bcp_bind(w_dbproc1, (BYTE *) &w_tax,        0, -
1,           NULL, 0, SQLFLT8, 8);
    bcp_bind(w_dbproc1, (BYTE *) &w_ytd,        0, -
1,           NULL, 0, SQLFLT8, 9);
    time_start = (TimeNow() / MILLI);
    warehouse_rows_loaded = 0;

    for (w_id = aptr->starting_warehouse; w_id < aptr-
>num_warehouses+1; w_id++)
    {
    MakeAlphaString(6,10, W_NAME_LEN, w_name);

    MakeAddress(w_street_1, w_street_2, w_city, w_state,
w_zip);

    w_tax = ((float) RandomNumber(0L,2000L))/10000.00;
    w_ytd = 300000.00;
    if (!bcp_sendrow(w_dbproc1))
        printf("Error, LoadWarehouse() failed calling
bcp_sendrow().  Check error file.\n");
    warehouse_rows_loaded++;
    CheckForCommit(i_dbproc1, warehouse_rows_loaded,
"warehouse", &time_start);
    }
    bcp_done(w_dbproc1);
    dbclose(w_dbproc1);
    printf("Finished loading warehouse table.\n");
    if (aptr->build_index == 1)
    BuildIndex("idxwarcl");
    stock_rows_loaded = 0;
    district_rows_loaded = 0;
    District(w_id);
    Stock(w_id);
    InterlockedIncrement(&main_threads_completed);
}
//============================================================
=============
//
// Function   : District
//
//============================================================
=============
void District()
{
    short  d_id;
    short  d_w_id;
    char   d_name[D_NAME_LEN+1];
    char   d_street_1[ADDRESS_LEN+1];
    char   d_street_2[ADDRESS_LEN+1];
    char   d_city[ADDRESS_LEN+1];
    char   d_state[STATE_LEN+1];
    char   d_zip[ZIP_LEN+1];
    double d_tax;
    double d_ytd;
    char   name[20];
    long   d_next_o_id;
    int    rc;
    long   time_start;
    int   w_id;
```

```
    for (w_id = aptr->starting_warehouse; w_id < aptr-
>num_warehouses+1; w_id++)
    {
    printf("...Loading district table: w_id = %ld\n", w_id);
    // Seed with unique number
    seed(4);
    InitString(d_name, D_NAME_LEN+1);
    InitAddress(d_street_1, d_street_2, d_city, d_state,
d_zip);
    sprintf(name, "%s..%s", aptr->database, "district");
    rc = bcp_init(w_dbproc2, name, NULL,
"logs\\district.err", DB_IN);
    bcp_bind(w_dbproc2, (BYTE *) &d_id,          0, -
1,            NULL, 0, 0, 1);
    bcp_bind(w_dbproc2, (BYTE *) &d_w_id,        0, -
1,            NULL, 0, 0, 2);
    bcp_bind(w_dbproc2, (BYTE *) d_name,         0,
D_NAME_LEN,    NULL, 0, 0, 3);
    bcp_bind(w_dbproc2, (BYTE *) d_street_1,     0,
ADDRESS_LEN,   NULL, 0, 0, 4);
    bcp_bind(w_dbproc2, (BYTE *) d_street_2,     0,
ADDRESS_LEN,   NULL, 0, 0, 5);
    bcp_bind(w_dbproc2, (BYTE *) d_city,         0,
ADDRESS_LEN,   NULL, 0, 0, 6);
    bcp_bind(w_dbproc2, (BYTE *) d_state,        0,
STATE_LEN,     NULL, 0, 0, 7);
    bcp_bind(w_dbproc2, (BYTE *) d_zip,          0,
ZIP_LEN,       NULL, 0, 0, 8);
    bcp_bind(w_dbproc2, (BYTE *) &d_tax,         0, -
1,            NULL, 0, SQLFLT8, 9);
    bcp_bind(w_dbproc2, (BYTE *) &d_ytd,         0, -
1,            NULL, 0, SQLFLT8, 10);
    bcp_bind(w_dbproc2, (BYTE *) &d_next_o_id,   0, -
1,            NULL, 0, 0, 11);
    d_w_id = w_id;
    d_ytd  = 30000.0;
    d_next_o_id = 3001L;
    time_start = (TimeNow() / MILLI);
    for (d_id = 1; d_id <= DISTRICT_PER_WAREHOUSE; d_id++)
    {
    MakeAlphaString(6,10,D_NAME_LEN, d_name);

    MakeAddress(d_street_1, d_street_2, d_city, d_state,
d_zip);
    d_tax = ((float) RandomNumber(0L,2000L))/10000.00;
    if (!bcp_sendrow(w_dbproc2))
    printf("Error, District() failed calling
bcp_sendrow().  Check error file.\n");
    district_rows_loaded++;
    CheckForCommit(w_dbproc2, district_rows_loaded,
"district", &time_start);
    }

    rc = bcp_done(w_dbproc2);
    }
    printf("Finished loading district table.\n");

    if (aptr->build_index == 1)
    BuildIndex("idxdiscl");
    return;
}
//============================================================
=============
//
// Function   : Stock
//
//============================================================
=============
void Stock()
{
    long  s_i_id;
    short s_w_id;
    short s_quantity;
    char  s_dist_01[S_DIST_LEN+1];
    char  s_dist_02[S_DIST_LEN+1];
    char  s_dist_03[S_DIST_LEN+1];
    char  s_dist_04[S_DIST_LEN+1];
    char  s_dist_05[S_DIST_LEN+1];
    char  s_dist_06[S_DIST_LEN+1];
    char  s_dist_07[S_DIST_LEN+1];
    char  s_dist_08[S_DIST_LEN+1];
    char  s_dist_09[S_DIST_LEN+1];
    char  s_dist_10[S_DIST_LEN+1];
    long  s_ytd;
    short s_order_cnt;
```

```
    short s_remote_cnt;
    char  s_data[S_DATA_LEN+1];
    short i;
    short len;
    int   rc;
    char  name[20];
    long  time_start;
    // Seed with unique number
    seed(3);

    sprintf(name, "%s..%s", aptr->database, "stock");
    rc = bcp_init(w_dbproc2, name, NULL, "logs\\stock.err",
DB_IN);

    bcp_bind(w_dbproc2, (BYTE *) &s_i_id,       0, -
1,         NULL, 0, 0, 1);
    bcp_bind(w_dbproc2, (BYTE *) &s_w_id,       0, -
1,         NULL, 0, 0, 2);
    bcp_bind(w_dbproc2, (BYTE *) &s_quantity,   0, -
1,         NULL, 0, 0, 3);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_01,     0,
S_DIST_LEN, NULL, 0, 0, 4);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_02,     0,
S_DIST_LEN, NULL, 0, 0, 5);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_03,     0,
S_DIST_LEN, NULL, 0, 0, 6);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_04,     0,
S_DIST_LEN, NULL, 0, 0, 7);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_05,     0,
S_DIST_LEN, NULL, 0, 0, 8);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_06,     0,
S_DIST_LEN, NULL, 0, 0, 9);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_07,     0,
S_DIST_LEN, NULL, 0, 0, 10);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_08,     0,
S_DIST_LEN, NULL, 0, 0, 11);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_09,     0,
S_DIST_LEN, NULL, 0, 0, 12);
    bcp_bind(w_dbproc2, (BYTE *) s_dist_10,     0,
S_DIST_LEN, NULL, 0, 0, 13);
    bcp_bind(w_dbproc2, (BYTE *) &s_ytd,        0, -
1,         NULL, 0, 0, 14);
    bcp_bind(w_dbproc2, (BYTE *) &s_order_cnt,  0, -
1,         NULL, 0, 0, 15);
    bcp_bind(w_dbproc2, (BYTE *) &s_remote_cnt, 0, -
1,         NULL, 0, 0, 16);
    bcp_bind(w_dbproc2, (BYTE *) s_data,        0,
S_DATA_LEN,   NULL, 0, 0, 17);

    s_ytd = s_order_cnt = s_remote_cnt = 0;
    time_start = (TimeNow() / MILLI);
    printf("...Loading stock table\n");
    for (s_i_id=1; s_i_id <= MAXITEMS; s_i_id++)
    {
    for (s_w_id = aptr->starting_warehouse; s_w_id < aptr-
>num_warehouses+1; s_w_id++)
    {
    s_quantity = RandomNumber(10L,100L);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_01);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_02);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_03);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_04);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_05);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_06);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_07);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_08);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_09);
    len = MakeAlphaString(24,24,S_DIST_LEN, s_dist_10);
    len = MakeOriginalAlphaString(26,50, S_DATA_LEN,
s_data,10);
    if (!bcp_sendrow(w_dbproc2))
        printf("Error, Stock() failed calling
bcp_sendrow().  Check error file.\n");
    stock_rows_loaded++;
    CheckForCommit(w_dbproc2, stock_rows_loaded, "stock",
&time_start);
    }
    }

    bcp_done(w_dbproc2);
    dbclose(w_dbproc2);
    printf("Finished loading stock table.\n");
    if (aptr->build_index == 1)
    BuildIndex("idxstkcl");
    return;
}
```

```
//=========================================================
=============
//
// Function   : LoadCustomer
//
//=========================================================
=============
void LoadCustomer()
{
    LOADER_TIME_STRUCT      customer_time_start;
    LOADER_TIME_STRUCT      history_time_start;
    short           w_id;
    short               d_id;
    DWORD           dwThreadID[MAX_CUSTOMER_THREADS];
    HANDLE          hThread[MAX_CUSTOMER_THREADS];
    char            name[20];
    charbuf[250];
    printf("\nLoading customer and history tables...\n");
    // Seed with unique number
    seed(5);

    // Initialize bulk copy
    sprintf(name, "%s..%s", aptr->database, "customer");
    bcp_init(c_dbproc1, name, NULL, "logs\\customer.err",
DB_IN);
    sprintf(name, "%s..%s", aptr->database, "history");
    bcp_init(c_dbproc2, name, NULL, "logs\\history.err",
DB_IN);
    customer_rows_loaded    = 0;
    history_rows_loaded     = 0;
    CustomerBufInit();

    customer_time_start.time_start = (TimeNow() / MILLI);
    history_time_start.time_start = (TimeNow() / MILLI);

    for (w_id = aptr->starting_warehouse; w_id <= aptr-
>num_warehouses; w_id++)
    {
    for (d_id = 1L; d_id <= DISTRICT_PER_WAREHOUSE; d_id++)
    {
    CustomerBufLoad(d_id, w_id);

    // Start parallel loading threads here...
    customer_threads_completed=0;
    // Start customer table thread
    printf("...Loading customer table for: d_id = %d, w_id
= %d\n", d_id, w_id);

    hThread[0] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadCustomerTable,
      &customer_time_start,
      0,
      &dwThreadID[0]);
    if (hThread[0] == NULL)
    {
    printf("Error, failed in creating creating thread =
0.\n");
    exit(-1);
    }
    // Start History table thread
    printf("...Loading history table for: d_id = %d, w_id =
%d\n", d_id, w_id);
    hThread[1] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadHistoryTable,
      &history_time_start,
      0,
      &dwThreadID[1]);
    if (hThread[1] == NULL)
    {
    printf("Error, failed in creating creating thread =
1.\n");
    exit(-1);
    }
    while (customer_threads_completed != 2)
    Sleep(1000L);
    }
    }

    // flush the bulk connection
    bcp_done(c_dbproc1);
    bcp_done(c_dbproc2);
```

```
    sprintf(buf,"update customer set c_first = 'C_LOAD =
%d' where c_id = 1 and c_w_id = 1 and c_d_id =
1",LOADER_NURAND_C);
    dbcmd(c_dbproc1, buf);
    dbsqlexec(c_dbproc1);
    while (dbresults(c_dbproc1) != NO_MORE_RESULTS);

    dbclose(c_dbproc1);
    dbclose(c_dbproc2);
    printf("Finished loading customer table.\n");

    if (aptr->build_index == 1)
    BuildIndex("idxcuscl");
    if (aptr->build_index == 1)
    BuildIndex("idxcusnc");
    InterlockedIncrement(&main_threads_completed);
    return;
}
//============================================================
=============
//
// Function   : CustomerBufInit
//
//============================================================
=============
void CustomerBufInit()
{
    int     i;
    for (i=0;i<CUSTOMERS_PER_DISTRICT;i++)
    {
    customer_buf[i].c_id = 0;
    customer_buf[i].c_d_id = 0;
    customer_buf[i].c_w_id = 0;

    strcpy(customer_buf[i].c_first,"");
    strcpy(customer_buf[i].c_middle,"");
    strcpy(customer_buf[i].c_last,"");
    strcpy(customer_buf[i].c_street_1,"");
    strcpy(customer_buf[i].c_street_2,"");
    strcpy(customer_buf[i].c_city,"");
    strcpy(customer_buf[i].c_state,"");
    strcpy(customer_buf[i].c_zip,"");
    strcpy(customer_buf[i].c_phone,"");
    strcpy(customer_buf[i].c_credit,"");

    customer_buf[i].c_credit_lim = 0;
    customer_buf[i].c_discount = (float) 0;
    customer_buf[i].c_balance = 0;
    customer_buf[i].c_ytd_payment = 0;
    customer_buf[i].c_payment_cnt = 0;
    customer_buf[i].c_delivery_cnt = 0;

    strcpy(customer_buf[i].c_data_1,"");
    strcpy(customer_buf[i].c_data_2,"");

    customer_buf[i].h_amount = 0;

    strcpy(customer_buf[i].h_data,"");
    }

}
//============================================================
=============
//
// Function   : CustomerBufLoad
//
// Fills shared buffer for HISTORY and CUSTOMER
//============================================================
=============
void CustomerBufLoad(int d_id, int w_id)
{
    long    i;
    CUSTOMER_SORT_STRUCT    c[CUSTOMERS_PER_DISTRICT];

    for (i=0;i<CUSTOMERS_PER_DISTRICT;i++)
    {
    if (i < 1000)
    LastName(i, c[i].c_last);
    else
    LastName(NURand(255,0,999,LOADER_NURAND_C),
c[i].c_last);
    MakeAlphaString(8,16,FIRST_NAME_LEN, c[i].c_first);
    c[i].c_id = i+1;
```

```
    }
    printf("...Loading customer buffer for: d_id = %d, w_id
= %d\n",
    d_id, w_id);

    for (i=0;i<CUSTOMERS_PER_DISTRICT;i++)
    {
    customer_buf[i].c_d_id = d_id;
    customer_buf[i].c_w_id = w_id;
    customer_buf[i].h_amount = 10.0;
    customer_buf[i].c_ytd_payment  = 10.0;
    customer_buf[i].c_payment_cnt  = 1;
    customer_buf[i].c_delivery_cnt = 0;
    // Generate CUSTOMER and HISTORY data
    customer_buf[i].c_id = c[i].c_id;

    strcpy(customer_buf[i].c_first, c[i].c_first);
    strcpy(customer_buf[i].c_last, c[i].c_last);

    customer_buf[i].c_middle[0] = 'O';
    customer_buf[i].c_middle[1] = 'E';

    MakeAddress(customer_buf[i].c_street_1,
        customer_buf[i].c_street_2,
        customer_buf[i].c_city,
        customer_buf[i].c_state,
        customer_buf[i].c_zip);
    MakeNumberString(16, 16, PHONE_LEN,
customer_buf[i].c_phone);
    if (RandomNumber(1L, 100L) > 10)
    customer_buf[i].c_credit[0] = 'G';
    else
    customer_buf[i].c_credit[0] = 'B';
    customer_buf[i].c_credit[1] = 'C';
    customer_buf[i].c_credit_lim = 50000.0;
    customer_buf[i].c_discount = ((float) RandomNumber(0L,
5000L)) / 10000.0;
    customer_buf[i].c_balance = -10.0;
    MakeAlphaString(250, 250, C_DATA_LEN,
customer_buf[i].c_data_1);
    MakeAlphaString(50, 250, C_DATA_LEN,
customer_buf[i].c_data_2);
    // Generate HISTORY data
    MakeAlphaString(12, 24, H_DATA_LEN,
customer_buf[i].h_data);
    }
}
//=============================================================
=============
//
// Function   : LoadCustomerTable
//
//=============================================================
=============
void LoadCustomerTable(LOADER_TIME_STRUCT
*customer_time_start)
{
    int         i;
    long        c_id;
    short       c_d_id;
    short       c_w_id;
    char        c_first[FIRST_NAME_LEN+1];
    char        c_middle[MIDDLE_NAME_LEN+1];
    char        c_last[LAST_NAME_LEN+1];
    char        c_street_1[ADDRESS_LEN+1];
    char        c_street_2[ADDRESS_LEN+1];
    char        c_city[ADDRESS_LEN+1];
    char        c_state[STATE_LEN+1];
    char        c_zip[ZIP_LEN+1];
    char        c_phone[PHONE_LEN+1];
    char        c_credit[CREDIT_LEN+1];
    double      c_credit_lim;
    double      c_discount;
    double      c_balance;
    double      c_ytd_payment;
    short       c_payment_cnt;
    short       c_delivery_cnt;
    char        c_data_1[C_DATA_LEN+1];
    char        c_data_2[C_DATA_LEN+1];
    char        name[20];
    charc_since[50];
    bcp_bind(c_dbproc1, (BYTE *) &c_id,          0, -
1,             NULL,0,0, 1);
```

```
    bcp_bind(c_dbproc1, (BYTE *) &c_d_id,        0, -
1,              NULL,0,0, 2);
    bcp_bind(c_dbproc1, (BYTE *) &c_w_id,        0, -
1,              NULL,0,0, 3);
    bcp_bind(c_dbproc1, (BYTE *) c_first,        0,
FIRST_NAME_LEN, NULL,0,0, 4);
    bcp_bind(c_dbproc1, (BYTE *) c_middle,       0,
MIDDLE_NAME_LEN,NULL,0,0, 5);
    bcp_bind(c_dbproc1, (BYTE *) c_last,         0,
LAST_NAME_LEN,  NULL,0,0, 6);
    bcp_bind(c_dbproc1, (BYTE *) c_street_1,     0,
ADDRESS_LEN,    NULL,0,0, 7);
    bcp_bind(c_dbproc1, (BYTE *) c_street_2,     0,
ADDRESS_LEN,    NULL,0,0, 8);
    bcp_bind(c_dbproc1, (BYTE *) c_city,         0,
ADDRESS_LEN,    NULL,0,0, 9);
    bcp_bind(c_dbproc1, (BYTE *) c_state,        0,
STATE_LEN,      NULL,0,0,10);
    bcp_bind(c_dbproc1, (BYTE *) c_zip,          0,
ZIP_LEN,        NULL,0,0,11);
    bcp_bind(c_dbproc1, (BYTE *) c_phone,        0,
PHONE_LEN,      NULL,0,0,12);
   bcp_bind(c_dbproc1, (BYTE *) c_since,        0,
50,             NULL,0,SQLCHAR,13);
    bcp_bind(c_dbproc1, (BYTE *) c_credit,       0,
CREDIT_LEN,     NULL,0,0,14);
    bcp_bind(c_dbproc1, (BYTE *) &c_credit_lim,  0, -
1,              NULL,0,SQLFLT8,15);
    bcp_bind(c_dbproc1, (BYTE *) &c_discount,    0, -
1,              NULL,0,SQLFLT8,16);
    bcp_bind(c_dbproc1, (BYTE *) &c_balance,     0, -
1,              NULL,0,SQLFLT8,17);
    bcp_bind(c_dbproc1, (BYTE *) &c_ytd_payment, 0, -
1,              NULL,0,SQLFLT8,18);
    bcp_bind(c_dbproc1, (BYTE *) &c_payment_cnt, 0, -
1,              NULL,0,0,19);
    bcp_bind(c_dbproc1, (BYTE *) &c_delivery_cnt,0, -
1,              NULL,0,0,20);
    bcp_bind(c_dbproc1, (BYTE *) c_data_1,       0,
C_DATA_LEN,     NULL,0,0,21);
    bcp_bind(c_dbproc1, (BYTE *) c_data_2,       0,
C_DATA_LEN,     NULL,0,0,22);
    for (i = 0; i < CUSTOMERS_PER_DISTRICT; i++)
    {
    c_id = customer_buf[i].c_id;
    c_d_id = customer_buf[i].c_d_id;
    c_w_id = customer_buf[i].c_w_id;
    strcpy(c_first, customer_buf[i].c_first);
    strcpy(c_middle, customer_buf[i].c_middle);
    strcpy(c_last, customer_buf[i].c_last);
    strcpy(c_street_1, customer_buf[i].c_street_1);
    strcpy(c_street_2, customer_buf[i].c_street_2);
    strcpy(c_city, customer_buf[i].c_city);
    strcpy(c_state, customer_buf[i].c_state);
    strcpy(c_zip, customer_buf[i].c_zip);
    strcpy(c_phone, customer_buf[i].c_phone);
    strcpy(c_credit, customer_buf[i].c_credit);
    CurrentDate(&c_since);

    c_credit_lim = customer_buf[i].c_credit_lim;
    c_discount = customer_buf[i].c_discount;
    c_balance = customer_buf[i].c_balance;
    c_ytd_payment = customer_buf[i].c_ytd_payment;
    c_payment_cnt = customer_buf[i].c_payment_cnt;
    c_delivery_cnt = customer_buf[i].c_delivery_cnt;

    strcpy(c_data_1, customer_buf[i].c_data_1);
    strcpy(c_data_2, customer_buf[i].c_data_2);

    // Send data to server
    if (!bcp_sendrow(c_dbproc1))
        printf("Error, LoadCustomerTable() failed calling
bcp_sendrow().  Check error file.\n");
    customer_rows_loaded++;
    CheckForCommit(c_dbproc1, customer_rows_loaded,
"customer", &customer_time_start->time_start);
    }
    InterlockedIncrement(&customer_threads_completed);
}
//============================================================
=============
//
// Function   : LoadHistoryTable
//
//============================================================
=============
```

```
void LoadHistoryTable(LOADER_TIME_STRUCT
*history_time_start)
{
    int         i;
    long        c_id;
    short       c_d_id;
    short       c_w_id;
    double  h_amount;
    char        h_data[H_DATA_LEN+1];
    charh_date[50];

    bcp_bind(c_dbproc2, (BYTE *) &c_id,         0, -
1,          NULL, 0, 0, 1);
    bcp_bind(c_dbproc2, (BYTE *) &c_d_id,       0, -
1,          NULL, 0, 0, 2);
    bcp_bind(c_dbproc2, (BYTE *) &c_w_id,       0, -
1,          NULL, 0, 0, 3);
    bcp_bind(c_dbproc2, (BYTE *) &c_d_id,       0, -
1,          NULL, 0, 0, 4);
    bcp_bind(c_dbproc2, (BYTE *) &c_w_id,       0, -
1,          NULL, 0, 0, 5);
    bcp_bind(c_dbproc2, (BYTE *) h_date,        0,
50,          NULL, 0, SQLCHAR, 6);
    bcp_bind(c_dbproc2, (BYTE *) &h_amount,     0, -
1,          NULL, 0, SQLFLT8, 7);
    bcp_bind(c_dbproc2, (BYTE *) h_data,        0,
H_DATA_LEN,   NULL, 0, 0, 8);
    for (i = 0; i < CUSTOMERS_PER_DISTRICT; i++)
    {
    c_id = customer_buf[i].c_id;
    c_d_id = customer_buf[i].c_d_id;
    c_w_id = customer_buf[i].c_w_id;
    h_amount = customer_buf[i].h_amount;
    strcpy(h_data, customer_buf[i].h_data);
    CurrentDate(&h_date);
    // send to server
    if (!bcp_sendrow(c_dbproc2))
        printf("Error, LoadHistoryTable() failed calling
bcp_sendrow().  Check error file.\n");
    history_rows_loaded++;
    CheckForCommit(c_dbproc2, history_rows_loaded,
"history", &history_time_start->time_start);
    }
    InterlockedIncrement(&customer_threads_completed);
}
//=============================================================
==-===============
//
// Function   : LoadOrders
//
//=============================================================
==================
void LoadOrders()
{
    LOADER_TIME_STRUCT      orders_time_start;
    LOADER_TIME_STRUCT      new_order_time_start;
    LOADER_TIME_STRUCT      order_line_time_start;
    short           w_id;
    short               d_id;
    DWORD           dwThreadID[MAX_ORDER_THREADS];
    HANDLE          hThread[MAX_ORDER_THREADS];
    char            name[20];
    printf("\nLoading orders...\n");
    // seed with unique number
    seed(6);

    // initialize bulk copy
    sprintf(name, "%s..%s", aptr->database, "orders");
    bcp_init(o_dbproc1, name, NULL, "logs\\orders.err",
DB_IN);

    sprintf(name, "%s..%s", aptr->database, "new_order");
    bcp_init(o_dbproc2, name, NULL, "logs\\neword.err",
DB_IN);
    sprintf(name, "%s..%s", aptr->database, "order_line");
    bcp_init(o_dbproc3, name, NULL, "logs\\ordline.err",
DB_IN);

    orders_rows_loaded      = 0;
    new_order_rows_loaded   = 0;
    order_line_rows_loaded  = 0;
    OrdersBufInit();

    orders_time_start.time_start = (TimeNow() / MILLI);
    new_order_time_start.time_start = (TimeNow() / MILLI);
```

```
    order_line_time_start.time_start = (TimeNow() / MILLI);

    for (w_id = aptr->starting_warehouse; w_id <= aptr-
>num_warehouses; w_id++)
    {
    for (d_id = 1L; d_id <= DISTRICT_PER_WAREHOUSE; d_id++)
    {
    OrdersBufLoad(d_id, w_id);

    // start parallel loading threads here...
    order_threads_completed=0;
    // start Orders table thread
    printf("...Loading Order Table for: d_id = %d, w_id =
%d\n", d_id, w_id);

    hThread[0] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadOrdersTable,
      &orders_time_start,
      0,
      &dwThreadID[0]);
    if (hThread[0] == NULL)
    {
    printf("Error, failed in creating creating thread =
0.\n");
    exit(-1);
    }
    // start NewOrder table thread
    printf("...Loading New-Order Table for: d_id = %d, w_id
= %d\n", d_id, w_id);
    hThread[1] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadNewOrderTable,
      &new_order_time_start,
      0,
      &dwThreadID[1]);
    if (hThread[1] == NULL)
    {
    printf("Error, failed in creating creating thread =
1.\n");
    exit(-1);
    }
    // start Order-Line table thread
    printf("...Loading Order-Line Table for: d_id = %d,
w_id = %d\n", d_id, w_id);
    hThread[2] = CreateThread(NULL,
      0,
      (LPTHREAD_START_ROUTINE) LoadOrderLineTable,
      &order_line_time_start,
      0,
      &dwThreadID[2]);
    if (hThread[2] == NULL)
    {
    printf("Error, failed in creating creating thread =
2.\n");
    exit(-1);
    }
    while (order_threads_completed != 3)
    Sleep(1000L);
    }
    }

    printf("Finished loading orders.\n");
    InterlockedIncrement(&main_threads_completed);
    return;
}
//=============================================================
=============
//
// Function   : OrdersBufInit
//
// Clears shared buffer for ORDERS, NEWORDER, and ORDERLINE
//
//=============================================================
=============
void OrdersBufInit()
{
    int     i;
    intj;
    for (i=0;i<ORDERS_PER_DISTRICT;i++)
    {
    orders_buf[i].o_id = 0;
    orders_buf[i].o_d_id = 0;
    orders_buf[i].o_w_id = 0;
```

```
    orders_buf[i].o_c_id = 0;
    orders_buf[i].o_carrier_id = 0;
    orders_buf[i].o_ol_cnt = 0;
    orders_buf[i].o_all_local = 0;

    for (j=0;j<=14;j++)
    {
    orders_buf[i].o_ol[j].ol = 0;
    orders_buf[i].o_ol[j].ol_i_id = 0;
    orders_buf[i].o_ol[j].ol_supply_w_id = 0;
    orders_buf[i].o_ol[j].ol_quantity = 0;
    orders_buf[i].o_ol[j].ol_amount = 0;
    strcpy(orders_buf[i].o_ol[j].ol_dist_info,"");
    }
    }

}
//============================================================
=============
//
// Function   : OrdersBufLoad
//
// Fills shared buffer for ORDERS, NEWORDER, and ORDERLINE
//
//============================================================
=============
void OrdersBufLoad(int d_id, int w_id)
{
    int     cust[ORDERS_PER_DIST+1];
    long    o_id;
    short   ol;
    printf("...Loading Order Buffer for: d_id = %d, w_id =
%d\n",
    d_id, w_id);

    GetPermutation(cust, ORDERS_PER_DIST);

    for (o_id=0;o_id<ORDERS_PER_DISTRICT;o_id++)
    {
    // Generate ORDER and NEW-ORDER data
    orders_buf[o_id].o_d_id = d_id;
    orders_buf[o_id].o_w_id = w_id;
    orders_buf[o_id].o_id = o_id+1;
    orders_buf[o_id].o_c_id = cust[o_id+1];
    orders_buf[o_id].o_ol_cnt = RandomNumber(5L, 15L);
    if (o_id < 2100)
    {
    orders_buf[o_id].o_carrier_id = RandomNumber(1L, 10L);
    orders_buf[o_id].o_all_local  = 1;
    }
    else
    {
    orders_buf[o_id].o_carrier_id = 0;
    orders_buf[o_id].o_all_local  = 1;
    }

    for (ol=0;ol<orders_buf[o_id].o_ol_cnt;ol++)
    {
    orders_buf[o_id].o_ol[ol].ol = ol+1;
    orders_buf[o_id].o_ol[ol].ol_i_id = RandomNumber(1L,
MAXITEMS);
    orders_buf[o_id].o_ol[ol].ol_supply_w_id = w_id;
    orders_buf[o_id].o_ol[ol].ol_quantity = 5;
    MakeAlphaString(24, 24, OL_DIST_INFO_LEN,
&orders_buf[o_id].o_ol[ol].ol_dist_info);
    // Generate ORDER-LINE data
    if (o_id < 2100)
    {
    orders_buf[o_id].o_ol[ol].ol_amount = 0;
    // Added to insure ol_delivery_d set properly during
load
    CurrentDate(&orders_buf[o_id].o_ol[ol].ol_delivery_d);
    }
    else
    {
    orders_buf[o_id].o_ol[ol].ol_amount =
RandomNumber(1,999999)/100.0;
    // Added to insure ol_delivery_d set properly during
load
    strcpy(orders_buf[o_id].o_ol[ol].ol_delivery_d,"Dec 31,
1889");
    }
    }
    }
```

```
}
//============================================================
=============
//
// Function   : LoadOrdersTable
//
//============================================================
=============
void LoadOrdersTable(LOADER_TIME_STRUCT *orders_time_start)
{
    int         i;
    long        o_id;
    short   o_d_id;
    short   o_w_id;
    long        o_c_id;
    short       o_carrier_id;
    short       o_ol_cnt;
    short       o_all_local;
    charo_entry_d[50];

    // bind ORDER data
    bcp_bind(o_dbproc1, (BYTE *) &o_id,          0, -
1,          NULL, 0, 0, 1);
    bcp_bind(o_dbproc1, (BYTE *) &o_d_id,        0, -
1,          NULL, 0, 0, 2);
    bcp_bind(o_dbproc1, (BYTE *) &o_w_id,        0, -
1,          NULL, 0, 0, 3);
    bcp_bind(o_dbproc1, (BYTE *) &o_c_id,        0, -
1,          NULL, 0, 0, 4);
    bcp_bind(o_dbproc1, (BYTE *) o_entry_d,      0,
50,          NULL, 0, SQLCHAR, 5);
    bcp_bind(o_dbproc1, (BYTE *) &o_carrier_id,  0, -
1,          NULL, 0, 0, 6);
    bcp_bind(o_dbproc1, (BYTE *) &o_ol_cnt,      0, -
1,          NULL, 0, 0, 7);
    bcp_bind(o_dbproc1, (BYTE *) &o_all_local,   0, -
1,          NULL, 0, 0, 8);
    for (i = 0; i < ORDERS_PER_DISTRICT; i++)
    {
    o_id         = orders_buf[i].o_id;
    o_d_id       = orders_buf[i].o_d_id;
    o_w_id       = orders_buf[i].o_w_id;
    o_c_id       = orders_buf[i].o_c_id;
    o_carrier_id = orders_buf[i].o_carrier_id;
    o_ol_cnt     = orders_buf[i].o_ol_cnt;
    o_all_local  = orders_buf[i].o_all_local;
    CurrentDate(&o_entry_d);

    // send data to server
    if (!bcp_sendrow(o_dbproc1))
        printf("Error, LoadOrdersTable() failed calling
bcp_sendrow().  Check error file.\n");
    orders_rows_loaded++;
    // CheckForCommit(o_dbproc1, orders_rows_loaded,
"ORDERS", &orders_time_start->time_start);
    }
    bcp_batch(o_dbproc1);
    if ((o_w_id == aptr->num_warehouses) && (o_d_id == 10))
    {
    bcp_done(o_dbproc1);
    dbclose(o_dbproc1);
    if (aptr->build_index == 1)
    BuildIndex("idxordcl");
    }
    InterlockedIncrement(&order_threads_completed);
}
//============================================================
=============
//
// Function   : LoadNewOrderTable
//
//============================================================
=============
void LoadNewOrderTable(LOADER_TIME_STRUCT
*new_order_time_start)
{
    int         i;
    long        o_id;
    short       o_d_id;
    short       o_w_id;

    // Bind NEW-ORDER data
    bcp_bind(o_dbproc2, (BYTE *) &o_id,          0, -1,
NULL, 0, 0, 1);
    bcp_bind(o_dbproc2, (BYTE *) &o_d_id,        0, -1,
NULL, 0, 0, 2);
```

```
    bcp_bind(o_dbproc2, (BYTE *) &o_w_id,        0, -1,
NULL, 0, 0, 3);
    for (i = 2100; i < 3000; i++)
    {
    o_id    = orders_buf[i].o_id;
    o_d_id  = orders_buf[i].o_d_id;
    o_w_id  = orders_buf[i].o_w_id;
    if (!bcp_sendrow(o_dbproc2))
        printf("Error, LoadNewOrderTable() failed calling
bcp_sendrow().  Check error file.\n");
    new_order_rows_loaded++;
    // CheckForCommit(o_dbproc2, new_order_rows_loaded,
"NEW_ORDER", &new_order_time_start->time_start);
    }
    bcp_batch(o_dbproc2);
    if ((o_w_id == aptr->num_warehouses) && (o_d_id == 10))
    {
    bcp_done(o_dbproc2);
    dbclose(o_dbproc2);
    if (aptr->build_index == 1)
    BuildIndex("idxnodcl");
    }
    InterlockedIncrement(&order_threads_completed);

}
//============================================================
=============
//
// Function   : LoadOrderLineTable
//
//============================================================
=============
void LoadOrderLineTable(LOADER_TIME_STRUCT
*order_line_time_start)
{
    int         i,j;
    long        o_id;
    short   o_d_id;
    short   o_w_id;
    long        ol;
    long    ol_i_id;
    short       ol_supply_w_id;
    short       ol_quantity;
    double      ol_amount;
    short       o_all_local;
    char        ol_dist_info[DIST_INFO_LEN+1];
    charol_delivery_d[50];
    // bind ORDER-LINE data
    bcp_bind(o_dbproc3, (BYTE *) &o_id,                 0, -
1, NULL, 0, 0, 1);
    bcp_bind(o_dbproc3, (BYTE *) &o_d_id,               0, -
1, NULL, 0, 0, 2);
    bcp_bind(o_dbproc3, (BYTE *) &o_w_id,               0, -
1, NULL, 0, 0, 3);
    bcp_bind(o_dbproc3, (BYTE *) &ol,                   0, -
1, NULL, 0, 0, 4);
    bcp_bind(o_dbproc3, (BYTE *) &ol_i_id,              0, -
1, NULL, 0, 0, 5);
    bcp_bind(o_dbproc3, (BYTE *) &ol_supply_w_id,       0, -
1, NULL, 0, 0, 6);
    bcp_bind(o_dbproc3, (BYTE *) ol_delivery_d,0, 50, NULL,
0, SQLCHAR, 7);
    bcp_bind(o_dbproc3, (BYTE *) &ol_quantity,          0, -
1, NULL, 0, 0, 8);
    bcp_bind(o_dbproc3, (BYTE *) &ol_amount,            0, -
1, NULL, 0, SQLFLT8, 9);
    bcp_bind(o_dbproc3, (BYTE *) ol_dist_info,          0,
DIST_INFO_LEN, NULL, 0, 0, 10);
    for (i = 0; i < ORDERS_PER_DISTRICT; i++)
    {
    o_id    = orders_buf[i].o_id;
    o_d_id  = orders_buf[i].o_d_id;
    o_w_id  = orders_buf[i].o_w_id;
    for (j=0; j < orders_buf[i].o_ol_cnt; j++)
    {
    ol             = orders_buf[i].o_ol[j].ol;
    ol_i_id        = orders_buf[i].o_ol[j].ol_i_id;
    ol_supply_w_id = orders_buf[i].o_ol[j].ol_supply_w_id;
    ol_quantity    = orders_buf[i].o_ol[j].ol_quantity;
    ol_amount      = orders_buf[i].o_ol[j].ol_amount;
    //  Changed to insure ol_delivery_d set properly (now
set in OrdersBufLoad)
    //  CurrentDate(&ol_delivery_d);

strcpy(ol_delivery_d,orders_buf[i].o_ol[j].ol_delivery_d);
    strcpy(ol_dist_info,orders_buf[i].o_ol[j].ol_dist_info);
```

```
    if (!bcp_sendrow(o_dbproc3))
    printf("Error, LoadOrderLineTable() failed calling
bcp_sendrow().  Check error file.\n");
    order_line_rows_loaded++;
    // CheckForCommit(o_dbproc3, order_line_rows_loaded,
"ORDER_LINE", &order_line_time_start->time_start);
    }
    }
    bcp_batch(o_dbproc3);
    if ((o_w_id == aptr->num_warehouses) && (o_d_id == 10))
    {
    bcp_done(o_dbproc3);
    dbclose(o_dbproc3);
    if (aptr->build_index == 1)
    BuildIndex("idxodlcl");
    }
    InterlockedIncrement(&order_threads_completed);
}
//============================================================
=============
//
// Function   : GetPermutation
//
//============================================================
=============
void GetPermutation(int perm[], int n)
{
    int i, r, t;
    for (i=1;i<=n;i++)
    perm[i] = i;
    for (i=1;i<=n;i++)
    {
    r = RandomNumber(i,n);
    t = perm[i];
    perm[i] = perm[r];
    perm[r] = t;
    }

}
//============================================================
=============
//
// Function   : CheckForCommit
//
//============================================================
=============
void CheckForCommit(DBPROCESS *dbproc,
        int rows_loaded,
    char *table_name,
        long *time_start)
{

    longtime_end, time_diff;

    // commit every "batch" rows
    if ( !(rows_loaded % aptr->batch) )
    {
    bcp_batch(dbproc);
    time_end = (TimeNow() / MILLI);
    time_diff = time_end - *time_start;
    printf("-> Loaded %ld rows into %s in %ld sec - Total =
%d (%.2f rps)\n",
        aptr->batch,
        table_name,
    time_diff,
        rows_loaded,
    (float) aptr->batch / (time_diff ? time_diff : 1L));
    *time_start = time_end;
    }

    return;
}
//============================================================
=============
//
// Function   : OpenConnections
//
//============================================================
=============
void OpenConnections()
{
    RETCODEretcode;
    LOGINREC *login;
    login = dblogin();
```

```
    retcode = DBSETLUSER(login, aptr->user);
    if (retcode == FAIL)
    {
    printf("DBSETLUSER failed.\n");
    }
    retcode = DBSETLPWD(login, aptr->password);
    if (retcode == FAIL)
    {
    printf("DBSETLPWD failed.\n");
    }
    retcode = DBSETLPACKET(login, (USHORT) aptr->pack_size);
    if (retcode == FAIL)
    {
    printf("DBSETLPACKET failed.\n");
    }

    printf("DB-Library packet size: %ld\n",aptr->pack_size);
    // turn connection into a BCP connection
    retcode = BCP_SETL(login, TRUE);
    if (retcode == FAIL)
    {
    printf("BCP_SETL failed.\n");
    }

    // open connections to SQL Server */
    if ((i_dbproc1 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 1 to server %s.\n", aptr-
>server);
    exit(-1);
    }
    if ((w_dbproc1 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 2 to server %s.\n", aptr-
>server);
    exit(-1);
    }
    if ((w_dbproc2 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 3 to server %s.\n", aptr-
>server);
    exit(-1);
    }
    if ((c_dbproc1 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 4 to server %s.\n", aptr-
>server);
    exit(-1);
    }
    if ((c_dbproc2 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 5 to server %s.\n", aptr-
>server);
    exit(-1);
    }
    if ((o_dbproc1 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 6 to server %s.\n", aptr-
>server);
    exit(-1);
    }
    if ((o_dbproc2 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 7 to server %s.\n", aptr-
>server);
    exit(-1);
    }

    if ((o_dbproc3 = dbopen(login, aptr->server)) == NULL)
    {
    printf("Error on login 8 to server %s.\n", aptr-
>server);
    exit(-1);
    }
}
//============================================================
=============
//
// Function name: SQLErrHandler
//
//============================================================
=============
int SQLErrHandler(SQLCONN *dbproc,
          int     severity,
          int     err,
```

```
          int     oserr,
          char    *dberrstr,
          char    *oserrstr)
{

    char msg[256];
    FILE *fp1;
    char timebuf[128];
    char datebuf[128];
    _strtime(timebuf);
    _strdate(datebuf);
    sprintf(msg, "%s %s : DBLibrary (%ld) %s\n", datebuf,
timebuf, err, dberrstr);
    printf("%s",msg);
    fp1 = fopen("logs\tpccldr.err","a");
    if (fp1 == NULL)
    {
    printf("Error in opening errorlog file.\n");
    }
    else
    {
    fprintf(fp1, msg);
    fclose(fp1);
    }
    if (oserr != DBNOERR)
    {
    sprintf(msg, "%s %s : OSError (%ld) %s\n", datebuf,
timebuf, oserr, oserrstr);
    printf("%s",msg);

    fp1 = fopen("logs\\tpccldr.err","a");
    if (fp1 == NULL)
    {
    printf("Error in opening errorlog file.\n");
    }
    else
    {
    fprintf(fp1, msg);
    fclose(fp1);
    }
    }
    if ((dbproc == NULL) || (DBDEAD(dbproc)))
    {
    exit(-1);
    }
    return (INT_CANCEL);
}
//============================================================
=============
//
// Function name: SQLMsgHandler
//
//============================================================
=============
int SQLMsgHandler(SQLCONN   *dbproc,
            DBINT     msgno,
      int       msgstate,
      int       severity,
      char      *msgtext)
{
    char msg[256];
    FILE*fp1;
    char timebuf[128];
    char datebuf[128];
    if ( (msgno == 5701) || (msgno == 2528) || (msgno ==
5703) || (msgno == 6006) )
    {
    return(INT_CONTINUE);
    }
    if (msgno == 0)
    {
    return(INT_CONTINUE);
    }
    else
    {
    _strtime(timebuf);
    _strdate(datebuf);

    sprintf(msg, "%s %s : SQLServer (%ld) %s\n", datebuf,
timebuf, msgno, msgtext);
    printf("%s",msg);

    fp1 = fopen("logs\\tpccldr.err","a");
    if (fp1 == NULL)
```

```
    {
    printf("Error in opening errorlog file.\n");
    }
    else
    {
    fprintf(fp1, msg);
    fclose(fp1);
    }
    exit(-1);
    }

    return (INT_CANCEL);
}
//============================================================
=============
//
// Function name: CurrentDate
//
//============================================================
=============
void CurrentDate(char*datetime)
{
    char timebuf[128];
    char datebuf[128];
    _strtime(timebuf);
    _strdate(datebuf);
    sprintf(datetime, "%s %s", datebuf, timebuf);
}
//============================================================
=============
//
// Function name: BuildIndex
//
//============================================================
=============
void BuildIndex(char*index_script)
{
    charcmd[256];
    printf("Starting index creation:  %s\n",index_script);
    sprintf(cmd, "isql -S%s -U%s -P%s -e -i%s\\%s.sql >>
logs\\%s.out",
    aptr->server,
    aptr->user,
    aptr->password,
    aptr->index_script_path,
    index_script,
    index_script);
    system(cmd);
    printf("Finished index creation:  %s\n",index_script);
    }
```

util.c

```
    // TPC-C Benchmark Kit
    //
    // Module:  UTIL.C
    // Author:  DamienL
    // Includes
    #include "tpcc.h"
    //============================================================
    =============
    //
    // Function name: UtilSleep
    //
    //============================================================
    =============
    void UtilSleep(long  delay)
    {
    #ifdef DEBUG
        printf("[%ld]DBG: Entering UtilSleep()\n", (int)
    GetCurrentThreadId());
    #endif
    #ifdef DEBUG
        printf("[%ld]DBG: Sleeping for %ld seconds...\n", (int)
    GetCurrentThreadId(), delay);
    #endif
        Sleep(delay * 1000);
    }
    //============================================================
    =============
    //
    // Function name: UtilSleep
    //
```

```
//============================================================
=============
void UtilSleepMs(long  delay)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilSleepMs()\n", (int)
GetCurrentThreadId());
#endif
#ifdef DEBUG
    printf("[%ld]DBG: Sleeping for %ld milliseconds...\n",
(int) GetCurrentThreadId(), delay);
#endif
    Sleep(delay);
}
//============================================================
=============
//
// Function name: UtilPrintNewOrder
//
//============================================================
=============
void UtilPrintNewOrder(NEW_ORDER_DATA *pNewOrder)
{
    int i;
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilPrintNewOrder()\n",
(int) GetCurrentThreadId());
#endif
    EnterCriticalSection(&ConsoleCritSec);
    printf("\n[%04ld]\tNewOrder Transaction\n\n", (int)
GetCurrentThreadId());
    printf("Warehouse: %ld\n"
       "District: %ld\n"
       "Date: %02ld/%02ld/%04ld %02ld:%02ld:%02ld\n\n"
       "Customer Number:  %ld\n"
       "Customer Name: %s\n"
       "Customer Credit: %s\n"
       "Cusotmer Discount: %02.2f%%\n\n"
       "Order Number: %ld\n"
       "Warehouse Tax: %02.2f%%\n"
       "District Tax: %02.2f%%\n\n"
       "Number of Order Lines: %ld\n\n",
    (int)    pNewOrder->w_id,
    (int)    pNewOrder->d_id,
    (char *) pNewOrder->o_entry_d.month,
    (char *) pNewOrder->o_entry_d.day,
    (char *) pNewOrder->o_entry_d.year,
    (char *) pNewOrder->o_entry_d.hour,
    (char *) pNewOrder->o_entry_d.minute,
    (char *) pNewOrder->o_entry_d.second,
    (int)    pNewOrder->c_id,
    (char *) pNewOrder->c_last,
    (char *) pNewOrder->c_credit,
    (float)  pNewOrder->c_discount,
    (int)    pNewOrder->o_id,
    (float)  pNewOrder->w_tax,
    (float)  pNewOrder->d_tax,
    (int)    pNewOrder->o_ol_cnt);

   printf("Supp_W Item_Id Item Name                  Qty
Stock B/G Price    Amount   \n");
   printf("------ ------- ------------------------- --- --
--- --- -------- ---------\n");
    for (i=0;i < pNewOrder->o_ol_cnt;i++)
    {
   printf("%04ld   %06ld  %24s   %02ld   %03ld   %1s
%8.2f %9.2f\n",
         (int)    pNewOrder->Ol[i].ol_supply_w_id,
         (int)    pNewOrder->Ol[i].ol_i_id,
       (char *) pNewOrder->Ol[i].ol_i_name,
        (int)  pNewOrder->Ol[i].ol_quantity,
         (int)    pNewOrder->Ol[i].ol_stock,
         (char *) pNewOrder->Ol[i].ol_brand_generic,
         (float)  pNewOrder->Ol[i].ol_i_price,
         (float)  pNewOrder->Ol[i].ol_amount);
    }
   printf("\nTotal: $%05.2f\n\n",
   (float)  pNewOrder->total_amount);

   printf("Execution Status: %s\n\n",
   (char *) pNewOrder->execution_status);

   LeaveCriticalSection(&ConsoleCritSec);

}
```

```
//============================================================
=============
//
// Function name: UtilPrintPayment
//
//============================================================
=============
void UtilPrintPayment(PAYMENT_DATA *pPayment)
{
    char    tmp_data[201];
    char    data_line_1[51];
    char    data_line_2[51];
    char    data_line_3[51];
    char    data_line_4[51];
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilPrintPayment()\n", (int)
GetCurrentThreadId());
#endif

    EnterCriticalSection(&ConsoleCritSec);

    printf("\n[%04ld]\tPayment Transaction\n\n", (int)
GetCurrentThreadId());
    printf("Date: %02ld/%02ld/%04ld %02ld:%02ld:%02ld\n\n",
        (int)    pPayment->h_date.month,
    (int)    pPayment->h_date.day,
        (int)    pPayment->h_date.year,
    (int)    pPayment->h_date.hour,
    (int)    pPayment->h_date.minute,
    (int)    pPayment->h_date.second);
    printf("Warehouse: %ld\n"
       "District: %ld\n\n",
    (int)    pPayment->w_id,
    (int)    pPayment->d_id);
    printf("Warehouse Address Street 1: %s\n"
       "Warehouse Address Street 2: %s\n",
    (char *) pPayment->w_street_1,
    (char *) pPayment->w_street_2);
    printf("Warehouse Address City: %s\n"
           "Warehouse Address State: %s\n"
           "Warehouse Address Zip: %s\n\n",
    (char *) pPayment->w_city,
(char *) pPayment->w_state,
(char *) pPayment->w_zip);
printf("District Address Street 1: %s\n"
   "District Address Street 2: %s\n",
(char *) pPayment->d_street_1,
    (char *) pPayment->d_street_2);
printf("District Address City: %s\n"
       "District Address State: %s\n"
       "District Address Zip: %s\n\n",
    (char *) pPayment->d_city,
(char *) pPayment->d_state,
(char *) pPayment->d_zip);

printf("Customer Number: %ld\n"
   "Customer Warehouse: %ld\n"
   "Customer District: %ld\n",
(int)    pPayment->c_id,
(int)    pPayment->c_w_id,
(int)    pPayment->c_d_id);
printf("Customer Name:   %s %s %s\n"
   "Customer Since:  %02ld-%02ld-%04ld\n",
(char *) pPayment->c_first,
(char *) pPayment->c_middle,
(char *) pPayment->c_last,
(int)    pPayment->c_since.month,
(int)    pPayment->c_since.day,
(int)    pPayment->c_since.year);
printf("Customer Address Street 1: %s\n"
       "Customer Address Street 2: %s\n"
       "Customer Address City: %s\n"
       "Customer Address State: %s\n"
       "Customer Address Zip: %s\n"
   "Customer Phone Number: %s\n\n"
       "Customer Credit: %s\n"
    "Customer Discount: %02.2f%%\n",
(char *) pPayment->c_street_1,
(char *) pPayment->c_street_2,
(char *) pPayment->c_city,
(char *) pPayment->c_state,
(char *) pPayment->c_zip,
(char *) pPayment->c_phone,
```

```
    (char *) pPayment->c_credit,
    (double) pPayment->c_discount);
    printf("Amount Paid: $%04.2f\n"
           "New Customer Balance: $%10.2f\n",
    (float)  pPayment->h_amount,
    (double) pPayment->c_balance);

    printf("Credit Limit: $%10.2f\n\n",
    (double) pPayment->c_credit_lim);

    if (strcmp(pPayment->c_data," ") != 0)
    {
    strcpy(tmp_data, pPayment->c_data);
    strncpy(data_line_1, tmp_data, 50);
data_line_1[50] = '\0';
    strncpy(data_line_2, &tmp_data[50], 50);
data_line_2[50] = '\0';
    strncpy(data_line_3, &tmp_data[100], 50);
data_line_3[50] = '\0';
    strncpy(data_line_4, &tmp_data[150], 50);
data_line_4[50] = '\0';

    }
    else
    {
    strcpy(data_line_1, " "); strcpy(data_line_2, " ");
    strcpy(data_line_3, " "); strcpy(data_line_4, " ");
    }
    printf("                ----------------------------------
------------------\n");
    printf("Customer Data: |%50s|\n", data_line_1);
    printf("               |%50s|\n", data_line_2);
    printf("               |%50s|\n", data_line_3);
    printf("               |%50s|\n", data_line_4);
    printf("                ----------------------------------
------------------\n\n");
    printf("Execution Status: %s\n\n",
    (char *) pPayment->execution_status);
    LeaveCriticalSection(&ConsoleCritSec);
}
//============================================================
=============
//
// Function name: UtilPrintOrderStatus
//
//============================================================
=============
void UtilPrintOrderStatus(ORDER_STATUS_DATA *pOrderStatus)
{
    int i;
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilPrintOrderStatus()\n",
(int) GetCurrentThreadId());
#endif
    EnterCriticalSection(&ConsoleCritSec);
    printf("\n[%04ld]\tOrder-Status Transaction\n\n", (int)
GetCurrentThreadId());
    printf("Warehouse: %ld\n"
           "District: %ld\n\n",
    (int) pOrderStatus->w_id,
    (int) pOrderStatus->d_id);
    printf("Customer Number: %ld\n"
           "Customer Name: %s %s %s\n\n",
    (int) pOrderStatus->c_id,
    (char *) pOrderStatus->c_first,
    (char *) pOrderStatus->c_middle,
    (char *) pOrderStatus->c_last);
    printf("Customer Balance: $%5.2f\n\n",
    (double) pOrderStatus->c_balance);
    printf("Order Number: %ld\n"
           "Entry Date: %02ld/%02ld/%04ld
%02ld:%02ld:%02ld\n"
           "Carrier Number: %ld\n\n"
           "Number of order lines: %ld\n\n",
    (int) pOrderStatus->o_id,
    (int) pOrderStatus->o_entry_d.month,
    (int) pOrderStatus->o_entry_d.day,
    (int) pOrderStatus->o_entry_d.year,
    (int) pOrderStatus->o_entry_d.hour,
    (int) pOrderStatus->o_entry_d.minute,
    (int) pOrderStatus->o_entry_d.second,
    (int) pOrderStatus->o_carrier_id,
    (int) pOrderStatus->o_ol_cnt);
```

```
    printf ("Supply-W    Item-Id    Delivery-Date    Qty
Amount    \n");
    printf ("--------    -------    -------------    ---   -
---------\n");
    for (i=0;i < pOrderStatus->o_ol_cnt; i++)
    {
    printf("%04ld        %06ld     %02ld/%02ld/%04ld
%02ld     %9.2f\n",
    (int) pOrderStatus->OlOrderStatusData[i].ol_supply_w_id,
    (int) pOrderStatus->OlOrderStatusData[i].ol_i_id,
    (int) pOrderStatus-
>OlOrderStatusData[i].ol_delivery_d.month,
    (int) pOrderStatus-
>OlOrderStatusData[i].ol_delivery_d.day,
    (int) pOrderStatus-
>OlOrderStatusData[i].ol_delivery_d.year,
    (int) pOrderStatus->OlOrderStatusData[i].ol_quantity,
    (double)pOrderStatus->OlOrderStatusData[i].ol_amount);
    }
    if (pOrderStatus->o_ol_cnt == 0)
    printf("\nNo Order-Status items.\n\n");
    printf("\nExecution Status: %s\n\n",
    (char *) pOrderStatus->execution_status);
    LeaveCriticalSection(&ConsoleCritSec);
}
//============================================================
=============
//
// Function name: UtilPrintDelivery
//
//============================================================
=============
void UtilPrintDelivery(DELIVERY_DATA *pQueuedDelivery)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilPrintDelivery()\n",
(int) GetCurrentThreadId());
#endif
    EnterCriticalSection(&ConsoleCritSec);
    printf("\n[%04ld]\tDelivery Transaction\n\n", (int)
GetCurrentThreadId());
    printf("Warehouse: %ld\n", (int) pQueuedDelivery->w_id);
    printf("Carrier Number: %ld\n\n", (int) pQueuedDelivery-
>o_carrier_id);
    printf("Execution Status: %s\n\n", (char *)
pQueuedDelivery->execution_status);
    LeaveCriticalSection(&ConsoleCritSec);
}
//============================================================
=============
//
// Function name: UtilPrintStockLevel
//
//============================================================
=============
void UtilPrintStockLevel(STOCK_LEVEL_DATA *pStockLevel)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilPrintStockLevel()\n",
(int) GetCurrentThreadId());
#endif
    EnterCriticalSection(&ConsoleCritSec);
    printf("\n[%04ld]\tStock-Level Transaction\n\n", (int)
GetCurrentThreadId());
    printf("Warehouse: %ld\nDistrict: %ld\n",
    (int) pStockLevel->w_id,
    (int) pStockLevel->d_id);

    printf("Stock Level Threshold: %ld\n\n", (int)
pStockLevel->thresh_hold);
    printf("Low Stock Count: %ld\n\n", (int) pStockLevel-
>low_stock);
    printf("Execution Status: %s\n\n", (char *) pStockLevel-
>execution_status);

    LeaveCriticalSection(&ConsoleCritSec);
}
//============================================================
=============
//
// Function name: UtilError
//
//============================================================
=============
void UtilError(long threadid, char * header, char *msg)
```

```
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilError()\n", (int)
GetCurrentThreadId());
#endif
    printf("[%ld] %s: %s\n", (int) threadid, header, msg);
}
//=============================================================
=============
//
// Function name: UtilFatalError
//
//=============================================================
=============
void UtilFatalError(long threadid, char * header, char *msg)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilFatalError()\n", (int)
GetCurrentThreadId());
#endif
    printf("[Thread: %ld]... %s: %s\n", (int) threadid,
header, msg);
    exit(-1);
}
//=============================================================
=============
//
// Function name: UtilStrCpy
//
//=============================================================
============
void UtilStrCpy(char * pDest, char * pSrc, int n)
{
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilStrCpy()\n", (int)
GetCurrentThreadId());
#endif
    strncpy(pDest, pSrc, n);
    pDest[n] = '\0';
}
#ifdef USE_CONMON
//=============================================================
=============
//
// Function name: WriteConsoleString
//
//=============================================================
============
void WriteConsoleString(HANDLE hConMon, char *str, short x,
short y, short color, BOOL pad)
{
    COORD   dwWriteCoord = {0, 0};
    DWORD   cCharsWritten;
    LPVOID  dummy;
    int     len, i;
#ifdef DEBUG
    printf("[%ld]DBG: Entering WriteConsoleString()\n",
(int) GetCurrentThreadId());
#endif

    dwWriteCoord.X = x;
    dwWriteCoord.Y = y;
    if (pad)
    {
    len = strlen(str);
    if (len < CON_LINE_SIZE)
    {
    for(i=1;i<CON_LINE_SIZE-len;i++)
    {
    strcat(str," ");
    }
    }
    }
    EnterCriticalSection(&ConsoleCritSec);
    switch (color)
    {
    case YELLOW:
    SetConsoleTextAttribute(hConMon,
    FOREGROUND_INTENSITY | FOREGROUND_GREEN |
FOREGROUND_RED | BACKGROUND_BLUE);
        break;
    case RED:
    SetConsoleTextAttribute(hConMon,
    FOREGROUND_INTENSITY | FOREGROUND_RED |
BACKGROUND_BLUE);
```

```
        break;
    case GREEN:
    SetConsoleTextAttribute(hConMon,
    FOREGROUND_INTENSITY | FOREGROUND_GREEN |
BACKGROUND_BLUE);
    break;
     }

    SetConsoleCursorPosition(hConMon, dwWriteCoord);
    WriteConsole(hConMon, str, strlen(str), &cCharsWritten,
dummy);
    LeaveCriticalSection(&ConsoleCritSec);
}
#endif
//============================================================
=============
//
// Function name: AddDeliveryQueueNode
//
//============================================================
=============
BOOL AddDeliveryQueueNode(DELIVERY_PTR node_to_add)
{

    DELIVERY_PTRlocal_node;
#ifdef DEBUG
    DELIVERY_PTRptrtmp;
    short           i;
#endif
    EnterCriticalSection(&QueuedDeliveryCritSec);

    if ((local_node = malloc(sizeof(struct delivery_node))
) == NULL)
    {
    printf("ERROR:  problem allocating memory for delivery
queue.\n");
    exit(-1);
    }
    else
    {
    memcpy(local_node, node_to_add, sizeof (struct
delivery_node));
    if (queued_delivery_cnt == 0)
    {
    delivery_head = local_node;
    delivery_head->next_delivery = NULL;
    delivery_tail = delivery_head;
    }
    else
    {
    local_node->next_delivery = NULL;
    delivery_tail->next_delivery = local_node;
    delivery_tail = local_node;
    }
    }

    queued_delivery_cnt++;
#ifdef DEBUG
    i=0;
    printf("Add to delivery list:
%ld\n",queued_delivery_cnt);
    ptrtmp=delivery_head;
    while (ptrtmp != NULL)
    {
    i++;
    printf("%ld - w_id %ld - o_carrier_id %ld - queue_time
%d/%d/%d %d:%d:%d:%d\n",
    i, ptrtmp->w_id, ptrtmp->o_carrier_id,
    ptrtmp->queue_time.wMonth,
    ptrtmp->queue_time.wDay,
    ptrtmp->queue_time.wYear,
    ptrtmp->queue_time.wHour,
    ptrtmp->queue_time.wMinute,
    ptrtmp->queue_time.wSecond,
    ptrtmp->queue_time.wMilliseconds);
    ptrtmp=ptrtmp->next_delivery;
    }
#endif
    LeaveCriticalSection(&QueuedDeliveryCritSec);

    return TRUE;
}
//============================================================
=============
```

```
//
// Function name: GetDeliveryQueueNode
//
//============================================================
=============
BOOL GetDeliveryQueueNode(DELIVERY_PTR node_to_get)
{

    DELIVERY_PTRlocal_node;
    BOOLrc;
#ifdef DEBUG
    DELIVERY_PTRptrtmp;
    shorti;
#endif

    EnterCriticalSection(&QueuedDeliveryCritSec);

    if (queued_delivery_cnt == 0)
    {
#ifdef DEBUG
    printf("No delivery nodes found.\n");
#endif
    rc = FALSE;
    }
    else
    {
    memcpy(node_to_get, delivery_head, sizeof(struct
delivery_node));
    if (queued_delivery_cnt == 1)
    {
    free(delivery_head);
    delivery_head = NULL;
    queued_delivery_cnt = 0;
    }
    else
    {
    local_node = delivery_head;
    delivery_head = delivery_head->next_delivery;
    free(local_node);
    queued_delivery_cnt--;
    }
#ifdef DEBUG
    i=0;
    printf("Get from delivery list:
%ld\n",queued_delivery_cnt);
    ptrtmp=delivery_head;
    while (ptrtmp != NULL)
    {
    i++;
    printf("%ld - w_id %ld - o_carrier_id %ld - queue_time
%d/%d/%d %d:%d:%d:%d\n",
    i, ptrtmp->w_id, ptrtmp->o_carrier_id,
    ptrtmp->queue_time.wMonth,
    ptrtmp->queue_time.wDay,
    ptrtmp->queue_time.wYear,
    ptrtmp->queue_time.wHour,
    ptrtmp->queue_time.wMinute,
    ptrtmp->queue_time.wSecond,
    ptrtmp->queue_time.wMilliseconds);
    ptrtmp=ptrtmp->next_delivery;
    }
#endif
    rc = TRUE;

    }
    LeaveCriticalSection(&QueuedDeliveryCritSec);

    return rc;
}
//============================================================
=============
//
// Function name: WriteDeliveryString
//
//============================================================
=============
void WriteDeliveryString(char   buf[255])
{
    DWORD   bytesWritten;
    DWORD   retCode;
#ifdef DEBUG
    printf("[%ld]DBG: Entering UtilDeliveryMsg()\n", (int)
GetCurrentThreadId());
#endif
```

```
    EnterCriticalSection(&WriteDeliveryCritSec);

    retCode = WriteFile (hDeliveryMonPipe, buf,
PLEASE_WRITE,
      &bytesWritten, NULL);
    LeaveCriticalSection(&WriteDeliveryCritSec);
}
```

tpc.inc

```
#
#################################################################
################
#       TPC.INC
#
#
#################################################################
################
# TYPE will be supplied as the type directory.
EXE_DIR = $(TPC_DIR)\run\ntintel
OBJ_DIR = $(TPC_DIR)\build\ntintel\obj
INC_DIR = $(TPC_DIR)\src
# C compiler flags.
# NT_WIN32 is always small model.
# OF will be supplied as the optimizing flag (/Od or /Ot).
# ZF will be supplied as the debugging flag (none or /Zi).
# DB will be supplied as a debugging flag.
CDEFINES = -DWIN32  -DNTWIN32 -Di386 -DDBNTWIN32  -D_X86_ -
DCONSOLE -D_WINDOWS -D_NTWIN
CFLAGS = /c /G4 /Gs $(OF) /W2 $(ZF) $(DB) $(DBAPI)
$(CDEFINES) /DLINT_ARGS=1
CFLAGSOPT = $(CFLAGS)  /Ot
CC = cl
# Linker flags.
# LF1 will be supplied as the link debugging flag (-
debug:full)
# LF2 will be supplied as the link debugging flag (-
debugtype:cv)
LFLAGS = -subsystem:console $(LF1) $(LF2) /NODEFAULTLIB:LIBC
LL = link $(LFLAGS)
# NTWIN32 libraries
# BUGBUG: Can't load strings in console subsystem mode yet.
NTLIBS= $(NTLIB)\kernel32.lib \
    $(NTLIB)\advapi32.lib \
    $(NTLIB)\libcmt.lib
```

Appendix C – Tunable Parameters

Microsoft Windows NT Version 4.0 Configuration Parameters

There were no Windows NT registry parameters that were changed from their defaults.

Microsoft SQL Server Version 6.5 Startup Parameters

c:\mssql\binn\sqlservr -c -x -t1081 -t3502

where

-c	start SQL Server independently of the Windows NT Service Control Manager
-x	disables the keeping of CPU time and cache-hit ratio statistics
-t1081	allows the index pages a "second" trip through the cache
-t3052	prints a message to the log at the start and end of each checkpoint

Microsoft SQL Server Version 6.5 Configuration Parameters

sp_configure:

name	minimum	maximum	config_value	run_value
affinity mask	0	2147483647	0	0
allow updates	0	1	1	1
backup buffer size	1	32	1	1
backup threads	0	32	0	0
cursor threshold	-1	2147483647	-1	-1

database size	2	10000	2	2
default language	0	9999	0	0
default sortorder id	0	255	50	50
fill factor	0	100	0	0
free buffers	20	524288	2000	2000
hash buckets	4999	265003	265003	265003
language in cache	3	100	3	3
LE threshold maximum	2	500000	200	200
LE threshold minimum	2	500000	20	20
LE threshold percent	1	100	0	0
locks	5000	2147483647	10000	10000
LogLRU buffers	0	2147483647	2000	2000
logwrite sleep (ms)	-1	500	0	0
max async IO	1	1024	20	20
max lazywrite IO	1	1024	128	128
max text repl size	0	2147483647	65536	65536
max worker threads	10	1024	250	250
media retention	0	365	0	0
memory	2800	1048576	905000	905000
nested triggers	0	1	1	1
network packet size	512	32767	4096	4096
open databases	5	32767	8	8
open objects	100	2147483647	200	200
priority boost	0	1	0	0
procedure cache	1	99	1	1
Protection cache size	1	8192	15	15
RA cache hit limit	1	255	4	4
RA cache miss limit	1	255	3	3
RA delay	0	500	15	15
RA pre-fetches	1	1000	3	3
RA slots per thread	1	255	5	5
RA worker threads	0	255	0	0
recovery flags	0	1	0	0
recovery interval	1	32767	32767	32767
remote access	0	1	0	0
remote conn timeout	-1	32767	10	10
remote login timeout	0	2147483647	5	5
remote proc trans	0	1	0	0
remote query timeout	0	2147483647	0	0
remote sites	0	256	0	0

resource timeout	5	2147483647	10	10
set working set size	0	1	0	0
show advanced options	0	1	1	1
SMP concurrency	-1	64	-1	-1
sort pages	64	511	64	64
spin counter	1	2147483647	10000	10000
tempdb in ram (MB)	0	2044	5	5
time slice	50	1000	100	100
user connections	5	32767	260	260
user options	0	4095	0	0

Server System Configuration Parameters

Board Information

HP NetServer LX System Board

System

This system board contains the following on-board features:

1) 2 CPU module slots supporting up to
   4 processors,
2) 1 ECC Memory connectors
   (Up to 1.5GB Total Memory),
3) 6 PCI connectors,
4) 4 EISA connectors,
5) Static RAM Cache,
6) Shadow RAM Control,
7) Paged Memory,
8) Dual I/O APIC Units,
9) 1 Parallel Port,
10) 2 Serial Ports,
11) Onboard Video Controller,
12) Onboard Floppy Controller,
13) Onboard IDE Hard Disk Controller,
14) Onboard mouse/keyboard interface,
15) 2 Onboard SCSI Controllers.

Manufacturer ..... Hewlett-Packard Co.

ID INT31C0

Category ..... SYS

Board slot type ..... Embedded

Readable ID ..... Yes

Overlay name INT31C0.OVL

Overlay version 1.32

SYSTEMS GROUP

System Identification and Version Information

System Identification String IDNOCD0L

Config and Overlay Version ..... Overlay version: 1.20m - CO

BIOS Version String ..... BIOS: 0.02.05.CD0L

MP Spec Version: ..... MP Spec V1.4 (Use for NT 3.5x)

System Processor Modules

CPU 1 in Slot 1 ..... Pentium (R) Pro Intel CPU at 200 MHz

CPU 2 in Slot 1 ..... Pentium (R) Pro Intel CPU at 200 MHz

CPU 1 in Slot 2 ..... Pentium (R) Pro Intel CPU at 200 MHz

CPU 2 in Slot 2 ..... Pentium (R) Pro Intel CPU at 200 MHz

System Processor Status

CPU 1 in Slot 1 ..... No Failures Detected

CPU 2 in Slot 1 ..... No Failures Detected

CPU 1 in Slot 2 ..... No Failures Detected

CPU 2 in Slot 2 ..... No Failures Detected

System Performance

Power-On Speed Option ..... CPU Speed=FAST

APIC Interrupt Routing ..... Local APIC, Mode A (Default)

Secondary IOAPIC Control Option ..... Disable Secondary IOAPIC

MEMORY SUBSYSTEM GROUP

Base Memory Options ..... 640KB Base Memory

Shadowing ISA ROMs Options ..... Press 'Enter'to Modify the Shadowing Options

Extended Memory Options (Cache, 1MB ISA Hole) 2048 MB Extended Memory /

512 KB Cache (WB)

On-Board Disk Controllers

On-Board Floppy Controller ..... Enable

On-board IDE Controller ..... Enable

On-Board Communication Devices

Serial Port 1 Configuration ..... Port 1 Disable

Serial Port 2 Configuration ..... Port 2 Disable

Parallel Port Configuration ..... Parallel Port Disable

Parallel Port Mode ..... Parallel Port Mode

ISA-Compatible

Parallel Port DMA (Valid only with ECP Mode) . No DMA

FLOPPY DRIVE SUBSYSTEMS GROUP

Floppy Drive A Options ..... 3.5 inch 1.44/1.25 MB drive

Floppy Drive B Options ..... Disable or Not Installed

IDE SUBSYSTEM GROUP

ISA IDE DMA Transfers ..... Disable

IDE Configuration -- Primary Master ..... No Drive Detected

IDE Drive Options -- Primary Master

Multi-Sector Transfer ..... Auto Configured

Translation Mode ..... Auto Configured

Fast Programmed I/O Modes ..... Auto Configured

IDE Configuration -- Primary Slave ..... No Drive Detected

IDE Drive Options -- Primary Slave

Multi-Sector Transfer ..... Auto Configured

Translation Mode ..... Auto Configured

Fast Programmed I/O Modes ..... Auto Configured

IDE Configuration -- Secondary Master ..... No Drive Detected

IDE Drive Options -- Secondary Master

Multi-Sector Transfer ..... Auto Configured

Translation Mode ..... Auto Configured

Fast Programmed I/O Modes ..... Auto Configured

IDE Configuration -- Secondary Slave ..... No Drive Detected

IDE Drive Options -- Secondary Slave

Multi-Sector Transfer ..... Auto Configured

Translation Mode ..... Auto Configured

Fast Programmed I/O Modes ..... Auto Configured

BIOS MESSAGE LANGUAGE

Language Support Options

Current Language ..... English (US)

KB and MOUSE SUBSYSTEM GROUP

Keyboard and Mouse Options

NumLock Options ..... OFF at Boot

Typematic Speed ..... Auto

Mouse Control Option ..... Mouse Auto detected

Console Redirection

Console Redirection Control

COM Port for Redirection ..... Disable

Serial Port Baud Rate ..... 19.2K Baud

Hardware Flow Control ..... None

Select Terminal Type ..... ANSI

SECURITY SUBSYSTEMS GROUP

Administrative Password Option ..... Disabled

User Password Option ..... Disabled

Hot Key Option ..... Disabled

Lockout Timer ..... 10 Minutes

Secure Boot Mode ..... Disable

Video Blanking ..... Disable

Floppy Writes ..... Disable

BOOT SUBSYSTEM GROUP

Boot Options

First Boot Device ..... Boot Floppy

Second Boot Device ..... Boot Hard Disk

Boot From Embedded SCSI ..... Onboard Boot Priority

Require User Interaction on POST Errors ..... Disable

SCSI ROM BIOS OPTIONS GROUP

SCSI-A ROM BIOS Scan ..... Enable

SCSI-B ROM BIOS Scan ..... Enable

LCD SUBSYSTEM GROUP

LCD Display String Enable or Disable ..... Enable

LCD Display String Before OS Boot ..... Default

MANAGEMENT SUBSYSTEM GROUP

Temperature/Voltage Limit Control ..... Press 'Enter' to modify the

System Limits

A/D Channel Enable Switch ..... Press 'Enter' to

Enable/Disable the A/D

Channels

Speaker Options ..... Enable

System Management Options

System Management Mode ..... Enable

Event Logging ..... Enable

PCI System Error Detection ..... Disable

Power Down Options

Cycle Power on ASR ..... Enable

Power Down on Critical Thermal or Voltage

Condition ..... Enable

ADVANCED CONFIGURATION - !CAUTION!

Advanced PCI Options

PCI Master Latency Timer ..... 60h (Default)

Bus Performance Mode ..... Auto Detect (Default)

Address Bit Permuting ..... Enabled

PCI Line Read Prefetch ..... Disabled

Advanced CPU Options

In-order Queue depth ..... Depth = 8 (Default)

Advanced Chipset Options

GAT Mode ..... Normal mode

Outbound Posting ..... Disabled (Default)

Memory Controller Page Open Policy ..... Hold page open with no

requests

Reserved System Resources

Reserve VGA Resources ..... Reserve VGA Memory (On-board

video)

Board Information

PCI Mass Storage Controller

PCI 1

Manufacturer ..... PCI

ID 101e9010

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

PCI Mass Storage Controller

PCI 2

Manufacturer ..... PCI

ID 101e9010

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

PCI Mass Storage Controller

PCI 3

Manufacturer ..... PCI

ID 101e9010

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

PCI Mass Storage Controller

PCI 4

Manufacturer ..... PCI

ID 101e9010

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

PCI Mass Storage Controller

PCI 5

Manufacturer ..... PCI

ID 101e9010

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

PCI Ethernet Controller

PCI 6

Manufacturer ..... PCI

ID 80861229

Category ..... NET

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

PCI SCSI Controller

SCSI A

Manufacturer ..... PCI

ID 90048078

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

Device Configuration for Embedded SCSI

SCSI A

Manufacturer ..... Hewlett-Packard Co.

ID ADP7880

Category ..... MSD

Board slot type ..... Embedded

Readable ID ..... No

Overlay name ADP7880.OVL

Overlay version 1.00

Wide SCSI Channel Configuration

SCSI Channel Interface ..... Wide Channel, Single-Ended

SCSI

Host Adapter SCSI ID 7

SCSI Bus Parity Check ..... Enabled

BIOS configuration ..... Press <Enter> to configure

Device configuration ..... Press <Enter> to configure

Boot Device option ..... Press <Enter> to configure

Utilities ..... Press <Enter> to access

Board Information

PCI SCSI Controller

SCSI B

Manufacturer ..... PCI

ID 90048078

Category ..... MSD

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Board Information

Device Configuration for Embedded SCSI

SCSI B

Manufacturer ..... Hewlett-Packard Co.

ID ADP7880

Category ..... MSD

Board slot type ..... Embedded

Readable ID ..... No

Overlay name ADP7880.OVL

Overlay version 1.00

Wide SCSI Channel Configuration

SCSI Channel Interface ..... Wide Channel, Single-Ended

SCSI

Host Adapter SCSI ID 7

SCSI Bus Parity Check ..... Enabled

BIOS configuration ..... Press <Enter> to configure

Device configuration ..... Press <Enter> to configure

Boot Device option ..... Press <Enter> to configure

Utilities ..... Press <Enter> to access

Board Information

Operating System Optimization

NOS

Manufacturer ..... Hewlett-Packard Co.

ID HWP21D0

Category ..... OSE

Board slot type ..... Other

Readable ID ..... No

Skirt ..... No

Length ..... 330 millimeters

Overlay name HWP21D0.OVL

Overlay version 0.01

System Optimization ..... No optimization

Board Information

PCI board

Embedded

Manufacturer ..... PCI

ID 80860008

Category ..... OTH

Board slot type ..... PCI

Readable ID ..... No

Skirt ..... No

PCI Function 1 ..... Enabled

Used Resources

Resource	Slot	Function
IRQ 0	System	Reserve Timer ports
IRQ 1	System	Reserve Keyboard Controller port
IRQ 3	SCSI A	PCI Function 1

IRQ 4..... SCSI B PCI Function 1

IRQ 5..... PCI 3 PCI Function 1

IRQ 6..... System On-Board Floppy Controller

IRQ 7..... PCI 5 PCI Function 1

IRQ 8..... System Reserve Real Time Clock ports

IRQ 2(9)..... PCI 2 PCI Function 1

IRQ 10..... PCI 1 PCI Function 1

IRQ 11..... PCI 4 PCI Function 1

IRQ 12..... System Keyboard and Mouse Options

IRQ 13..... System Reserve Math Co-processor ports

IRQ 14..... System On-board IDE Controller

IRQ 15..... PCI 6 PCI Function 1

DMA 2..... System On-Board Floppy Controller

DMA 4..... System Reserve EISA DMA ports

Port 0h - 0Fh..... System Reserve EISA DMA ports

Port 20h - 21h..... System Reserve ISA PIC ports

Port 40h - 43h..... System Reserve Timer ports

Port 60h..... System Reserve Keyboard Controller port

Port 61h..... System Reserve Speaker ports

Port 64h..... System Reserve Keyboard Controller port

Port 70h - 71h..... System Reserve Real Time Clock ports

Port 80h - 90h..... System Reserve EISA DMA ports

Port 94h - 9Fh..... System Reserve EISA DMA ports

Port 0A0h - 0A1h..... System Reserve ISA PIC ports

Port 0C0h - 0DEh..... System Reserve EISA DMA ports

Port 0F0h - 0FFh..... System Reserve Math Co-processor ports

Port 1F0h - 1F7h..... System On-board IDE Controller

Port 3B4h - 3B5h..... System Reserve VGA Resources

Port 3BAh..... System Reserve VGA Resources

Port 3C0h - 3CAh..... System Reserve VGA Resources

Port 3CCh..... System Reserve VGA Resources

Port 3CEh - 3CFh..... System Reserve VGA Resources

Port 3D4h - 3D5h..... System Reserve VGA Resources

Port 3DAh..... System Reserve VGA Resources

Port 3F0h - 3F5h..... System On-Board Floppy Controller

Port 3F6h..... System On-board IDE Controller

Port 3F7h..... System On-Board Floppy Controller

```
Port 40Bh..... System     Reserve EISA DMA ports
Port 410h - 43Fh..... System     Reserve EISA DMA ports
Port 481h - 483h..... System     Reserve EISA DMA ports
Port 487h..... System     Reserve EISA DMA ports
Port 489h - 48Ch..... System     Reserve EISA DMA ports
Port 4D6h..... System     Reserve EISA DMA ports
Port 0C80h - 0C83h..... System     Reserved EISA ID Ports

Port 0CA0h - 0CA1h..... System     Reserve IC2 ports
Port 0CA2h - 0CAFh..... System     Reserved System Ports
Port 0CB0h - 0CB7h..... System     Reserved LCD ports
Port 1C80h - 1C83h..... System     Reserved EISA ID Ports
Port 2C80h - 2C83h..... System     Reserved EISA ID Ports
Port 3C80h - 3C83h..... System     Reserved EISA ID Ports
Port 4C80h - 4C83h..... System     Reserved EISA ID Ports
Port 0E0E0h - 0E0FFh.... PCI 6      PCI Function 1
Port 0E400h - 0E47Fh.... PCI 5      PCI Function 1
Port 0E480h - 0E4FFh.... PCI 4      PCI Function 1
Port 0E800h - 0E8FFh.... SCSI B     PCI Function 1
Port 0EC00h - 0ECFFh.... SCSI A     PCI Function 1
Port 0F880h - 0F8FFh.... PCI 3      PCI Function 1
Port 0FC00h - 0FC7Fh.... PCI 2      PCI Function 1
Port 0FC80h - 0FCFFh.... PCI 1      PCI Function 1

Memory
Address       Amount
# 0.....640K.... System     Base Memory Options
  0A0000h.....64K.... System     Reserve VGA Resources
  0B0000h.....64K.... System     Reserve VGA Resources
# 0C0000h.....32K.... System     Reserve VGA Resources
  0C8000h.....8K.... PCI 1      PCI Function 1
  0CC000h.....8K.... PCI 2      PCI Function 1
  0D0000h.....8K.... PCI 3      PCI Function 1
# 0E8000h.....96K.... System     Reserve SYSTEM Memory
# 1M.....15M.... System     System Memory 1M - 16M
# 16M.....48M.... System     System Memory 16M - 592M
  0FE0FF000h.....4K.... PCI 6      PCI Function 1
  4071M.....1M.... PCI 6      PCI Function 1
  0FE8FE000h.....4K.... SCSI B     PCI Function 1
  0FE8FF000h.....4K.... SCSI A     PCI Function 1
```

0FEC00400h.....3K.... System Reserve P6 resources

0FEC01000h.....1K.... Embedded PCI Function 1

0FEC01400h....19963K.... System Reserve P6 resources

0FFF80000h.....512K.... System Reserve SYSTEM Memory

= Caching

Available Resources

---IRQs--+---DMAs--+-----ISA I/O Ports---+-Memory Amount---Address----

| 0 | 10h - 1Fh | 8K 0CA000h

| 1 | 22h - 3Fh | 8K 0CE000h

| 3 | 44h - 5Fh | 56K 0D2000h

| 5 | 62h - 63h | 32K 0E0000h

| 6 | 65h - 6Fh |

| 7 | 72h - 7Fh |

| | 91h - 93h |

| | 0A2h - 0BFh |

| | 0DFh - 0EFh |

| | 100h - 1EFh |

| | 1F8h - 3B3h |

| | 3B6h - 3B9h |

| | 3BBh - 3BFh |

| | 3CBh |

| | 3CDh |

| | 3D0h - 3D3h |

| | 3D6h - 3D9h |

| | 3DBh - 3EFh |

| | 3F8h - 400h |

System Specifications

Slot Name	Slot Type	Board ID	Accept Skirted	Max Length	Bus-master	Slot Tag(s)
PCI 1	PCI	101e9010	Yes	341mm	Yes	
PCI 2	PCI	101e9010	Yes	341mm	Yes	
PCI 3	PCI	101e9010	Yes	341mm	Yes	
PCI 4	PCI	101e9010	Yes	341mm	Yes	
PCI 5	PCI	101e9010	Yes	341mm	Yes	
PCI 6	PCI	80861229	Yes	341mm	Yes	

EISA 1	EISA	(Empty)	Yes	341mm	Yes	
EISA 2	EISA	(Empty)	Yes	341mm	Yes	
EISA 3	EISA	(Empty)	Yes	341mm	Yes	
EISA 4	EISA	(Empty)	Yes	341mm	Yes	
SCSI A	PCI	90048078	Yes	341mm	Yes	
SCSI A	Other	ADP7880	Yes	341mm	No	ADP7880
SCSI B	PCI	90048078	Yes	341mm	Yes	
SCSI B	Other	ADP7880	Yes	341mm	No	ADP7880
NOS	Other	HWP21D0	Yes	341mm	No	HWP21D0

Nonvolatile memory 8K

Disk Array Configuration Parameters

MegaRAID DiskArray Display Utility version 1.01

HA #2 FwVersion = Hj64, BIOS Version = 1.37, DRAM Size = 32MB

HA #3 FwVersion = Hj64, BIOS Version = 1.37, DRAM Size = 32MB

HA #4 FwVersion = Hj64, BIOS Version = 1.37, DRAM Size = 32MB

HA #5 FwVersion = Hj64, BIOS Version = 1.37, DRAM Size = 32MB

HA #6 FwVersion = Hj64, BIOS Version = 1.37, DRAM Size = 32MB

No of RAIDCard Adapters Found = 5

ADAPTER MAPPINGS :

Adapter = 0 Device Location = \\.\Scsi2:

Adapter = 1 Device Location = \\.\Scsi3:

Adapter = 2 Device Location = \\.\Scsi4:

Adapter = 3 Device Location = \\.\Scsi5:

Adapter = 4 Device Location = \\.\Scsi6:

```
                                MEGARAID HA-0

                                LogicalDrives Found  = 1

Logical Drive : 1

Raid Level : 0                  Spans : 3       Read Ahead
: No

Stripe Size : 8K                Status : Optimal Write Mode :
Write Through

DirectIO : Enabled              Num Stripes : 6

                                Physical Drives ###
Channel  ID    ConfiguredSize

                                      0     0     8677
MB
                                      0     1     8677
MB
                                      0     2     8677
MB
                                      0     3     8677
MB
                                      0     4     8677
MB
                                      0     6     8677
MB
                                      1     0     8677
MB
                                      1     1     8677
MB
                                      1     2     8677
MB
                                      1     3     8677
MB
                                      1     4     8677
MB
                                      1     6     8677
MB
                                      2     0     8677
MB
                                      2     1     8677
MB
                                      2     2     8677
MB
                                      2     3     8677
MB
                                      2     4     8677
MB
                                      2     6     8677
MB
------------------------------------------------------------------

                                MEGARAID HA-1
```

LogicalDrives Found = 1

Logical Drive : 1

Raid Level : 0 Spans : 3 Read Ahead : No

Stripe Size : 8K Status : Optimal Write Mode : Write Through

DirectIO : Disabled Num Stripes : 6

Physical Drives ###

Channel	ID	ConfiguredSize
0	1	4066 MB
0	2	4066 MB
0	3	4066 MB
0	4	4066 MB
0	5	4066 MB
0	6	4066 MB
1	1	4066 MB
1	2	4066 MB
1	3	4066 MB
1	4	4066 MB
1	5	4066 MB
1	6	4066 MB
2	0	4066 MB
2	1	4066 MB
2	2	4066 MB
2	3	4066 MB
2	4	4066 MB
2	6	4066 MB

MEGARAID HA-2

LogicalDrives Found = 1

Logical Drive : 1

Raid Level : 0 Spans : 3 Read Ahead : No

Stripe Size : 8K Status : Optimal Write Mode : Write Through

DirectIO : Disabled Num Stripes : 6

Physical Drives ###

Channel	ID	ConfiguredSize
0	0	4066 MB
0	1	4066 MB
0	2	4066 MB
0	3	4066 MB
0	4	4066 MB
0	6	4066 MB
1	0	4066 MB
1	1	4066 MB
1	2	4066 MB
1	3	4066 MB
1	4	4066 MB
1	6	4066 MB
2	0	4066 MB
2	1	4066 MB
2	2	4066 MB
2	3	4066 MB
2	4	4066 MB
2	6	4066 MB

MEGARAID HA-3

```
                        LogicalDrives Found  = 1
Logical Drive : 1
Raid Level : 0          Spans : 3       Read Ahead
: No
Stripe Size : 8K        Status : Optimal Write Mode :
Write Through
DirectIO : Enabled      Num Stripes : 6

                        Physical Drives ###
Channel  ID    ConfiguredSize
                                0     1     4066
MB
                                0     2     4066
MB
                                0     3     4066
MB
                                0     4     4066
MB
                                0     5     4066
MB
                                0     6     4066
MB
                                1     1     4066
MB
                                1     2     4066
MB
                                1     3     4066
MB
                                1     4     4066
MB
                                1     5     4066
MB
                                1     6     4066
MB
                                2     1     4066
MB
                                2     2     4066
MB
                                2     3     4066
MB
                                2     4     4066
MB
                                2     5     4066
MB
                                2     6     4066
MB
------------------------------------------------------------------
                                        MEGARAID HA-4
```

LogicalDrives Found = 1

Logical Drive : 1

Raid Level : 0 Spans : 3 Read Ahead : No

Stripe Size : 8K Status : Optimal Write Mode : Write Through

DirectIO : Enabled Num Stripes : 6

Physical Drives ###

Channel	ID	ConfiguredSize
0	1	4066 MB
0	2	4066 MB
0	3	4066 MB
0	4	4066 MB
0	5	4066 MB
0	6	4066 MB
1	1	4066 MB
1	2	4066 MB
1	3	4066 MB
1	4	4066 MB
1	5	4066 MB
1	6	4066 MB
2	1	4066 MB
2	2	4066 MB
2	3	4066 MB
2	4	4066 MB
2	5	4066 MB
2	6	4066 MB

Tuxedo UBBconfig

```
# This is a UBBconfig for a client1-server configuration.
#
# This UBBconfig requires settings for:
# SERVER_NAME CLIENT_NAME MASTER_NAME
SERVER_ADDR CLIENT_ADDR NODE_NAMES
# TLISTEN_PORT TBRIDGE_PORT
# In addition, it requires setting the things all UBBconfig.gens
need:
#                       IPCKEYsome decent
IPCKEY, should be different for each config
#                       ROOTDIR
#                       TUXCONFIG
#                       APPDIR
#                       ULOGDIR
#
#--------------------------------------------------------------------
*RESOURCES
#--------------------------------------------------------------------
                        IPCKEY40001
                        PERM0666
                        MASTER client1
  MAXACCESSERS          100# 1024 or more
  MAXGTT                1024
  MAXSERVERS            7
  MAXSERVICES           20   # MAXSERVERS * #-of-
services-each-server + 10( for BBL)
  MODEL                 SHM
  LDBAL                 Y
# During benchmark, don't want to scan too often.  In particular,
while
# the client1s are stabilizing in virtual memory, we don't want to
sanity
# scan; and if we do sanity scan, we want large timeouts, since the
BRIDGE
# the BBL, the DBBL, and the client1s aren't getting much CPU
time during that
# period.  Current settings:
#                       *  scan servers every 5
minutes (maximum allowed by TUXEDO);
#                       *  wait 1 minute for sanity
responses (maximum allowed by TUXEDO);
```

```
#                                       *  scan all the BBLs from
DBBL every 30 minutes (want one scan in the
#                                          audited results);
#                                       *  timeout a blocking call
after 5 minutes (the maximum).
                                       SCANUNIT60
                                       SANITYSCAN5
                                       DBBLWAIT1
                                       BBLQUERY30
                                       BLOCKTIME5
#
#--------------------------------------------------------------------
*MACHINES
#--------------------------------------------------------------------
DEFAULT:
            TUXCONFIG="/project/iti/confs/TUXconfig.client1"
                                          ROOTDIR="/project/iti"

APPDIR="/project/tpcc/bin"

ULOGPFX="/tmp/TUXEDO_LOG"

# for debugging, put both into the same log on the same machine
#
ULOGPFX="/home/iti/confs/tpcc/ULOG"
# but for a big run, need some space, and want them local to the
# machine rather than across the net.
# Leave TUXCONFIG alone on the MASTER machine; over-ride
for each
# other machine?
client1                                LMID=client1
        TUXCONFIG="/project/iti/confs/TUXconfig.client1"
#--------------------------------------------------------------------
*GROUPS
#--------------------------------------------------------------------
group1          LMID=client1
                GRPNO=1
#--------------------------------------------------------------------
#--------------------------------------------------------------------
#--------------------------------------------------------------------
*SERVERS
#--------------------------------------------------------------------
#
```

```
# "--" is application-specific arguments to be passed to server
# "-n" is designed to specify server-id
service SRVGRP=group1
                                CLOPT="-s NEWO_SVC -s
PMT_SVC -s ORDS_SVC -s STKL_SVC -s DVRY_SVC -- -n1"
    RQADDR=tpcc_1 SRVID=1
service SRVGRP=group1
                                CLOPT="-s NEWO_SVC -s
PMT_SVC -s ORDS_SVC -s STKL_SVC -s DVRY_SVC -- -n2"
    RQADDR=tpcc_2 SRVID=2
#------------------------------------------------------------------
*SERVICES
#------------------------------------------------------------------
*ROUTING
#------------------------------------------------------------------
```

HP-UX Configuration - Clients

```
**************************************
* $Source: /usr/local/kcs/sys.SSR10_800/filesets.info/CORE-
KRN/RCS/generic,v $
* $Revision: 1.2.71.3 $          $Author: craig $
* $State: Exp $                  $Locker: CRT $
* $Date: 94/05/23 14:52:23 $
*
******************************************************
**************************
* SCSI drivers
******************************************************
**************************
scsi1
target
tape2
disc3
******************************************************
**************************
* Networking
******************************************************
**************************
lan2
```

lan3

dlpi

inet

uipc

nm

ni

****

* Misc drivers

****

mux2

****

* Subsystems

****

cdfs

nfs

prf

****

* Streams, DLIP, and Streams-based PTY Drivers/Modules

* Note: To remove the Streams PTY driver from the dfile, you need to

* yank out the following items:

* ptm, pts. ldterm, ptem, pckt, and nstrpty 60

****

hpstreams

clone

strlog

sad

echo

sc

timod

tirdwr

pipedev

pipemod

```
ffs


*******************************************************
**********************
* Tunables
*******************************************************
**********************
swap default
default_disk_ir    0
*
bufpages        1024
maxusers        3100
maxswapchunks   2048
maxuprc         5000
nproc           5050
*
msgmap          (2*MSGMNI)
msgmax          4096
msgmnb          65536
msgmni          4096
msgseg          20000
msgssz          200
msgtql          (MSGMAP+2)
*
nfile           15000
nflocks         800
ninode          15000
npty            100
*
semaem          16384
semmap          2048
semmni          4096
semmns          4096
semmnu          4096
semume          32
semvmx          32767
*
shmmni          50
shmmax          0x7fffffff
shmseg          12
*
```

timezone 480

Appendix D – Disk Storage

180-day and 8 hour Space Calculations are provided below:

Note: Numbers are in Kbytes unless otherwise specified

180 day growth

Warehouses 650 tpmC 8028.07

Table	Rows	Data	Index	Extra 5%	Data + Index + 5%
warehouse	650	1300	10	66	1376
district	6500	13000	56	653	13709
customer	19500000	13002600	1009188	700589	14712377
history	19500000	975002	0		975002
new_order	5850000	65000	398	3270	68668
orders	19500000	507000	3060		510060
order_line	195004080	10839880	70856		10910736
item	100000	9100	46	457	9603
stock	65000000	21671000	119736	1089537	22880273
Totals		47083882	1203350	1794572	50081804

Segment	Size
master & msdb & model & tempdb	60000
misc_seg	6640000
ordln_seg	17305600
cs_seg	44000000
Total	68005600

Dynamic Space	12321882	Sum of Data for order, order_line and history
Static Space	37759922	Sum of all data and index +5 % - dynamic space
Free Space	17923796	Total space allocated to DBMS - dynamic - static
Daily Growth	2434977	Dynamic Space*tpmC/(W*62.5)
Daily Spread	14271331	Free Space - 1.5 * Daily Growth
		This can be reconfigured to eliminate daily spread (zero assumed)
180 day space	476055740.1	Static space + 180*(daily growth + daily spread)
8 hr log space	21187740	

Disk Allocation	Space Needed	Disk Size		Disks Needed
180 day space	476055740	4160512	RAID 0	38
		8885248	RAID 0	36
8 hr log space	21187740	4160512	RAID 1	12
OS and swap	2400000	4160512	RAID 0	1

Appendix E – Quotations

All quotes can be found on the following pages.

Metropolitan Technologies
8791 Commerce Court
Manassas, VA 20110
phone: 703-361-9553

TO: Larry Gray, Hewlett-Packard, Santa Clara, CA
From: Bob Fletcher Date: April 3, 1997
Subject: Price quote
As you requested, here are the prices for the equipment list you provided.
These prices are good for 60 days from the above date.

	Product Number	Product Brand	METROPOLITAN Unit Price
HP NetServer LX Pro 6/200 Array M1	D4958B	HP	25,909
3 year, on-site, next day warranty	incl		
2 200MHz Pentium Pro processors	incl		
128 Mb memory	incl		
12 Hot swap disk bays	incl		
CD-ROM drive	incl		
PCI Disk Array controller - dual F/W SCSI-2 channels	incl		
Integrated dual PCI F/W SCSI-2 cntrlrs	incl		
Integrated IDE controller	incl		
Integrated 1024x768 16 color video 512KB video mem	incl		
3.5-inch, 1.44MB floppy drive	incl		
1 parallel, 2 serial ports	incl		
keyboard & mouse	incl		
3 410W hot-swap power modules & redundant fans	incl		
HP NetServer Navigator	incl		
HP NetServer Assistant	incl		
HP Open View for Windows	incl		
NetServer LX 6/200 Dual Processor card	D4866A	HP	856
NetServer LX 6/200 Pentium Pro chip	D4867A	HP	2,532
128Mbyte SIMM Module Memory Upgrade	D4893A	HP	2,697
15" VGA Monitor	D2808A	HP	372
HP 10/100 PCI Network Adaptor	J3171A	HP	121
HP 3-Channel NetRAID PCI Array cntrl + 10% spare	D4943A	HP	2,117
HP Storage System/6 + 10% spare	D3604A	HP	897
HP 9GB SCSI-2 hot swap drives + 10% spares	D4289A	HP	2,337
HP 4.2 GB SCSI-2 hot swap drive + 10% spares	D3583B	HP	1,281
HP SureStore Tape 6000i 8Gb Internal DAT	C1528F	HP	946
Microsoft Windows NT Server 4.0		Microsoft	714

Page 1 of 1

Redmond, WA 98052-6399 Fax 206 936 7329

Microsoft®

March 13, 1997

Mr. Bill Groves
R&D Project Manager
Hewlett-Packard Company
Network Server Division
5301 Stevens Creek Blvd.
Santa Clara, CA 85052

via FAX # 408-553-3674

Dear Bill,

Microsoft has received your request for permission to disclose results of TPC-C benchmarks done with the following HP system and Microsoft SQL Srever:

HP NetServer LX Pro 6/200, 4-processor, Pentium Pro-based, 200 MHz

Microsoft hereby grants HP permission to disclose these results and acknowledges that HP has formally requested permission to do so in accordance with the license agreement for Microsoft SQL Server software.

Best Regards,

Sid Arora
Product Manager, Microsoft SQL Server
Personal and Business Systems Group

Redmond, WA 98052-6399 Fax 206 936 7329

Microsoft®

March 13, 1997

Mr. Bill Groves
R&D Project Manager
Hewlett-Packard Company
Network Server Division
5301 Stevens Creek Blvd.
Santa Clara, CA 95052

via FAX # 408-553-3674

Dear Bill,

In response to your inquiry, here is the U.S. pricing information you requested:

Microsoft Windows NT Server 4.0 (5-client pack)	$809
Microsoft SQL Server 6.5 plus user license (unlimited)	$24,999
Microsoft Priority Plus Database Server Support for 5 yrs @ $2,095/yr	$10,475

The prices quoted above are valid for the next 60 days. Please let me know if I can be of any further assistance.

Sincerely,

Sid Arora

Sid Arora
Product Manager, Microsoft SQL Server
Personal and Business Systems Group

Visigenic Software, Inc.

March 26, 1997

Larry Gray
Ph: 408-553-4186
Fx: 408-553-3674

Dear Mr. Gray,

Please find below the price quote for the Visigenic VisiODBC SDK and Microsoft SQL Server Driver which you are using in the TPC-C benchmark testing. Also attached is the text which we would like to have included in the Full Disclosure Report. Please let me know if you would prefer this information electronically, simply notify me of your e-mail address and I can provide this.

Visigenic Product Pricing for TPC-C Benchmarks on HP-UX

The following is the product pricing for the Visigenic VisiODBC components used in the TPC-C benchmarks.

- VisiODBC Microsoft SQL Server Driver - $39,990 total cost

  $1,995 for 10 users on one machine. For a 50 user license per machine the cost is $9,975. Therefore, if 4 machines were used, then the total cost for the driver on both machines is $39,990.

- VisiODBC SDK - $995

  A single SDK must be purchased for each developer for development of the ODBC application - the benchmark software.

- 5 years of support for the VisiODBC MS SQL Server Driver - 20% of software purchase price per year

  For example, if 4 machines were used, and the total purchase price was $39,990, then the support cost is $7,980 per year, for a total of $39,990 for 5 years of support for a single site and 2 designated contacts.

Please feel free to contact me with any questions regarding this matter. Visigenic would like to review the Visigenic portion of the Full Disclosure Report before it is published. Please let me know when a draft will be available. My phone number is 415-312-0853.

Sincerely,

Paul Oldham
Product Manager

Visigenic Software, Inc.
951 Mariner's Island Blvd. Ste. 120
San Mateo, CA 94404
415-286-1900
415-286-2464(fax)
http://www.visigenic.com

Visigenic ODBC SDK and the Microsoft SQL Server ODBC Driver

The database connectivity software utilized in the Hewlett Packard TPC-C benchmark is the Visigenic VisiODBC SDK and the Microsoft SQL Server ODBC Driver. The VisiODBC SDK was used to develop the TPC-C benchmark on the HP-UX operating system. The Microsoft SQL Server Driver was used to provide database connectivity from the HP-UX benchmark platform to the Microsoft SQL Server running on an HP Windows NT 3.51 machine. The Microsoft SQL Server Driver is one of many VisiODBC drivers provided by Visigenic which can be purchased separately or as part of the VisiODBC DriverSet.

Company Description. Visigenic is playing a key role in creating the foundation on which mission-critical applications of tomorrow will be written—the open, distributed, object-based architecture for the new global enterprise. Building on its leadership and expertise in standards-based distributed object and data access technologies, Visigenic is a pioneer in managing distributed business logic and its access to data.

VisiODBC Drivers and DriverSets. With the VisiODBC Drivers and DriverSets (formerly Visigenic ODBC Drivers and DriverSets), you can provide cross-platform access to the most popular SQL databases—including CA-Ingres, IBM DB2, Informix, Microsoft SQL Server, Oracle, Sybase—from any ODBC-enabled application. The VisiODBC Driver acts as the communication link between an ODBC-compliant application and a specific RDBMS—the driver processes ODBC function calls, takes vendor-independent SQL calls and translates them to RDBMS-specific SQL calls, and returns the results of those calls to the ODBC-enabled application. VisiODBC drivers are carefully designed to support the development of mission-critical applications and are available for Windows, Windows NT, Windows 95, ATT GIS, IBM AIX, HP-UX, SCO, Solaris, Sun OS, Macintosh and Power Macintosh, and OS/2. VisiODBC Drivers are sold separately or as the VisiODBC DriverSet, a complete set of drivers for a given platform.

VisiODBC SDKs. With the VisiODBC SDKs (formerly Visigenic ODBC SDKs), you can develop vendor-independent database applications and ODBC-compliant drivers. Through an agreement with Microsoft, Visigenic has the exclusive right to license and port the ODBC Software Development Kit (SDK) to all non-Windows platforms— from this strategic position, Visigenic has advanced ODBC as the cross-platform standard for database access. Visigenic has ported the Microsoft ODBC 2.0 SDK to ATT GIS, IBM AIX, HP-UX, SCO, Solaris, Sun OS, Macintosh and Power Macintosh, and OS/2. Additional platforms will be available on an on-going basis.

VisiChannel. VisiChannel (formerly Visigenic OpenChannel) provides the only complete database connectivity architecture that is open, flexible, and significantly reduces the cost of building and maintaining your client/server environment. Designed to meet the needs of large client/server Internet, Intranet, and enterprise deployments, VisiChannel's revolutionary server-centric architecture greatly simplifies database connectivity and improves data access control. Based on the ODBC standard, VisiChannel is database-independent and Internet-ready.

3/14//97

BEA Systems Inc.
17101 Preston Rd.
LB 115, Suite 260
Dallas, TX 75248-1370

Dear Mr. Groves,

Here is the price quote you requested the other day. In your message you asked for BEA TUXEDO in a four machine configuration.

This quote is based on HP E55 system.

Description	Machine Class	List Price Price	Units	Extended List Price	5 Yr. Maintenance (5X8)
TUXEDO 6.2 CFS	2 (E55)	$3,000	4	$12,000	$9,000

Bill, if I can assist you in the future please give me a call.

Sincerely,
Ron Hurt

NETLUX

14180 Live Oak Ave., Unit E
Baldwin Park, Ca. 91760

1-800-789-1780
Phone #818-851-9737
Fax #818-851-9837

March 14, 1997

Hewlett Packard
Bill Grove
408-553-3674

Quotation

Quantity	Description	Unit Price	Total
301	24-Port 10Base-T Rack Mount Ethernet Hub	$251.00	$75,551.00

Total	$75,551.00
Shipping	TBD

Terms and Conditions:

FOB Origin
5 Year Warranty
Prices good for 30 Days
24-Port will be scheduled for delivery over 1 month
8-Port FAST hub will ship from stock

Sincerely,
Martin Parry
NETLUX

Forsythe Solutions Group, Inc.
7440 N. Long Avenue
Skokie, IL 60077

03/14/97

Bill Laflamme
HP Product Specialist
(TEL) 847-982-6834

HP 9000 Model E55

New System

Model:

Includes:

Post-it® Fax Note 7671 | Date 3/14 | # of pages ▶ 2
To Bill Groves | From Bill
Co./Dept. HP | Co. FSG
Phone # | Phone #
Fax # 408-553-3674 | Fax #

Qty	Part Number		Unit Price	Price Ext
Operating System Option:				
4	A3194AW	HP9000 Series 800 E55	$8,900.00	$35,600.00
4	A2440A	HP-UX 2-User Operating System	$0.00	$0.00
4	A2440A\ABA	English system manuals	$0.00	$0.00
4	A2440A\APS	HP-UX revision 10.0	$0.00	$0.00
System Chassis:				
4	A2442A	MUX, Base System I/O, S/800	$0.00	$0.00
4	A2442A\001	8 RS-232 Modem Ports	$150.00	$600.00
System Memory:				
12	A3131A	128MB Memory, Field Add-On	$1,450.00	$17,400.00
12	A3131A\0DZ	Integrated in SPU	$0.00	$0.00
System Disk:				
4	A3349A	1GB, SCSI Int. Disk, Nova/WB	$0.00	$0.00
4	A3349A\0D1	Factory integrated	$300.00	$1,200.00
System Console:				
4	C1064WX	System Console - White Screen	$200.00	$800.00
4	C1064WX\ABA	Contains United States keyboar	$0.00	$0.00
Office Software & Compilers				
4	B3901AA	ANSI C Compiler, UX 10.0	$0.00	$0.00
4	B3901AA\AH0	Tier 1 License	$1,575.00	$6,300.00
4	B3900AA	C/ANSI C Dev. Bundle Media	$0.00	$0.00
4	B3900AA\AAU	CD-ROM Certificate Only	$0.00	$0.00
4	B3900AA\APS	HP-UX Revision 10.0	$0.00	$0.00
Disk & Tape Storage Products				
4	A3184A	CD-ROM, Internal	$0.00	$0.00
4	A3184A\0DZ	Factory installed unit	$250.00	$1,000.00

Forsythe Solutions Group, Inc.
7440 N. Long Avenue
Skokie, IL 60077

03/14/97

Bill Laflamme
HP Product Specialist
(TEL) 847-982-6834

Local & Wide Area Communications

8	J2146A	LAN/9000 Link	$0.00	$0.00
8	J2146A\0DM	LAN/9000 Link for HP9000/800 E	$750.00	$6,000.00

Vendor Pricing February **System Total:** $68,900.00