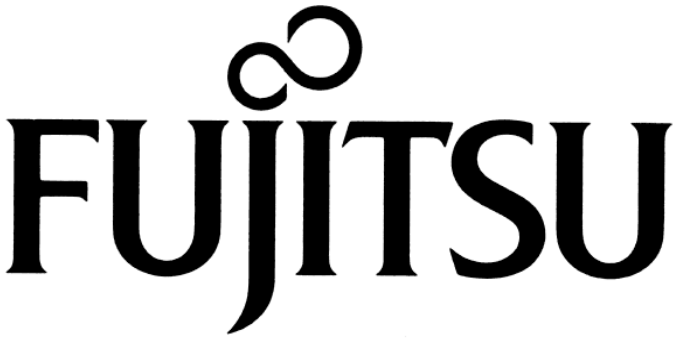


TPC Benchmark™C

Full Disclosure Report

Fujitsu
GRANPOWER 7000
Model 200

running

SymfoWARE V11L20

May 12, 1997

The benchmark results contained in this document were submitted for compliance with version 3.3 of the TPC Benchmark C Standard Specification. The result of that action is to place these benchmark results into the sixty day "under review" status as of May 12, 1997.

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

The pricing information in this document is believed to accurately reflect the current prices as of the publication date. However, Fujitsu provides no warranty of the pricing information in this document.

Benchmark results are highly dependent upon workload, specific application requirements, and system design and implementation. Relative system performance will vary as a result of these and other factors. Therefore the TPC Benchmark C should not be used as a substitute for a specific customer application benchmark when critical capacity planning and/or product evaluation decisions are contemplated.

All performance data contained in this report were obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. Fujitsu 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 the United States May 12, 1997

UXP/DS V20 is derived from UNIX System V Release 4.2

UXP/DS is a trademark of Fujitsu Limited in Japan.

UNIX is a registered trademark in the United States and other countries, licensed exclusively through X/OPEN Company Limited.

SymfoWARE is a trademark of Fujitsu in Japan.

TP-Base V20 is derived from TUXEDO, which is a registered trademark of BEA Systems, Inc.

TP-Base is a trademark of Fujitsu Limited in Japan.

TPC Benchmark, TPC-C and tpmC are trademarks of the Transaction Processing Performance Council.

Preface

The TPC Benchmark C was developed by the Transaction Processing Performance Council (TPC). The TPC was founded to define transaction processing benchmarks and to disseminate objective, verifiable performance data to the industry. This full disclosure report is based on the TPC Benchmark C Standard Specifications Version 3.3, released April 8, 1997.

TPC Benchmark C Overview

The TPC describes this benchmark in Clause 0.1 of the specifications as follows:

TPC Benchmark C is an On Line Transaction Processing (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.

Benchmark results are highly dependent upon workload, specific application requirements, and systems design and implementation. Relative system performance will vary as a result of these and other factors. Therefore, TPC-C should not be used as a substitute for a specific customer application benchmarking when critical capacity planning and/or product evaluation decisions are contemplated.

FUJITSU

Abstract

Overview

This report documents the methodology and results of the TPC Benchmark C test conducted by Fujitsu Ltd. on the Fujitsu GRANPOWER 7000 Model 200. The operating system used for the benchmark was UXP/DS V20. The DBMS used was SymfoWARE V11L20.

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:

5,738.30 tpmC
¥69,585 per tpmC
Available as of November 12, 1997

Standard and Executive Summary Statements

The following pages contain the executive summary of results for this benchmark.

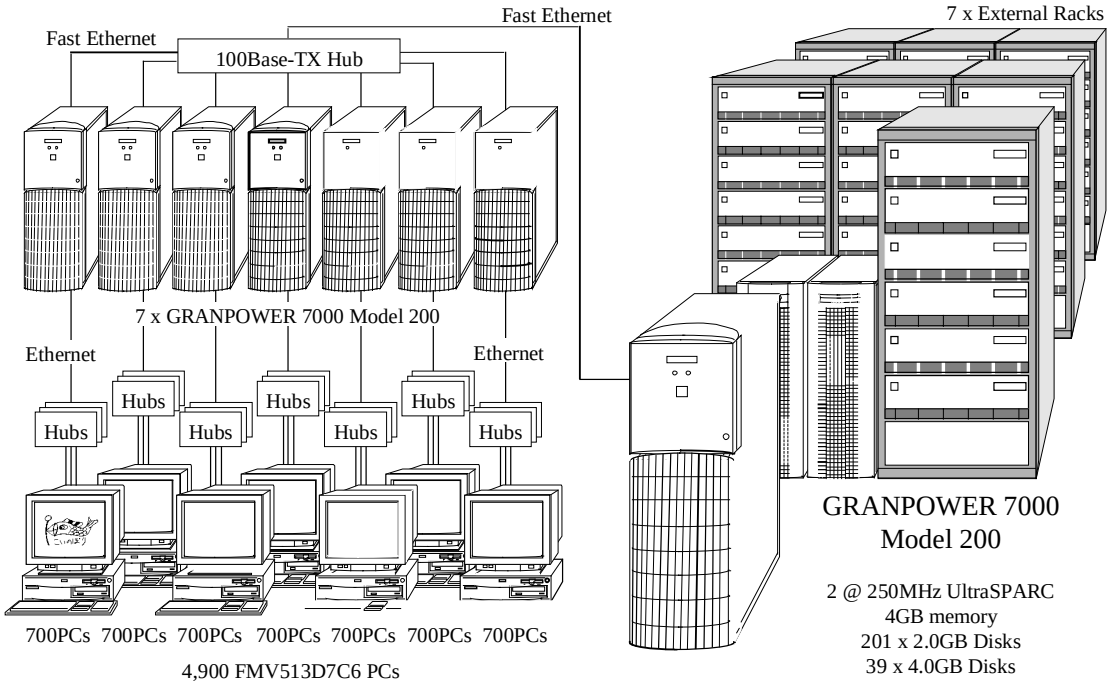
Auditor

The benchmark configuration, environment and methodology, along with the pricing model used to calculate the cost per tpmC, were audited by Lorna Livingtree of Performance Metrics, Inc. to verify compliance with the relevant TPC specifications.

Priced Configuration

FUJITSU	Fujitsu GRANPOWER 7000 Model 200 C/S with 7 Front-Ends		TPC-C Rev. 3.3
			Report Date: May. 1997
Total System Cost	TPC-C Throughput	Price/Performance	Availability Date
399,301,820 Yen	5,738.30 tpmC	69,585 Yen/tpmC	Nov. 12, 1997

Processors	Database Manager	Operating System	Other Software	Number of Users
2 @ 250MHz UltraSPARC	SymfoWARE Server for UltraSPARC V11L20	UXP/DS Basic Software V20	LVCF V22 TP-Base V20 COBOL85 V20	4,900



System Components	Qty	Server Description	Qty	Client Description (each)
Processor	2	UltraSPARC @ 250MHz	7	2 UltraSPARC @ 167MHz
Cache Memory		1MB (each processor)		512KB (each processor)
Memory		4,096MB	7	768MB
Disk Controller	1	Wide-SCSI (1 Channel, internal)	7	SCSI-2 (1 Channel)
	19	Wide-SCSI (1 Channel)		
Disks	201	2.0GB Disk	7	2.0GB Disk
	39	4.0GB Disk		
Total Disk Storage		558.0GB	7	2.0GB
Terminals	1	Console	7	Console
Hubs	1	8-port (100Base-TX)	210	24-port (10Base-T)

Detailed Pricing information

FUJITSU

Fujitsu GRANPOWER 7000 Model 200 C/S with 7 Front-Ends

TPC-C Rev. 3.3

Report Date: May. 1997

Order Number	Description	Quantity	Unit Price	Extended Price	Maintenance rate/unit	5 Years Maintenance
Server Hardware						
GP720B1	GRANPOWER 7000 model 200 (1cpu@250MHz) with 100/10Mbps LAN adapter	1	3,600,000	3,600,000	15,000	810,000
GP721B11	Additional CPU module (1cpu@250MHz)	1	2,300,000	2,300,000	9,600	518,400
GP762M8202	Additional memory (4GB)	1	50,400,000	50,400,000	0	0
F7978SB2	SBus extention unit	3	900,000	2,700,000	4,500	729,000
F7958HS1	Wide SCSI-2 adapter	19	250,000	4,750,000	0	0
GP723D41	Additional Wide-SCSI Disk unit (4GB/internal)	3	390,000	1,170,000	2,000	324,000
F7945A5E	Additional Wide-SCSI Disk unit (2GB)	176	380,000	66,880,000	1,900	18,057,600
F7973D41A	Additional Wide-SCSI Disk unit (4GB)	21	680,000	14,280,000	3,400	3,855,600
F7915AR11	RAID5 Disk Array unit (8GB)	1	5,100,000	5,100,000	25,500	1,377,000
F7915AR31A	Additional RAID5 Array disks (8GB)	4	1,200,000	4,800,000	6,000	1,296,000
F7915AR2	RAID0 Disk Array unit (20GB)	1	6,200,000	6,200,000	31,000	1,674,000
F7915AR33	Additional RAID0 Array disks (20GB)	2	2,100,000	4,200,000	10,500	1,134,000
F7949RA3	External Rack	7	630,000	4,410,000	3,200	1,209,600
F7949FU2A	External File unit	32	700,000	22,400,000	3,500	6,048,000
F7960A11	Display unit	1	380,000	380,000	1,500	81,000
DCBL-RCB05	RS-232 cable	1	16,000	16,000	0	0
GP723ET1	8mm Tape device	1	840,000	840,000	4,200	226,800
	Server Hardware Subtotals			194,426,000		37,341,000
Server Software						
B7831DK62	UXP/DS Basic Software V20	1	262,000	262,000	440,000	2,200,000
B7836KM3L	LVCF V22	1	400,000	400,000	0	0
D782MEB16	SymfoWARE Server for UltraSPARC V11L20 (64 users)	1	13,820,000	13,820,000	752,400	3,762,000
D782MEB8U	Additional user license (16 users)	1	2,850,000	2,850,000	0	0
	Server Software Subtotals			17,332,000		5,962,000
Client Hardware						
GP720A1	GRANPOWER 7000 model 200 (1cpu@167MHz) with 100/10Mbps LAN adapter	7	2,400,000	16,800,000	10,000	3,780,000
GP721A11	Additional CPU module (1cpu@167MHz)	7	1,495,000	10,465,000	6,200	2,343,600
GP722M41	Additional memory (256MB)	14	2,600,000	36,400,000	0	0
GP722M31	Additional memory (128MB)	14	960,000	13,440,000	0	0
F7958FE1	100M/10Mbps LAN adapter	7	165,000	1,155,000	0	0
F7960A11	Display unit	7	380,000	2,660,000	1,500	567,000
DCBL-RCB05	RS-232 cable	7	16,000	112,000	0	0
	Client Hardware Subtotals			81,032,000		6,690,600
Client Software						
S7831DK0Z	UXP/DS Basic Software V20 (unlimited client access license)	7	1,698,000	11,886,000	352,000	12,320,000
D782R0K31	COBOL85 V20 (4 user)	1	400,000	400,000	0	0
D782R4K64	COBOL85 runtime system V20 (16 users)	1	200,000	200,000	0	0
S782R4K04	Additional machine license	6	160,000	960,000	0	0
D783HZK60	TP-Base/sdk V20 (1 user)	1	300,000	300,000	33,000	165,000
D783HUK32	TP-Base/rt V20 (8 user)	1	500,000	500,000	27,500	137,500
S783HUK02	Additional user license	6	400,000	2,400,000	27,500	825,000
	Client Software Subtotals			16,646,000		13,447,500
User Connectivity						
(Pricing from Fujitsu Limited)						
LH1100	Fast Ethernet hub units (8ports) *	3	188,000	564,000	900	145,800
(Pricing from Allied Telesis, K.K.)						
	CentreCOM 3024TR hub units (24ports) *	231	89,800	20,743,800	5,380	4,971,120
	User Connectivity Subtotals			21,307,800		5,116,920
	Totals			330,743,800		68,558,020
	5 Year cost					399,301,820
	tpmC					5738.30
	Yen / tpmC					69,585
	(* 10% or minimum of 2 spares are included.)					

Notes:

- Audited by Performance Metrics Inc.
- Japanese yen prices are not convertible to other currencies at exchange rates.
- GRANPOWER hardware has a 6 months warranty. Thus to cost 5 years of hardware maintenance, a total of 54 months is calculated.
- Allied Telesys hubs have a 1 year warranty. Therefore, an additional 48 months of maintenance is included.

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 of the TPC benchmark specifications. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.

Numerical Quantities Summary

GRANPOWER 7000 Model 200 SymfoWARE V11L20

MQTH, Computed Maximum Qualified Throughput					5,738.30 tpmC	
Response Times (in seconds)	**Average**		**90%**		**Max.**	
New-Order	**1.71**		**2.81**		**39.45**	
Payment	**1.43**		**2.47**		**44.67**	
Order-Status	**1.48**		**2.49**		**33.64**	
Delivery (interactive portion)	**0.13**		**0.27**		**1.32**	
Delivery (deferred portion)	**1.68**		**2.99**		**28.91**	
Stock-Level	**1.70**		**3.47**		**16.36**	
Menu	**0.17**		**0.26**		**2.03**	
Transaction Mix, in percent of total transaction						
New-Order					**44.75**	
Payment					**43.12**	
Order-Status					**4.04**	
Delivery					**4.03**	
Stock-Level					**4.06**	
Emulation Delay (in seconds)			**Resp. Time**		**Menu**	
New-Order			N/A		N/A	
Payment			N/A		N/A	
Order-Status			N/A		N/A	
Delivery (interactive)			N/A		N/A	
Stock-Level			N/A		N/A	
Keying/Think Times (in seconds)	**Min.**		**Average**		**Max.**	
New-Order	**18.04**	**0.00**	**18.27**	**12.04**	**18.62**	**121.19**
Payment	**3.08**	**0.00**	**3.13**	**12.15**	**3.36**	**121.68**
Order-Status	**2.09**	**0.00**	**2.14**	**10.15**	**2.35**	**91.40**
Delivery (interactive)	**2.09**	**0.00**	**2.14**	**5.14**	**2.39**	**48.70**
Stock-Level	**2.09**	**0.01**	**2.14**	**5.12**	**2.34**	**49.40**
Test Duration						
Ramp-up time (seconds)					**2990**	
Measurement interval					**1800**	
Transactions during measurement interval					**172149**	
Ramp down time						
Checkpointing						
Number of checkpoints					**1**	
Checkpoint interval					**1800 sec.**	
Reproducibility Run						
Reported measurement					**5738.30**	
Reproducibility measurement					**5729.03**	
Difference					**0.1%**	

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Table Of Contents

General Items

Application Code and Definition Statements

The application program (as defined in clause 2.1.7) must be disclosed. This includes, but is not limited to, the code implementing the five transactions and the terminal input output functions.

Appendices A and B contain all source code implemented in this benchmark.

Test Sponsor

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

Fujitsu was the sponsor of this TPC Benchmark C.

Parameter Settings

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

- *Database options,*
- *Recover/commit options,*
- *Consistency/locking options*
- *Operating system and application configuration parameter.*

This requirement can be satisfied by providing a full list of all parameters.

Appendix D contains the parameters for the database, the operating system, and the configuration for the transaction monitor.

Configuration Items

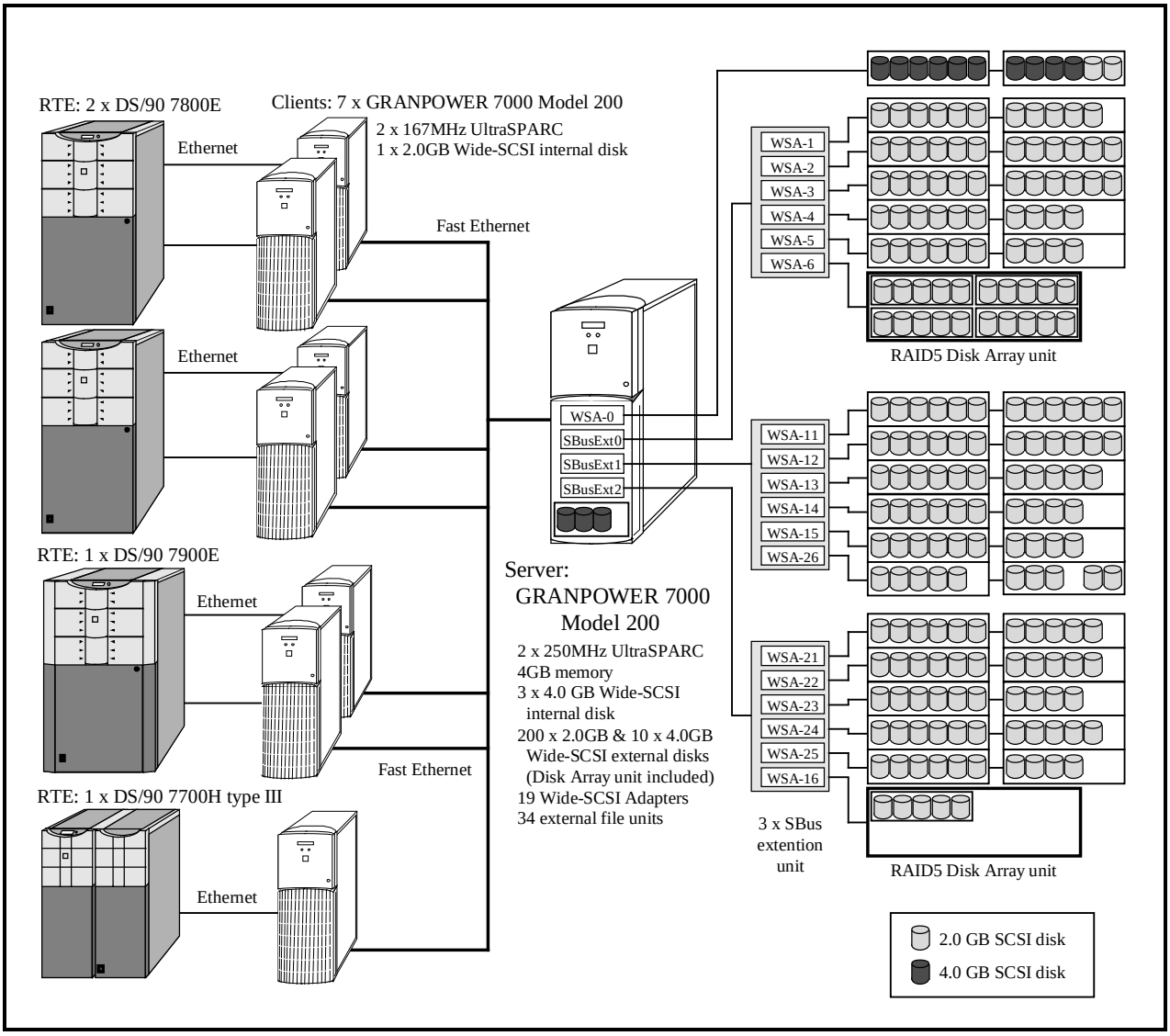
Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences.

The System Under Test (SUT), a GRANPOWER 7000 Model 200, is depicted in the following diagrams.

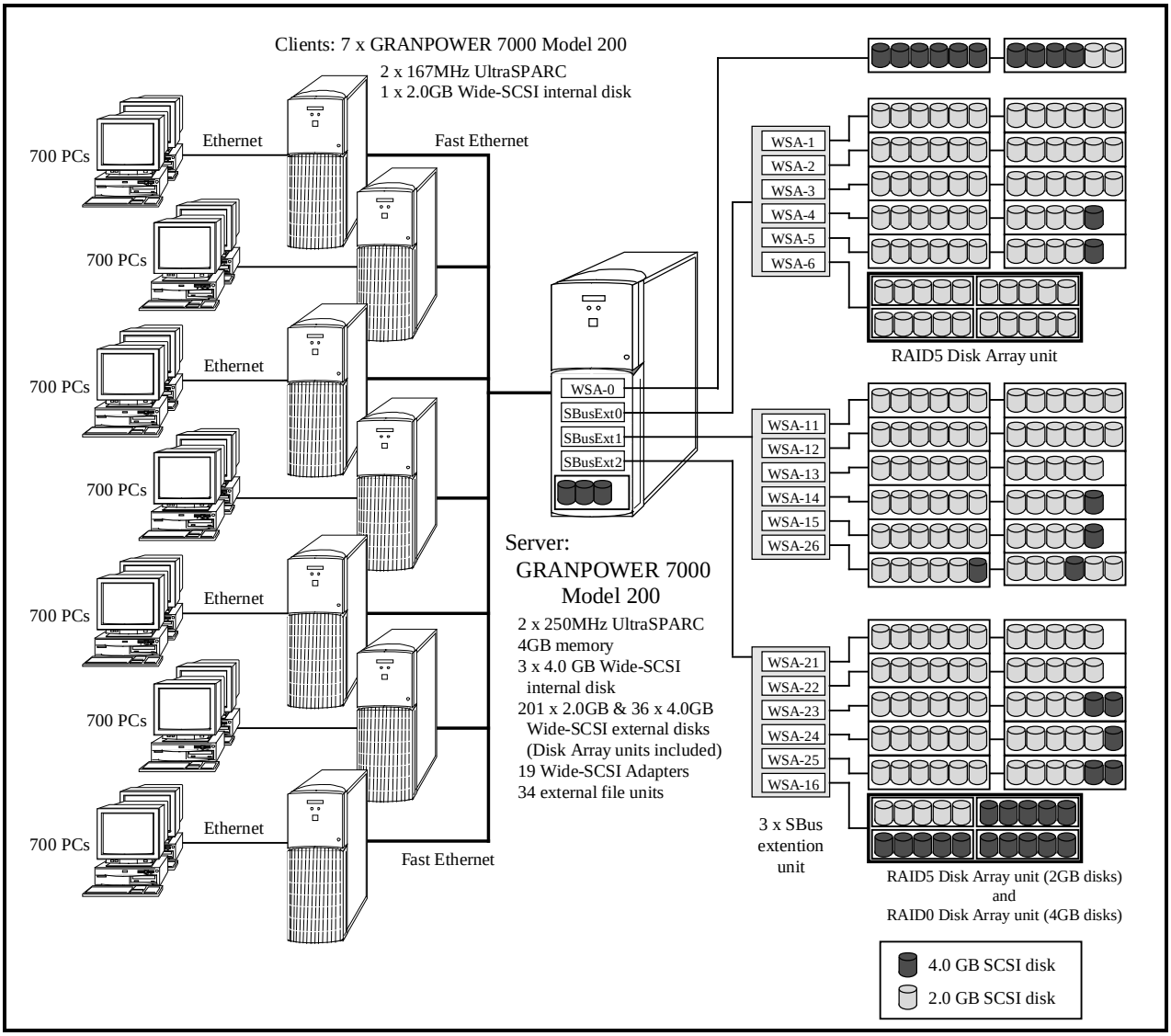
The configuration diagrams for both the tested and priced systems are included on the following pages.

The only difference is the number of disks and the use of the RTE.

GRANPOWER 7000 Tested Configuration



GRANPOWER 7000 Priced Configuration



Clause 1 Related Items

1.1. Table Definitions

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

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

1.2. Physical Organization of Database

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

The following table depicts the organization of tables and indices on the disks.

Distribution of Tables and Logs for GRANPOWER 7000

SCSI adapter	Device	Using	Filename	Size (Mbytes)	DISK CAPACITY
SA	hd00	Operating System		567.0	4.0GB
		swap		842.0	
		DIRECTORY FILE	/dev/dsk/hd0006	2740.2	
	hd01	After Image LOG	/dev/rdsk/hd0101	1024.0	4.0GB (*)
	hd02	After Image LOG (mirror)	/dev/rdsk/hd0201	1024.0	4.0GB (*)
WSA-0	hd10	Striping D-l	/dev/rdsk/hd1001	838.6	4.0GB
	hd11	Striping D-l	/dev/rdsk/hd1101	838.6	4.0GB
	hd12	Striping D-l	/dev/rdsk/hd1201	838.6	4.0GB
	hd13	Striping D-l	/dev/rdsk/hd1301	838.6	4.0GB
	hd14	Striping D-l	/dev/rdsk/hd1401	838.6	4.0GB

SCSI adapter	Device	Using	Filename	Size (Mbytes)	DISK CAPACITY
	hd15	Striping D-l	/dev/rdsk/hd1501	838.6	4.0GB
	hd16	Striping D-l	/dev/rdsk/hd1601	838.6	4.0GB
	hd17	Striping D-l	/dev/rdsk/hd1701	838.6	4.0GB
	hd18	Striping D-l	/dev/rdsk/hd1801	838.6	4.0GB
	hd19	Striping D-l	/dev/rdsk/hd1901	838.6	4.0GB
	hdd00	Striping D-s	/dev/rdsk/hdd0001	582.4	2.0GB
WSA-1	hda00	Striping D-l	/dev/rdsk/hda0001	838.6	2.0GB
	hda01	Striping D-l	/dev/rdsk/hda0101	838.6	2.0GB
	hda02	Striping D-l	/dev/rdsk/hda0201	838.6	2.0GB
	hda03	Striping D-l	/dev/rdsk/hda0301	838.6	2.0GB
	hda04	Striping D-l	/dev/rdsk/hda0401	838.6	2.0GB
	hda05	Striping D-l	/dev/rdsk/hda0501	838.6	2.0GB
	hda06	Striping D-l	/dev/rdsk/hda0601	838.6	2.0GB
	hda07	Striping D-l	/dev/rdsk/hda0701	838.6	2.0GB
	hda08	Striping D-l	/dev/rdsk/hda0801	838.6	2.0GB
	hda09	Striping D-l	/dev/rdsk/hda0901	838.6	2.0GB
	hdd01	Striping D-s	/dev/rdsk/hdd0101	582.4	2.0GB
WSA-2	hda10	Striping A-l	/dev/rdsk/hda1001	413.1	2.0GB
	hda11	Striping A-s	/dev/rdsk/hda1101	401.9	2.0GB
	hda12	Striping A-s	/dev/rdsk/hda1201	401.9	2.0GB
	hda13	Striping A-s	/dev/rdsk/hda1301	401.9	2.0GB
	hda14	Striping B	/dev/rdsk/hda1401	352.0	2.0GB
	hda15	Striping B	/dev/rdsk/hda1501	352.0	2.0GB
	hda16	Striping B	/dev/rdsk/hda1601	352.0	2.0GB
	hda17	Striping C	/dev/rdsk/hda1701	424.0	2.0GB
	hda18	Striping C	/dev/rdsk/hda1801	424.0	2.0GB
	hda19	Striping C	/dev/rdsk/hda1901	424.0	2.0GB
	hdd02	Striping D-s	/dev/rdsk/hdd0201	582.4	2.0GB
	hde00	Before Image LOG	/dev/rdsk/hde0001	700.0	2.0GB (*)
WSA-3	hda20	Striping A-l	/dev/rdsk/hda2001	413.1	2.0GB
	hda21	Striping A-s	/dev/rdsk/hda2101	401.9	2.0GB
	hda22	Striping A-s	/dev/rdsk/hda2201	401.9	2.0GB
	hda23	Striping A-s	/dev/rdsk/hda2301	401.9	2.0GB
	hda24	Striping B	/dev/rdsk/hda2401	352.0	2.0GB
	hda25	Striping B	/dev/rdsk/hda2501	352.0	2.0GB
	hda26	Striping B	/dev/rdsk/hda2601	352.0	2.0GB
	hda27	Striping C	/dev/rdsk/hda2701	424.0	2.0GB
	hda28	Striping C	/dev/rdsk/hda2801	424.0	2.0GB
	hda29	Striping C	/dev/rdsk/hda2901	424.0	2.0GB
	hdd03	Striping D-s	/dev/rdsk/hdd0301	582.4	2.0GB
	hde01	LOG Index	/dev/rdsk/hde0101	1024.0	2.0GB (*)
WSA-4	hda30	Striping A-l	/dev/rdsk/hda3001	413.1	2.0GB
	hda31	Striping A-s	/dev/rdsk/hda3101	401.9	2.0GB
	hda32	Striping A-s	/dev/rdsk/hda3201	401.9	2.0GB
	hda33	Striping A-s	/dev/rdsk/hda3301	401.9	2.0GB
	hda34	Striping B	/dev/rdsk/hda3401	352.0	2.0GB
	hda35	Striping B	/dev/rdsk/hda3501	352.0	2.0GB
	hda36	Striping B	/dev/rdsk/hda3601	352.0	2.0GB
	hda37	Striping C	/dev/rdsk/hda3701	424.0	2.0GB
	hda38	Striping C	/dev/rdsk/hda3801	424.0	2.0GB
	hda39	Striping C	/dev/rdsk/hda3901	424.0	2.0GB
WSA-5	hda40	Striping A-l	/dev/rdsk/hda4001	413.1	2.0GB
	hda41	Striping A-s	/dev/rdsk/hda4101	401.9	2.0GB
	hda42	Striping A-s	/dev/rdsk/hda4201	401.9	2.0GB
	hda43	Striping A-s	/dev/rdsk/hda4301	401.9	2.0GB
	hda44	Striping B	/dev/rdsk/hda4401	352.0	2.0GB
	hda45	Striping B	/dev/rdsk/hda4501	352.0	2.0GB
	hda46	Striping B	/dev/rdsk/hda4601	352.0	2.0GB
	hda47	Striping C	/dev/rdsk/hda4701	424.0	2.0GB
	hda48	Striping C	/dev/rdsk/hda4801	424.0	2.0GB
	hda49	Striping C	/dev/rdsk/hda4901	424.0	2.0GB
WSA-6	hd90	Archive LOG	/dev/rdsk/hd9001	1573	7.7GB
		Archive LOG	/dev/rdsk/hd9002	1573	

SCSI adapter	Device	Using	Filename	Size (Mbytes)	DISK CAPACITY
		Archive LOG	/dev/rdsk/hd9003	1573	
		Archive LOG	/dev/rdsk/hd9004	1573	
		Archive LOG	/dev/rdsk/hd9005	1573	
	hd91	Archive LOG	/dev/rdsk/hd9101	1573	7.7GB
		Archive LOG	/dev/rdsk/hd9102	1573	
		Archive LOG	/dev/rdsk/hd9103	1573	
		Archive LOG	/dev/rdsk/hd9104	1573	
		Archive LOG	/dev/rdsk/hd9105	1573	
	hd92	Archive LOG	/dev/rdsk/hd9201	1573	7.7GB
		Archive LOG	/dev/rdsk/hd9202	1573	
		Archive LOG	/dev/rdsk/hd9203	1573	
		Archive LOG	/dev/rdsk/hd9204	1573	
		Archive LOG	/dev/rdsk/hd9205	1573	
	hd93	Archive LOG	/dev/rdsk/hd9301	1573	7.7GB
		Archive LOG	/dev/rdsk/hd9302	1573	
WSA-11	hdb00	Striping A-l	/dev/rdsk/hdb0001	413.1	2.0GB
	hdb01	Striping A-s	/dev/rdsk/hdb0101	401.9	2.0GB
	hdb02	Striping A-s	/dev/rdsk/hdb0201	401.9	2.0GB
	hdb03	Striping A-s	/dev/rdsk/hdb0301	401.9	2.0GB
	hdb04	Striping B	/dev/rdsk/hdb0401	352.0	2.0GB
	hdb05	Striping B	/dev/rdsk/hdb0501	352.0	2.0GB
	hdb06	Striping B	/dev/rdsk/hdb0601	352.0	2.0GB
	hdb07	Striping C	/dev/rdsk/hdb0701	424.0	2.0GB
	hdb08	Striping C	/dev/rdsk/hdb0801	424.0	2.0GB
	hdb09	Striping C	/dev/rdsk/hdb0901	424.0	2.0GB
	hdd04	Striping D-s	/dev/rdsk/hdd0401	582.4	2.0GB
	hde02	Before Image LOG (mirror)	/dev/rdsk/hde0201	700.0	2.0GB (*)
WSA-12	hdb10	Striping A-l	/dev/rdsk/hdb1001	413.1	2.0GB
	hdb11	Striping A-s	/dev/rdsk/hdb1101	401.9	2.0GB
	hdb12	Striping A-s	/dev/rdsk/hdb1201	401.9	2.0GB
	hdb13	Striping B	/dev/rdsk/hdb1301	352.0	2.0GB
	hdb14	Striping B	/dev/rdsk/hdb1401	352.0	2.0GB
	hdb15	Striping B	/dev/rdsk/hdb1501	352.0	2.0GB
	hdb16	Striping B	/dev/rdsk/hdb1601	352.0	2.0GB
	hdb17	Striping C	/dev/rdsk/hdb1701	424.0	2.0GB
	hdb18	Striping C	/dev/rdsk/hdb1801	424.0	2.0GB
	hdb19	Striping C	/dev/rdsk/hdb1901	424.0	2.0GB
	hdd05	Striping D-s	/dev/rdsk/hdd0501	582.4	2.0GB
	hde03	LOG Index (mirror)	/dev/rdsk/hde0301	1024.0	2.0GB (*)
WSA-13	hdb20	Striping A-l	/dev/rdsk/hdb2001	413.1	2.0GB
	hdb21	Striping A-s	/dev/rdsk/hdb2101	401.9	2.0GB
	hdb22	Striping A-s	/dev/rdsk/hdb2201	401.9	2.0GB
	hdb23	Striping B	/dev/rdsk/hdb2301	352.0	2.0GB
	hdb24	Striping B	/dev/rdsk/hdb2401	352.0	2.0GB
	hdb25	Striping B	/dev/rdsk/hdb2501	352.0	2.0GB
	hdb26	Striping B	/dev/rdsk/hdb2601	352.0	2.0GB
	hdb27	Striping C	/dev/rdsk/hdb2701	424.0	2.0GB
	hdb28	Striping C	/dev/rdsk/hdb2801	424.0	2.0GB
	hdb29	Striping C	/dev/rdsk/hdb2901	424.0	2.0GB
	hdd06	Striping D-s	/dev/rdsk/hdd0601	582.4	2.0GB
WSA-14	hdb30	Striping A-l	/dev/rdsk/hdb3001	413.1	2.0GB
	hdb31	Striping A-s	/dev/rdsk/hdb3101	401.9	2.0GB
	hdb32	Striping A-s	/dev/rdsk/hdb3201	401.9	2.0GB
	hdb33	Striping B	/dev/rdsk/hdb3301	352.0	2.0GB
	hdb34	Striping B	/dev/rdsk/hdb3401	352.0	2.0GB
	hdb35	Striping B	/dev/rdsk/hdb3501	352.0	2.0GB
	hdb36	Striping B	/dev/rdsk/hdb3601	352.0	2.0GB
	hdb37	Striping C	/dev/rdsk/hdb3701	424.0	2.0GB
	hdb38	Striping C	/dev/rdsk/hdb3801	424.0	2.0GB
	hdb39	Striping C	/dev/rdsk/hdb3901	424.0	2.0GB
WSA-15	hdb40	Striping A-l	/dev/rdsk/hdb4001	413.1	2.0GB
	hdb41	Striping A-s	/dev/rdsk/hdb4101	401.9	2.0GB
	hdb42	Striping A-s	/dev/rdsk/hdb4201	401.9	2.0GB

SCSI adapter	Device	Using	Filename	Size (Mbytes)	DISK CAPACITY
	hdb43	Striping B	/dev/rdsk/hdb4301	352.0	2.0GB
	hdb44	Striping B	/dev/rdsk/hdb4401	352.0	2.0GB
	hdb45	Striping B	/dev/rdsk/hdb4501	352.0	2.0GB
	hdb46	Striping B	/dev/rdsk/hdb4601	352.0	2.0GB
	hdb47	Striping C	/dev/rdsk/hdb4701	424.0	2.0GB
	hdb48	Striping C	/dev/rdsk/hdb4801	424.0	2.0GB
	hdb49	Striping C	/dev/rdsk/hdb4901	424.0	2.0GB
WSA-26	hdc50	Striping A-s	/dev/rdsk/hdc5001	401.9	2.0GB
	hdc51	Striping A-s	/dev/rdsk/hdc5101	401.9	2.0GB
	hdc52	Striping A-s	/dev/rdsk/hdc5201	401.9	2.0GB
	hdc53	Striping B	/dev/rdsk/hdc5301	352.0	2.0GB
	hdc54	Striping B	/dev/rdsk/hdc5401	352.0	2.0GB
	hdc55	Striping B	/dev/rdsk/hdc5501	352.0	2.0GB
	hdc56	Striping C	/dev/rdsk/hdc5601	424.0	2.0GB
	hdc57	Striping C	/dev/rdsk/hdc5701	424.0	2.0GB
	hdc58	Striping C	/dev/rdsk/hdc5801	424.0	2.0GB
	hdc59	Striping C	/dev/rdsk/hdc5901	424.0	2.0GB
WSA-21	hdc00	Striping A-m	/dev/rdsk/hdc0001	406.8	2.0GB
	hdc01	Striping A-s	/dev/rdsk/hdc0101	401.9	2.0GB
	hdc02	Striping A-s	/dev/rdsk/hdc0201	401.9	2.0GB
	hdc03	Striping B	/dev/rdsk/hdc0301	352.0	2.0GB
	hdc04	Striping B	/dev/rdsk/hdc0401	352.0	2.0GB
	hdc05	Striping B	/dev/rdsk/hdc0501	352.0	2.0GB
	hdc06	Striping B	/dev/rdsk/hdc0601	352.0	2.0GB
	hdc07	Striping C	/dev/rdsk/hdc0701	424.0	2.0GB
	hdc08	Striping C	/dev/rdsk/hdc0801	424.0	2.0GB
	hdc09	Striping C	/dev/rdsk/hdc0901	424.0	2.0GB
	hdd07	Striping D-s	/dev/rdsk/hdd0701	582.4	2.0GB
WSA-22	hdc10	Striping A-m	/dev/rdsk/hdc1001	406.8	2.0GB
	hdc11	Striping A-s	/dev/rdsk/hdc1101	401.9	2.0GB
	hdc12	Striping A-s	/dev/rdsk/hdc1201	401.9	2.0GB
	hdc13	Striping B	/dev/rdsk/hdc1301	352.0	2.0GB
	hdc14	Striping B	/dev/rdsk/hdc1401	352.0	2.0GB
	hdc15	Striping B	/dev/rdsk/hdc1501	352.0	2.0GB
	hdc16	Striping C	/dev/rdsk/hdc1601	424.0	2.0GB
	hdc17	Striping C	/dev/rdsk/hdc1701	424.0	2.0GB
	hdc18	Striping C	/dev/rdsk/hdc1801	424.0	2.0GB
	hdc19	Striping C	/dev/rdsk/hdc1901	424.0	2.0GB
	hdd08	Striping D-s	/dev/rdsk/hdd0801	582.4	2.0GB
WSA-23	hdc20	Striping A-s	/dev/rdsk/hdc2001	401.9	2.0GB
	hdc21	Striping A-s	/dev/rdsk/hdc2101	401.9	2.0GB
	hdc22	Striping A-s	/dev/rdsk/hdc2201	401.9	2.0GB
	hdc23	Striping B	/dev/rdsk/hdc2301	352.0	2.0GB
	hdc24	Striping B	/dev/rdsk/hdc2401	352.0	2.0GB
	hdc25	Striping B	/dev/rdsk/hdc2501	352.0	2.0GB
	hdc26	Striping C	/dev/rdsk/hdc2601	424.0	2.0GB
	hdc27	Striping C	/dev/rdsk/hdc2701	424.0	2.0GB
	hdc28	Striping C	/dev/rdsk/hdc2801	424.0	2.0GB
	hdc29	Striping C	/dev/rdsk/hdc2901	424.0	2.0GB
WSA-24	hdc30	Striping A-s	/dev/rdsk/hdc3001	401.9	2.0GB
	hdc31	Striping A-s	/dev/rdsk/hdc3101	401.9	2.0GB
	hdc32	Striping A-s	/dev/rdsk/hdc3201	401.9	2.0GB
	hdc33	Striping B	/dev/rdsk/hdc3301	352.0	2.0GB
	hdc34	Striping B	/dev/rdsk/hdc3401	352.0	2.0GB
	hdc35	Striping B	/dev/rdsk/hdc3501	352.0	2.0GB
	hdc36	Striping C	/dev/rdsk/hdc3601	424.0	2.0GB
	hdc37	Striping C	/dev/rdsk/hdc3701	424.0	2.0GB
	hdc38	Striping C	/dev/rdsk/hdc3801	424.0	2.0GB
	hdc39	Striping C	/dev/rdsk/hdc3901	424.0	2.0GB
	hdd09	Striping D-s	/dev/rdsk/hdd0901	582.4	2.0GB
WSA-25	hdc40	Striping A-s	/dev/rdsk/hdc4001	401.9	2.0GB
	hdc41	Striping A-s	/dev/rdsk/hdc4101	401.9	2.0GB
	hdc42	Striping A-s	/dev/rdsk/hdc4201	401.9	2.0GB

SCSI adapter	Device	Using	Filename	Size (Mbytes)	DISK CAPACITY
	hdc43	Striping B	/dev/rdsk/hdc4301	352.0	2.0GB
	hdc44	Striping B	/dev/rdsk/hdc4401	352.0	2.0GB
	hdc45	Striping B	/dev/rdsk/hdc4501	352.0	2.0GB
	hdc46	Striping C	/dev/rdsk/hdc4601	424.0	2.0GB
	hdc47	Striping C	/dev/rdsk/hdc4701	424.0	2.0GB
	hdc48	Striping C	/dev/rdsk/hdc4801	424.0	2.0GB
	hdc49	Striping C	/dev/rdsk/hdc4901	424.0	2.0GB
WSA-16	hd96	DICTIONARY	/dev/rdsk/hd9602	1024.0	7.7GB

(*); see remarks*

Striping table map

Striping A-l	
Table name	Size (Mbytes)
Warehouse	8.0
District	1.2
Stock	127.0
NewOrder	10.0
NewOrder Index	26.3
Orders	32.0
Orders Index	23.6
OrderLine	168.0
History	15.0
Item	2.0
Customer Index	14.4

Striping A-m	
Table name	Size (Mbytes)
Stock	127.0
NewOrder	10.0
NewOrder Index	26.3
Orders	32.0
Orders Index	23.6
OrderLine	168.0
History	15.0
Item	4.9
Customer Index	14.4

Striping A-s	
Table name	Size (Mbytes)
Stock	127.0
NewOrder	10.0
NewOrder Index	26.3
Orders	32.0
Orders Index	23.6
OrderLine	168.0
History	15.0
Customer Index	14.4

Striping B	
Table name	Size (Mbytes)
Stock	127.0
NewOrder	10.0
Orders	32.0
OrderLine	168.0
History	15.0

Striping C	
Table name	Size (Mbytes)
Stock	185.6
NewOrder	4.4
Orders	14.7
OrderLine	186.5
History	18.1
Customer	14.7

Striping D-l	
Table name	Size (Mbytes)
Customer	468.8
OrderLine Index	369.8

Striping D-s	
Table name	Size (Mbytes)
Customer	234.4
OrderLine Index	348.0

```
* remarks
            (*) disks mirrored by LVCF
            each logical filenames are;
hd0101 & hd0201     ... /dev/rvol/LOG_AI
hde0001 & hde0201   ... /dev/rvol/LOG_BI
hde0101 & hde0301   ... /dev/rvol/LOG_IX
(These logical filenames use LOG making)
```

1.3. Insert and Delete Operations

It must be ascertained that insert and/or 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 maximum key value for these new rows.

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

1.4. 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.

Horizontal partitioning was used on all tables except the Item table. The Warehouse and District tables were horizontally partitioned every sixty (60) w_id values. The Orderline and History tables had one partition for each w_id. The other tables were horizontally partitioned every ten (10) w_id values. This partitioning was transparent to the application code.

1.5. Replication, Duplication or Additions

Replication of tables, if used, must be disclosed. 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 in this benchmark.

Clause 2 Related Items

2.1 Random Number Generation

The method of verification for the random number generation must be described.

The seeds for each user were generated using the process id. Each RTE machine was given a number incremented by 30,000. The process id was appended to this number to ensure uniqueness across all RTE machines. These seeds were printed to a file and verified by the auditor to be unique.

2.2 Input/Output Screen Layout

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

All screen layouts followed the specifications exactly.

2.3 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 attributes were verified by the auditor manually exercising each specification during the onsite audit portion of this benchmark on a FMV513D7C6 PC.

2.4 Presentation Manager or Intelligent Terminal

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

The PC's in the priced configuration come with Microsoft Windows 95. Presentation is handled by the terminal emulator found in Windows software.

2.5 Transaction Statistics

Table 2.1 lists the numerical quantities that Clauses 8.1.3.5 to 8.1.3.11 require.

Table 2. 1 Transaction Statistics

Statistic		Value
New Order	Home warehouse order lines	99.00%
	Remote warehouse order lines	1.00%
	Rolled back transactions	0.97%
	Average items per order	10.00
Payment	Home warehouse	85.16%
	Remote warehouse	14.84%
	Accessed by last name	60.28%
Order Status	Accessed by last name	59.75%
Delivery	Skipped transactions	none
Transaction Mix	New Order	44.75%
	Payment	43.12%
	Order status	4.04%
	Delivery	4.03%
	Stock level	4.06%

2.6 Queueing Mechanism

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

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

Clause 3 Related Items

3.1 Transaction System Properties (ACID)

The results of the ACID tests must be disclosed along with a description of how the ACID 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 SUT must support during the execution of the benchmark. Those properties are Atomicity, Consistency, Isolation and Durability (ACID).

This section defines each of those properties, describes the steps taken to ensure that they were present during the test and describes a series of tests done to demonstrate compliance with the specification.

3.2 Atomicity

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

3.2.1 Completed Transactions

Perform the Payment transaction for a randomly selected warehouse, district, and customer (by customer number as specified in Clause 2.5.1.2) and verify that the records in the CUSTOMER, DISTRICT, and WAREHOUSE tables have been changed appropriately.

A row was randomly selected from the warehouse, district and customer tables, and the balances noted. A payment transaction was started with the same warehouse, district and customer identifiers and a known amount. The payment transaction was committed and the rows were verified to contain correctly updated balances.

3.2.2 Aborted Transactions

Perform the Payment transaction for a randomly selected warehouse, district and customer (by customer number as specified in Clause 2.5.1.2) and substitute a ROLLBACK of the transaction for the COMMIT of the transaction. Verify that the records in the CUSTOMER, DISTRICT, and WAREHOUSE tables have NOT been changed.

A row was randomly selected from the warehouse, district and customer tables, and the balances noted. A payment transaction was started with the same warehouse, district and customer identifiers and a known amount. The payment transaction was rolled back and the rows were verified to contain the original balances.

3.3 Consistency

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

The benchmark specification requires explicit demonstration of the following four consistency conditions;

- The sum of the district balances in a warehouse is equal to the warehouse balance;
- for each district, the next order id minus one is equal to the maximum order id in the ORDER table and equal to the maximum new order id in the NEW-ORDER table;
- for each district, the maximum order id minus minimum order id in the ORDER table plus one equals the number of rows in the NEW-ORDER table for that district;
- for each district, the sum of the order line counts in the ORDER table equals the number of rows in the ORDER-LINE table for that district.

These consistency conditions were tested using a shell script to issue queries to the database. The results of the queries verified that the database was consistent for all four tests.

A performance run was completed including a full 30 minutes of steady state and checkpoints.

The shell script was executed again. The result of the same queries verified that the database remained consistent after the run.

3.4 Isolation

Isolation can be defined in terms of phenomena that can occur during the execution of concurrent transactions. These phenomena are P0 ("Dirty Write"), P1 ("Dirty Read"), P2 ("non-repeatable Read"), and P3 ("Phantom"). The table in Clause 3.4.1 of the TPC-C specifications defines the isolation requirements which must be met by the TPC-C transactions. Sufficient conditions must be

enabled at either the system or application level to ensure the required isolation defined above (clause 3.4.1) is obtained.

The benchmark specification defines nine required tests to be performed to demonstrate that the required levels of transaction isolation are met. These tests, described in Clauses 3.4.2.1 - 3.4.2.9, were all performed and verified as required.

Isolation tests one through nine were executed using shell scripts to issue queries to the database. Each script included timestamps to demonstrate the concurrency of operations. The results of the queries were captured to files. The captured files were verified by the auditor to demonstrate the required isolation had been met.

For Isolation test seven, case A was followed.

3.5 Durability

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

3.5.1 Durable Media Failure

3.5.1.1 Loss of Data

To demonstrate recovery from a permanent failure of durable medium containing TPC-C tables the following steps were executed:

1. The database was backed up to extra disks.
2. The total number of orders was determined by the sum of D_NEXT_O_ID of all rows in the DISTRICT table giving the beginning count.
3. The RTE was started with 4,900 users.
4. The test was allowed to run for a minimum of 5 minutes.
5. One of the data disks was powered off by removing it from the cabinet.
6. The RTE was shut down.
7. A new disk was inserted into the cabinet and formatted to simulate complete loss of data.
8. SymfoWARE was restarted.
9. Data from the backup disk was copied to the new disk and SymfoWARE used the transaction logs to roll forward and recover the data from committed transactions.
10. Step 2 was repeated and the difference between the first and second counts was noted.
11. The success file was used to determine the number of NEW-ORDERS successfully returned to the RTE.
12. The counts in step 9 and 10 were compared and the results verified that all committed transactions had been successfully recovered.
13. Data from the success file was used to query the database to demonstrate successful transactions had corresponding rows in the ORDER table, and rolled back transactions did not.

3.5.1.2 Loss of Log

To demonstrate recovery from a permanent failure of durable medium containing SymfoWARE recovery log data the following steps were executed:

1. The total number of orders was determined by the sum of D_NEXT_O_ID of all rows in the DISTRICT table giving the beginning count.
2. The RTE was started with 4,900 users.
3. The test was allowed to run for a minimum of 6 minutes.
4. One log disk was powered off by removing it from the cabinet.
5. Since the disk was mirrored, processing was not interrupted.
6. The RTE was shut down.
7. A new disk was inserted into the cabinet and began normal recovery by synchronizing with its mirror image.
8. Step 2 was repeated and the difference between the first and second counts was noted.
9. The success file was used to determine the number of NEW-ORDERS successfully returned to the RTE.
10. The counts in step 9 and 10 were compared and the results verified that all committed transactions had been successfully recovered.
11. Samples were taken from the RTE files and used to query the database to demonstrate successful transactions had corresponding rows in the ORDER table.

3.5.2 Instantaneous Interruption and Loss of Memory

Because loss of power erases the contents of memory, the instantaneous interruption and the loss of memory tests were combined into a single test. This test was executed on a fully scaled database of 490 warehouses under a full load of 4,900 users. The following steps were executed:

1. The total number of orders was determined by the sum of D_NEXT_O_ID of all rows in the DISTRICT table giving the beginning count.
2. The RTE was started with 4,900 users.
3. The test was allowed to run for a minimum of 5 minutes.
4. The primary power to the processor was shutdown.
5. The RTE was shutdown.
6. Power was restored and the system performed an automatic recovery.
7. SymfoWARE was restarted and performed an automatic recovery .
8. Step 2 was repeated and the difference between the first and second counts was noted.
9. The success file was used to determine the number of NEW-ORDERS successfully returned to the RTE.
10. The counts in step 9 and 10 were compared and the results verified that all committed transactions had been successfully recovered.
11. Data from the success file was used to query the database to demonstrate successful transactions had corresponding rows in the ORDER table, and rolled back transactions did not.

Clause 4 Related Items

4.1 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 4.1 Number of Rows for Server

Table	Occurrences
Warehouse	490
District	4,900
Customer	14,700,000
History	14,700,000
Order	14,700,000
New Order	4,410,000
Order Line	146,982,261
Stock	49,000,000
Item	100,000

4.2 Database Layout

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

Section 1.2 of this report details the distribution of database tables across all disks. The code that creates the tables is included in Appendix E.

4.3 Type of Database

A statement must be provided that describes:

1. *The data model implemented by DBMS used (e.g. relational, network, hierarchical).*
2. *The database interface (e.g. embedded, call level) and access language (e.g. SQL, DL/1, COBOL read/write used to implement the TPC-C transaction. If more than one interface/access language is used to implement TPC-C, each interface/access language must be described and a list of which interface/access language is used with which transaction type must be disclosed.*

SymfoWARE V11L20 is a relational DBMS.

The interface used was SymfoWARE V11L20 stored procedures embedded in C code. The new-order transaction also used COBOL85 to accomplish bulk inserts of the order lines.

4.4 Database Mapping

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

The database, with the exception of the Item table, was horizontally partitioned. This partitioning is fully described in Section 1.4.

4.5 180 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 dynamic tables (Order, Order-Line, and History) must be disclosed.

The 180 day space requirement is shown in Appendix F.

The database was configured with 17 archive logfiles. Each file was the same size. Since this file is switched at each checkpoint, and checkpoints were scheduled every 30 minutes, this was more than enough space for 8 hours. The space used on each file during the measured run was demonstrated to the auditor to verify the file would not overflow at the measured rate.

For dynamic tables the following steps were followed:

1. The number of rows and number of used blocks were counted on a freshly loaded database.
2. The number of rows were divided by the number of blocks, giving rows per block.
3. The number of rows inserted in 8 hours was estimated equal to tpmC for HISTORY and ORDER, and ten times tpmC for ORDERLINE.

4. The number of rows in step 3 was divided by the number derived in step 2.
5. The number in step 4 was added to the number of used blocks from step 1.
6. The database was queried to show the space allocated exceeded the number in step 5.

Clause 5 Related Items

5.1 Throughput

Measured tpmC must be reported.

Measured tpmC 5,738.30 tpmC
Price per tpmC ¥69,585

5.2 Response Times

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

Table 5.1 Response Times

Type	Average	Maximum	90th %
New-Order	1.71	39.45	2.81
Payment	1.43	44.67	2.47
Order-Status	1.48	33.64	2.47
Interactive Delivery	0.13	1.32	0.27
Deferred Delivery	1.68	28.91	2.99
Stock-Level	1.70	16.36	3.47
Menu	0.17	2.03	0.26

5.3 Keying and Think Times

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

Table 5.2 Keying Times

Type	Minimum	Average	Maximum
New-Order	18.04	18.27	18.62
Payment	3.08	3.13	3.36
Order-Status	2.09	2.14	2.35
Interactive Delivery	2.09	2.14	2.39
Stock-Level	2.09	2.14	2.34

Table 5.3 Think Times

Type	Minimum	Average	Maximum
New-Order	0.00	12.04	121.19
Payment	0.00	12.15	121.68
Order-Status	0.00	10.15	91.40
Interactive Delivery	0.00	5.14	48.70
Stock-Level	0.01	5.12	49.40

5.4 Response Time Frequency Distribution Curves and Other Graphs

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 the New-Order transaction.

A graph of throughput versus elapsed time (see Clause 5.6.5) must be reported for the New-Order transaction.

Figure 5.1: New Order Response Time Distribution

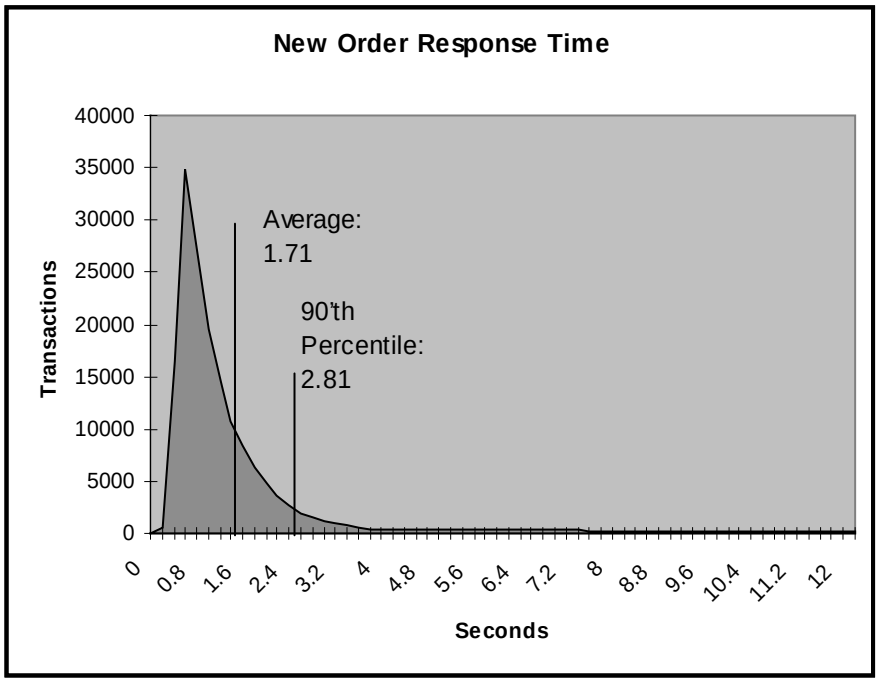


Figure 5.2: Payment Response Time Distribution

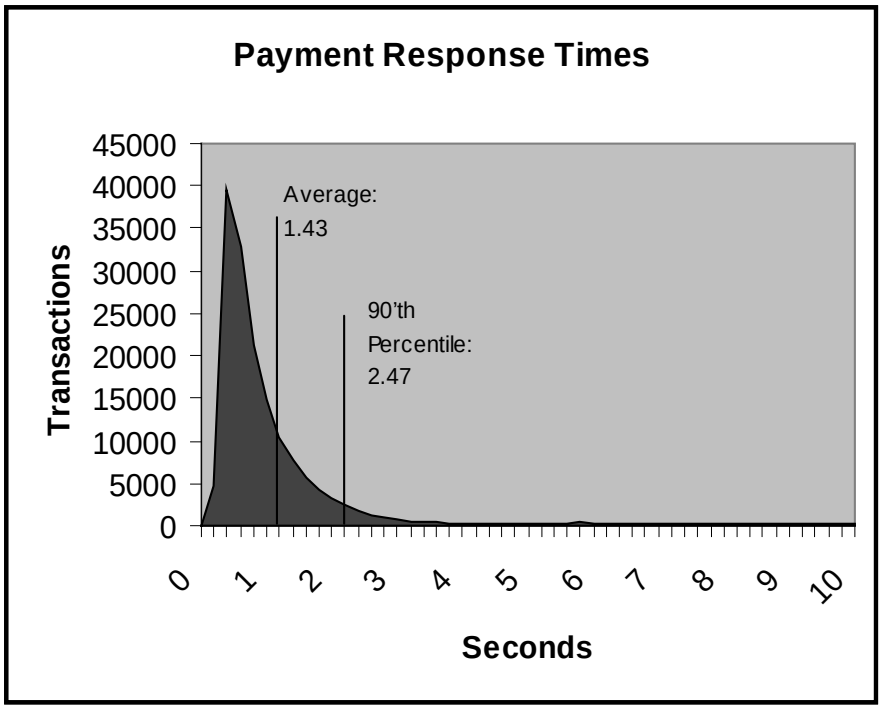


Figure 5.3: Order Status Response Time Distribution

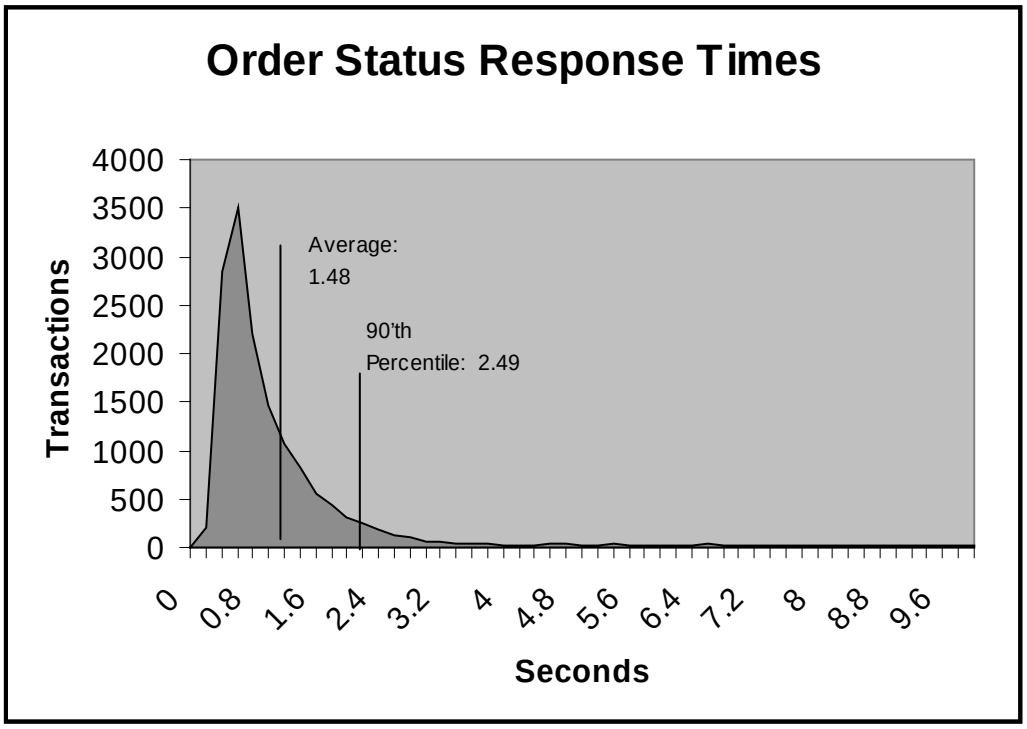


Figure 5.4: Delivery Response Time Distribution

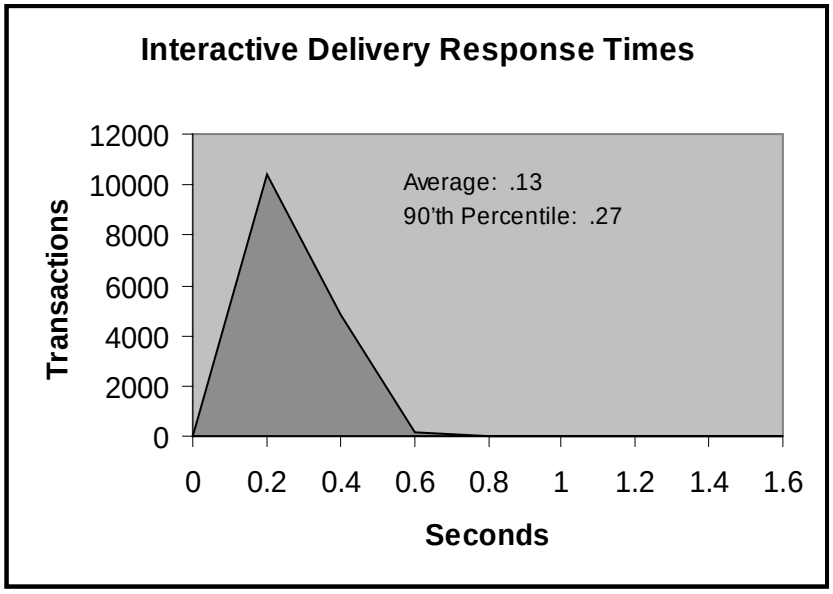


Figure 5.5: Stock Level Response Time Distribution

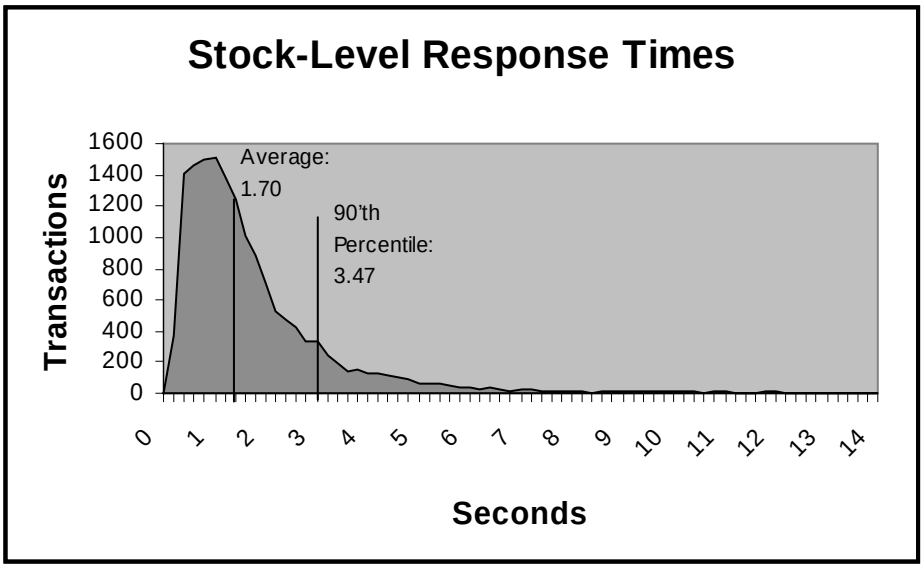


Figure 5.6: New Order Think Time Frequency Distribution

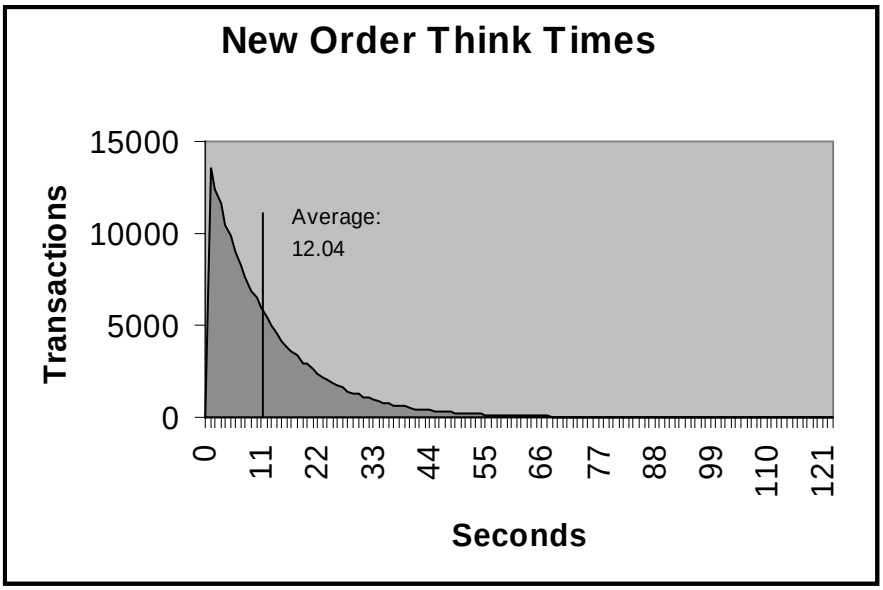


Figure 5.7: Response time versus Throughput

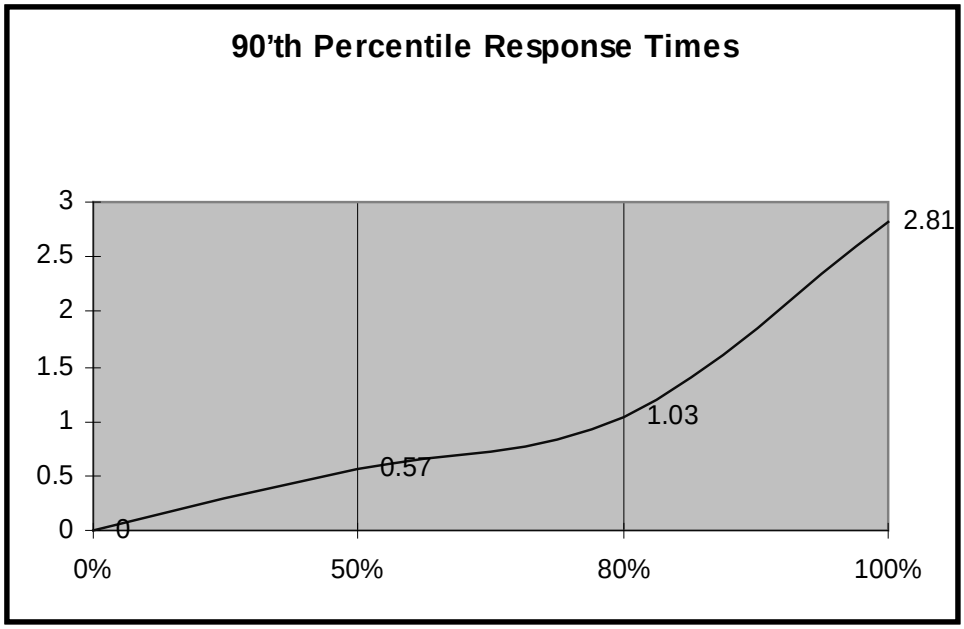
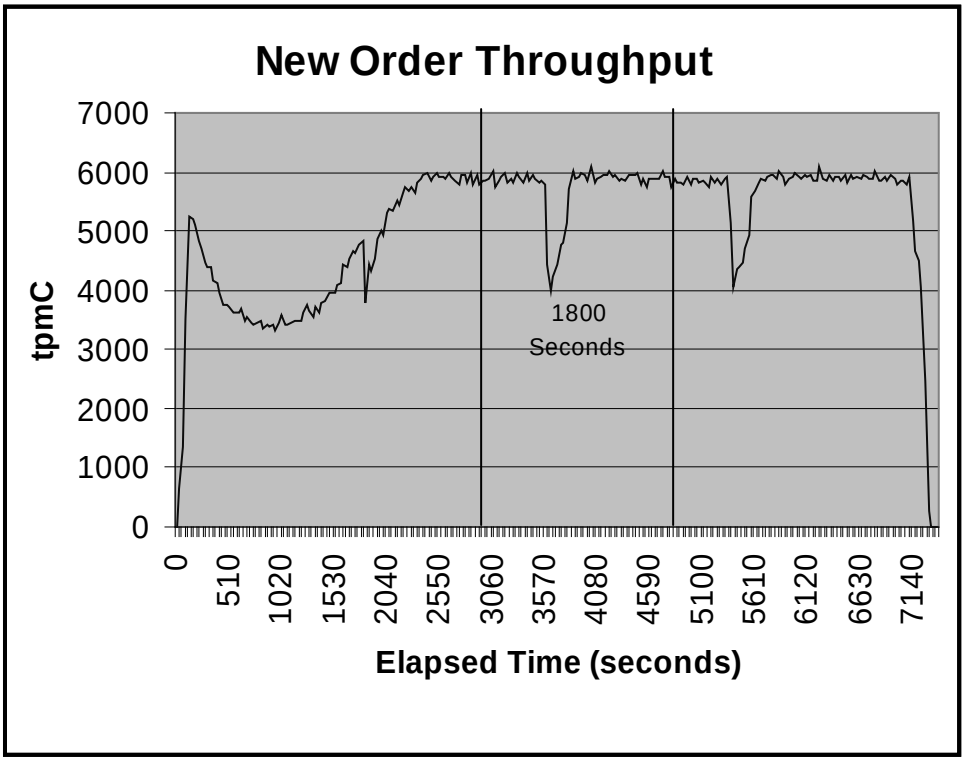


Figure 5.8: New Order Sustained Throughput



5.5 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.

Steady state was determined by examining data reported for each 30-second interval over the duration of the measured run. Steady state was further confirmed by the throughput data collected during the run and graphed in Figure 5.8.

5.6 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.

A SymfoWARE checkpoint forces all "dirty" pages (pages that have been updated since they were last written) to be physically written to the durable disks. The checkpoint forces the archive log to be switched. SymfoWARE executes a checkpoint for the following conditions:

1. The amount of recovery data reaches the value specified at the creation of the temporary log, which contains the before images and after images of each transaction. The interval the recovery data takes to reach the specified value depends upon workload. The temporary log is configured by the *rdblog* command.
2. Upon an explicit *rdbrcp* request.

For each benchmark measurement, after all users are active, the script that issues *rdbrcp* is started manually on the server. The script sleeps and performs another checkpoint every 30 minutes, which is equal to the measurement interval. *Rdbrcp* notifies the time upon the completion of the checkpoint and the start time and end time of all checkpoints are captured to a flat file. The recovery log is configured to be large enough that no other checkpoint will occur during the measurement. The recovery log is marked as reusable after the checkpoint completes. The positioning of the checkpoint is verified to be clear of the guard zones and is depicted on the graph in Figure 5.8.

5.7 Reproducibility

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

The measurement procedure was repeated and the throughput verified to be within 2% of the reported measurement.

5.8 Measurement Period Duration

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

The reported measured interval was exactly 30 minutes long.

5.9 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 RTE used the a weighted distribution to control the transaction mix, and could not be adjusted during the run.

5.10 Transaction Statistics

The percentage of the total mix for each transaction type must be disclosed. 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 per New-Order transaction must be disclosed. The percentage of remote Payment transactions must be disclosed. The percentage of customer selections 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 5.4: Transaction Statistics

Statistics		Value
Transaction Mix	New Order	44.75%
	Payment	43.12%
	Order status	4.04%
	Delivery	4.03%
	Stock level	4.06%
New Order	Home warehouse order lines	99.00%
	Remote warehouse order lines	1.00%
	Rolled back transactions	0.97%
	Average items per order	10.00
Payment	Home warehouse	85.16%
	Remote warehouse	14.84%
	Accessed by last name	60.28%
Order Status	Accessed by last name	59.75%
Delivery	Skipped transactions	0

5.11 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.

One checkpoint was recorded before the measured window opened and another checkpoint was started 647 seconds inside the measured window. Both checkpoints were clear of the guard zone. Checkpoints were started exactly 30 minutes apart.

Clause 6 Related Items

6.1 RTE Descriptions

If the RTE is commercially available, then its inputs must be specified. Otherwise, a description must be supplied of what inputs (e.g., scripts) to the RTE had been used.

The RTE used was developed at Fujitsu Limited and is proprietary. It consists of an RTE management process as shown in Appendix C, which forks off the individual RTE processes and controls the run. After the run completes, a separate report generator program collects all the log files and generates the final statistics of a run.

Inputs to the RTE include the names of the RTE machine to run, client machines to attach to, the database scale, the ramp-up, measurement and ramp-down times. These come from the configuration script file for the RTE management process.

6.2 Emulated Components

It must be demonstrated that the functionality and performance of the components being emulated in the Driver System are equivalent to the priced system. The results of the test described in Clause 6.6.3.4 must be disclosed.

There were no emulated components in the benchmark configuration other than the emulated users' workstations.

6.3 Functional Diagrams

A complete functional diagram of both the benchmark configuration and the configuration of the proposed (target) system must be disclosed. A detailed list of all hardware and software functionality being performed on the Driver System and its interface to the SUT must be disclosed.

The driver system performed the data generation and input functions of the display device. It also captured the input and output data and timestamps for post-processing of the reported metrics. No other functionality was included on the driver system

The abstract at the beginning of this report contains detailed diagrams of both the benchmark configuration and the priced configuration, including the driver system.

6.4 Networks

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

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

Seven ethernet 10 MBPS LAN's were used between the emulated users and the client machines. One ethernet 100 MBPS LAN was used between the clients and the server. The abstract at the beginning of this report contains detailed diagrams of the configuration.

6.5 Operator Intervention

If the configuration requires operator intervention (see Clause 6.6.6), the mechanism and the frequency of this intervention must be disclosed.

This configuration does not require any operator intervention to sustain eight hours of the reported throughput, other than beginning the checkpointing process.

Clause 7 Related Items

7.1 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 effective date(s) of price(s) must also be reported.

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

A detailed price list is included in the abstract at the beginning of this report.

7.2 Availability

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 availability dates, the reported availability date for the priced system must be the date at which all components are committed to be available.

All hardware components and software will be available no later than November 12, 1997.

7.3 Throughput and Price Performance

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

Maximum Qualified Throughput:	5,738.30 tpmC
Price per tpmC	¥69,585
Available	November 12, 1997

7.4 Country Specific Pricing

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

This system is being priced for Japan.

7.5 Usage Pricing

For any usage pricing, the sponsor must disclose:

- *Usage level at which the component was priced.*
- *A statement of the company policy allowing such pricing.*

SymfoWARE is sold with a 64 user license. There were 70 connections between the client and the server, therefore another 16 user license has been priced.

Clause 9 Related Items

9.1 Auditor's Report

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.

This implementation of the TPC Benchmark C was audited by Lorna Livingtree of Performance Metrics, Inc.

Performance Metrics, Inc.
2229 Benita Dr. Suite 101
Rancho Cordova, CA
(phone) 916/635-2822
(fax) 916/858-0109

9.2 Availability of the Full Disclosure Report

The Full Disclosure Report must be readily available to the public at a reasonable charge, similar to the charges for similar documents by the test sponsor. The report must be made available when results are made public. In order to use the phrase "TPC Benchmark™ C", the Full Disclosure Report must have been submitted to the TPC Administrator as well as written permission obtained to distribute same.

Requests for this TPC Benchmark C Full Disclosure Report should be sent to:

Transaction Processing Performance Council
c/o Shanley Public Relations
777 North First Street, Suite 6000
San Jose, CA 95112-6311
408/295-8894