Full Disclosure Report

ECperf Benchmark

IBM® WebSphere® Application Server Advanced Edition, Version 4.0.3

IBM @server x330 Cluster
Red Hat Linux 7.2

IBM DB2® Workgroup Unlimited Edition V7.2

IBM @server x440 Database
Microsoft® Windows® 2000 Server

April 8, 2002

First Printing

Trademarks

Revision History:

2002-04-22:
Incorporate review comments.

7.2.3 Summary Statement
See 7.3 for the Summary statement.

7.2.4 Sponsors
This benchmark was sponsored and conducted by International Business Machines Corporation (IBM).

7.2.5 Diagrams of both measured and priced configurations must be provided, accompanied by a description of the differences. This includes, but is not limited to:

- *Number and type of processors.*
- *Size of allocated memory, and any specific mapping/partitioning of memory unique to the test.*
- *Number and type of disk units (and controllers, if applicable).*
- *Number of LAN (e.g., Ethernet) connections, including routers, etc., that were physically used in the test.*
- *Type and the runtime execution location of software components (e.g., EJB Server/Containers, DBMS, client processes, software load balancers, etc.). This section provides detailed information about the priced configuration. The only differences in the measured configuration are:*

The tested configuration is the priced configuration.

PRICED CONFIGURATION:
Application Server System Configuration:
WebSphere Application Servers (nine Systems):
IBM xSeries 330 (Model 8674-31X)
2 x 1.266GHz Intel® Pentium® III CPUs with 512KB L2 Cache
1.75GB RAM
Red Hat Linux 7.2
J2RE 1.3.1 IBM build cxia32131w-20020223 ORB130
WebSphere Application Server, Version 4.0.3, Advanced Edition. Availability: 04/30/2002

Database Server Configuration:
IBM xSeries x440 (Model 8687-3RX), Availability: 04/26/2002
4 x 1.6GHz Intel Xeon™ Processor MP CPUs with 256KB L2 Cache and 1MB L3 Cache
4 GB RAM
Microsoft Windows 2000 Server
DB2 Workgroup Unlimited Edition V7.2

Number and type of disk units:
xSeries 330 Application Servers:
SCSI controller
    1 - 18.2GB 15K RPM disks

xSeries 440 Database Server:
SCSI controller
    2 - 18.2GB 15K RPM disks
ServeRAID®-4H Ultra160 SCSI Adapter
    4 - 18.2GB 15K RPM disks

Number of LAN connections used: A single switched LAN connecting Driver/Emulator to the System Under Test (SUT) as well connectivity for the systems comprising the SUT.

Network 1: Connection of Driver/Emulator to SUT (10 Interfaces - 1 Driver, 9 WebSphere SUT Nodes)
Driver/Emulator (IBM xSeries 350 (4 x 900MHz)) connected with a 1Gb adapter to Cisco switch. Each WebSphere Application Server (x330) used first (of two) on-board 10/100 Ethernet ports to connect to this Cisco 10/100/1000Mbit switch.

Network 2: Interconnection of all SUT Nodes

The second 10/100 on-board Ethernet port from each WebSphere SUT Node was connected via a Cisco 10/100/1000Mbit switch. The DB node (xSeries x440) was connected with a 1Gb adapter to this switch.

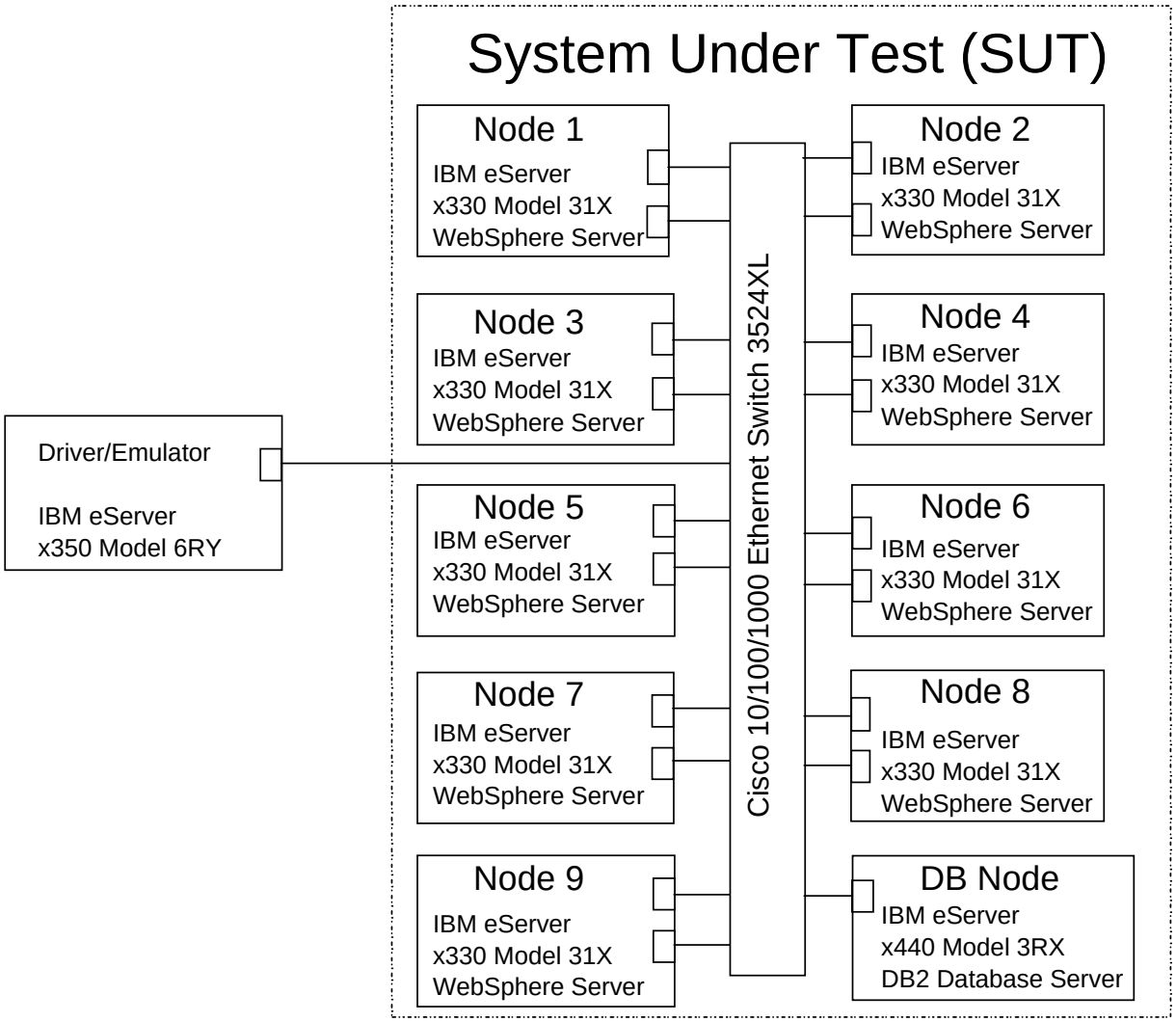

Figure 7.2.1: Network Description

7.3 Summary Statement

7.3.1 The Summary Statement is a high-level view of the ECperf benchmark configuration and run results. An example of the Summary Statement is presented in Appendix B. The Summary Statement must include all of the information contained in this example in the same format for the benchmark being reported.

IBM Corporation: xSeries 330 Cluster with xSeries 440 Database Server
WebSphere Application Server Advanced Edition Version 4.0.3
DB2 Workgroup Unlimited Edition V7.2

Metrics:
32581.47 BBops/min@Std $11/BBops/min@Std

Availability Date:
WebSphere 4.0.3 will be available April 30, 2002. All other components are available as of April 26, 2002.

Bean Deployment Mode:
CMP only

Configuration:

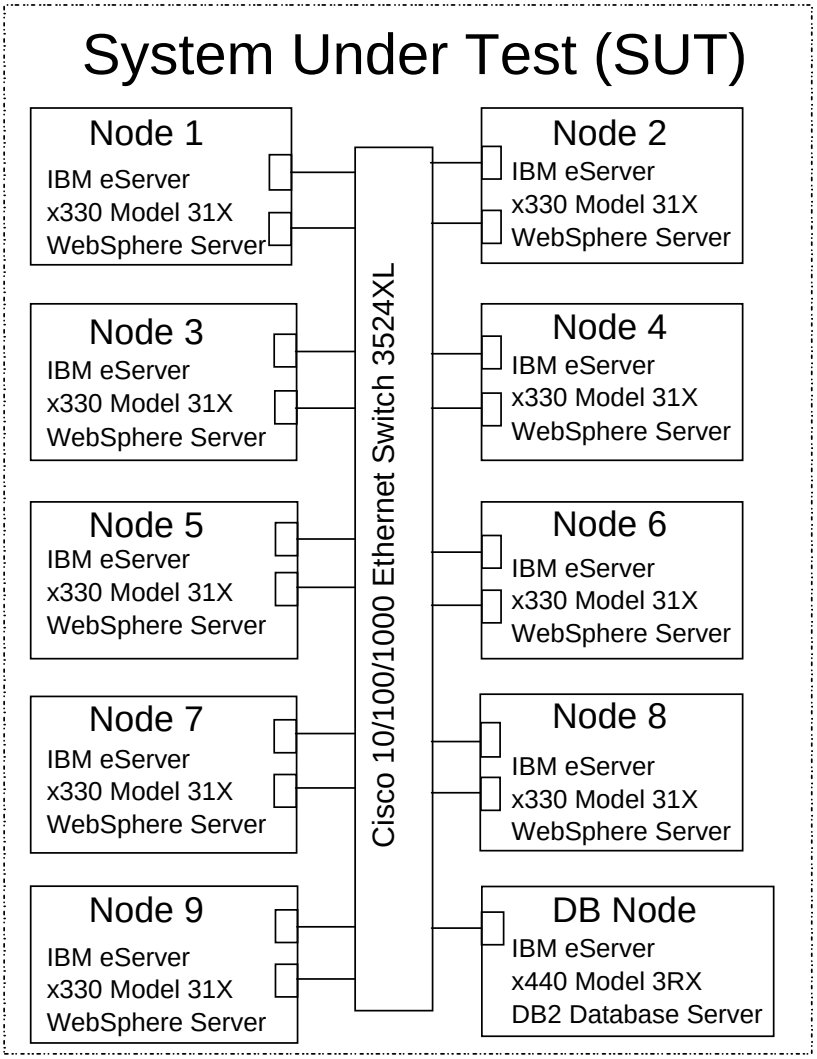

Figure 7.3.1: System Under Test

System	Software	CPUs	Memory	Disk
Nodes 1 through **9** IBM xSeries 330 Model 8674-31X	WebSphere Application Server Advanced Edition Version 4.0.3 Red Hat Linux 7.2 J2RE 1.3.1 IBM build cxia32131w-20020223 ORB130	2 x 1.266GHz Pentium III 512KB L2 Cache	1.75GB	Internal: 1x 18.2GB
DB Node IBM xSeries 440 Model 8687-3RX	IBM DB2 WorkGroup Unlimited Edition V7.2 FP 6 Microsoft Windows 2000 Server SP2	4 x 1.6GHz Xeon Processor MP 256KB L2 Cache 1MB L3 Cache	4GB	Internal: 2 x 18.2GB External 4 x 18.2GB

7.3.2 The Driver summary reports must appear as part of the Summary Statement. These include the ECperf.summary, Orders.summary and Mfg.summary files.

Contents of ECperf.summary:

```
                ECPerf Summary Report
                Version : ECperf 1.0 Update 2


Run Parameters :
runOrderEntry = 1
runMfg = 1
txRate = 316
rampUp (in seconds) = 600
rampDown (in seconds) = 300
stdyState (in seconds) = 1800
triggerTime (in seconds) = 360
numOrdersAgents = 1, numMfgAgents = 1
dumpStats = 0
Benchmark Started At : Sat Apr 06 13:21:43 EST 2002


Orders Summary report is in : Orders.summary
Orders Detailed report is in : Orders.detail
Orders Transaction Rate : 18771.57 Transactions/min

Manufacturing Summary report is in : Mfg.summary
Manufacturing Detail report is in : Mfg.detail
Manufaturing Rate : 13809.90 WorkOrders/min

ECperf Metric : 32581.47 BBops/min
```

Contents of Orders.summary:

```
                  Orders Summary Report
                  Version : ECperf 1.0 Update 2

Orders Transaction Rate : 18771.57 Transactions/min

TRANSACTION MIX

Total number of transactions = 563147
TYPE               TX. COUNT    MIX          REQD. MIX.(5% Deviation Allowed)
----               ---------    ---          ----------
NewOrder:          281016       49.90%       50%    PASSED
ChangeOrder:       112537       19.98%       20%    PASSED
OrderStatus:       113075       20.08%       20%    PASSED
CustStatus:        56519        10.04%       10%    PASSED
ECPerf Requirement PASSED

RESPONSE TIMES           AVG.         MAX.         90TH%  REQD. 90TH%

NewOrder                 0.672        10.313       1.600        2
ChgOrder                 0.421        7.156        1.000        2
OrderStatus              0.180        6.672        0.500        2
CustStatus               0.229        6.609        0.600        2
ECPerf Requirement for 90% Response Time PASSED
ECPerf Requirement for Avg. Response Time PASSED


CYCLE TIMES TARGETED AVG. ACTUAL AVG.  MIN.         MAX.

NewOrder     4.961        5.051       0.000        25.000       PASSED
ChgOrder     4.981        5.017       0.000        25.000       PASSED
OrderStatus  4.940        4.948       0.000        25.000       PASSED
CustStatus   4.999        5.010       0.000        25.000       PASSED

MISC. STATISTICS

Average items per order               28.530
Widget Ordering Rate                  267247.467/min      PASSED
Percent orders that are Large Orders  10.03               PASSED
Average items per Large order         149.965             PASSED
Largeorder Widget Ordering Rate       140877.067/min      PASSED
Average items per Regular order       14.994              PASSED
Regular Widget Ordering Rate          126370.400/min      PASSED
Percent orders submitted from Cart    50.15               PASSED
Percent ChgOrders that were delete    10.24               PASSED


LITTLE'S LAW VERIFICATION


Number of users = 1580
Sum of Avg. RT * TPS for all Tx. Types = 1570.431255
```

Contents of Mfg.summary:

```
               Mfg Summary Report
               Version : ECperf 1.0 Update 2

Total Number of WorkOrders Processed : 414297
Number of WorkOrders as a result of LargeOrders : 73820
Total WorkOrders Production Rate : 13809.90 WorkOrders/min
LargeOrders Production Rate : 2460.67 LargeOrders/min

Total Widget Manufacturing Rate : 251868.77 widgets/min
LargeOrderLine Widget Rate : 124184.53 widgets/min   PASSED
PlannedLines Widget Rate : 127684.23 widgets/min     PASSED

RESPONSE TIMES       AVG.       MAX.       90TH%  REQD. 90TH%

                     2.055      6.984      2.750      5
ECPerf Requirement for 90% Response Time PASSED
ECPerf Requirement for Avg. Response Time PASSED
```

7.3.3 The Audit.report file generated by the Driver for run validation must appear as part of the Summary Statement.

Contents of Audit.report:

```
                    ECperf Audit Report
                    Version : ECperf 1.0 Update 2

Study State Started at : Sat Apr 06 13:31:43 EST 2002
Study State Ended at : Sat Apr 06 14:01:43 EST 2002
Orders Domain Transactions

New Order Transaction validation
Condition : New Order TxCount <= New Order DB Count
New Order Tx Count 238035
New Order DB Count 242139
Orders Transaction validation PASSED

Corp Domain Transactions

Corp Customer Transaction validation
Condition : Final Corp Customer Count >= Initial Count
Initial Corp Customer  Count = 24000
Final Corp Customer  Count  = 129646
Corp Customer Transaction validation PASSED

Mfg Domain Transactions

Work Order Transaction validation
Condition : New Work Order TxCount <= New Work Order DB Count
Work Order Tx Count 414297
Work Order DB Count 415246
Work Order Transaction validation PASSED

Suppier Domain Transactions

Purchase Order (PO) Transaction validation
Condition : PO DB Count <= Emulator TxCount
Emulator Tx Count  = 5520
PO DB Count  = 5520
PO Transaction validation PASSED

Purchase Order Line (POLine) Transaction validation
Condition : New POLine DB Count >= Delivery Servlet Tx Count
Delivery Servlet Tx Count  = 5569
New POLine DB Count  = 5572
POLine Transaction validation PASSED
```

7.4 Clause 4 Scaling and Run Rules Related Items

7.4.1 All commercially available software products used must be identified. Settings must be provided for all customer-tunable parameters and options which have been changed from the defaults found in actual products, including but not limited to:

- Operating system options.

RedHat 7.2 Settings (WebSphere nodes):
net.ipv4.ip_forward = 0
net.ipv.tcp_max_syn_backlog = 8192
kernel.msgmni = 1024
kernel.sem = 1000 32000 32 512
fs.file-max = 65535
ulimit -n 65535
export LD_ASUMME_KERNEL=2.2.5

Kernel version: 2.4.9-31smp
glibc version: 2.2.4-13

- Web Container options used for the Supplier Domain and the Emulator.

The following options were changed from their default values for the Web container for both the Supplier and Emulator. (All changes were accomplished using the Administrative Console)
Emulator: WebSphere V4.0.3 AEs
JVM Settings:
- Specify Java min and max heap size as 256m
Web Container Settings:
- Add MaxKeepAliveConnections to 0
- Add MaxKeepAliverequests to 0
- Change Minimum Thread to 200
- Change Maximum Thread to 300
- Specify “True” for “Thread Growable”

Supplier (same JVM as EJB container on Node 1)
JVM Settings Panel
- Specify Java min and max heap size as 768m
Web Container Panel
- Change KeepAlives to 0

- J2EE Server and EJB Container options.

The following options were changed from their default values for the EJB container. (All changes were accomplished using the Administrative Console).
JVM Settings Panel
- Specify Java min and max heap size as 768m
- Add -Dcom.ibm.ws.Orb.ThreadPoolGrowable=false
- Add -Djavax.rmi.CORBA.UtilClass=com.ibm.CORBA.iiop.Util
ORB Services Panel
Specify Max Threads of 20
EJB Container (a single EJB container was run on each WebSphere Node)
Specify cache size of 8191

DataSource Options
ECperfDataSource - Min/Max Connections 20, Statement Cache Size 1500
UtilDataSource - Min/Max 20 Connections, Statement Cache Size 1500 (Used only for the util.jar - SequenceEnt bean)

• Database options.
Refer to schema/db2/db2tune.bat in the Full Disclosure Archive for a script that shows the database parameters that were changed.

DB2 JDBC Type 2 (CLI) driver was used to connect to the Database Server.

Comment 1: This requirement can be satisfied by providing a full list of all parameters and options.

7.4.2 For a new version of a J2EE Compatible Product, the date by which it is expected to have passed the J2EE Compatibility Test Suite (CTS) should be indicated.
WebSphere Application Server 4.0 passed CTS testing in July 2001.
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7.4.3 The Orders Injection Rate used to load the database(s) must be disclosed.
The databases were loaded with an Orders Injection Rate of 316.

7.4.4 The Full Disclosure Archive must include all table definition statements and all other statements used to set-up the database.
These can be found in the schema subdirectory in the Full Disclosure Archive. Note, two additional indexes were added to the M_LargeOrder table. See the schema_M.sql file in the archive for specific information. These indexes were added to decrease table locks and improve performance.

Also, script db2tune was executed after the database tables were re-populated with the load utility. This file can be found in the FDA schema/db2.

7.4.5 If the Load Programs in the ECperf kit were modified (see Clause 4.4.4), all such modifications must be disclosed and the modified programs must be included in the Full Disclosure Archive.
The load programs were not modified.

7.4.6 All scripts/programs used to create any logical volumes for the database devices must be included as part of the Full Disclosure Archive. The distribution of tables and logs across all media must be explicitly depicted.
The commands used to create the database environment can be found in schema/db2/ in the Full Disclosure Archive.

The database was laid out on a total of 5 disks; 4 of these were used for the log and 1 for the tables. The tables were placed on a single disk image. The log files were striped across two pairs of mirrored disks in a RAID-10 configuration using the hardware RAID card. Write-through was enabled on the card.

7.4.7 The type of persistence, whether CMP, BMP or mixed mode used by the EJB Containers must be disclosed. If mixed mode is used, the list of beans deployed using CMP and BMP must be enumerated.
Only CMP persistence was used.

All beans were deployed at an isolation level of READ_COMMITTED (Cursor stability) except SequenceEnt which was deployed at REPEATABLE_READ (Read Stability).

7.4.8 If the ECperf Reference Beans were modified (see Clause 4.1.3), a statement describing the modifications must appear in the Full Disclosure Report and the modified code must be included in the Full Disclosure Archive.

No modifications were made.

7.4.9 All Deployment Descriptors used must be included in the Full Disclosure Archive.

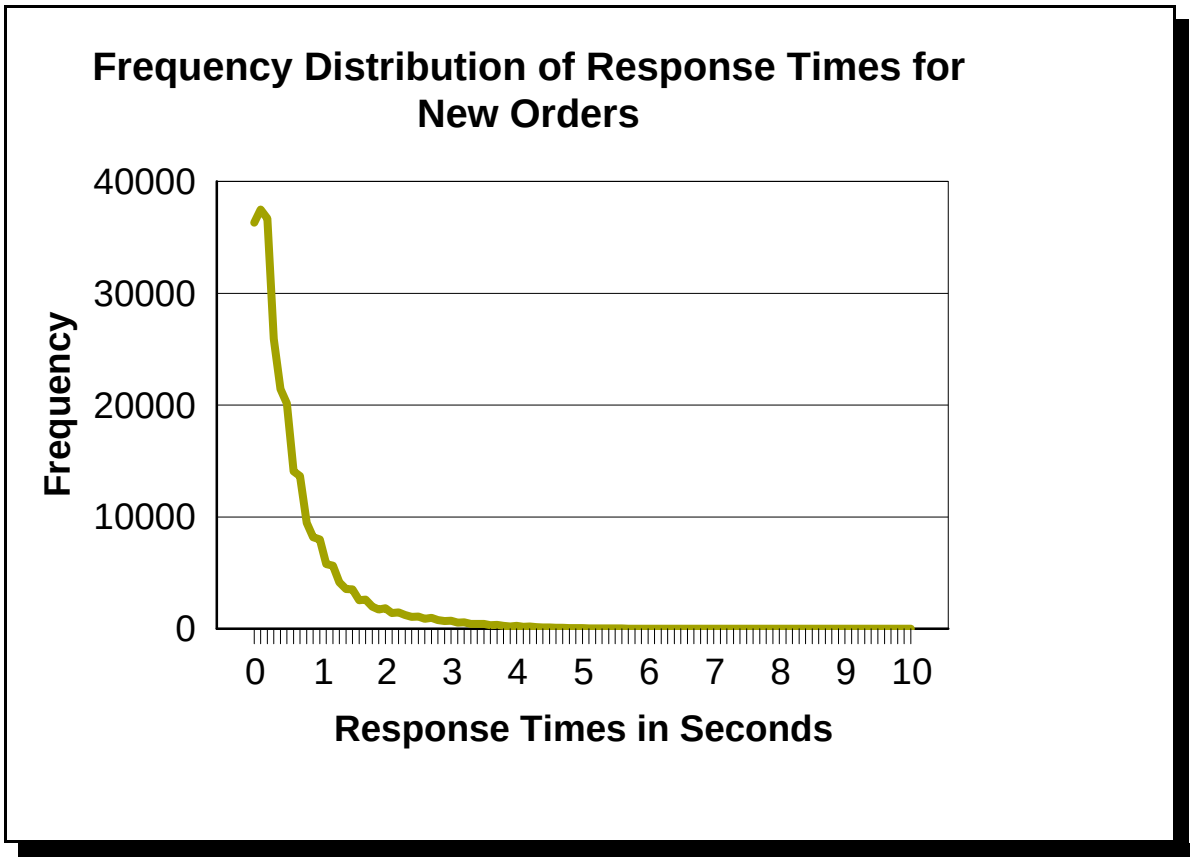
The Full Disclosure Archive contains the deployment descriptors used in the deploy/WebSphere directory. The jars used for deployment were generated using the ant scripts provided with the kit. The following command was used to generate these jars:

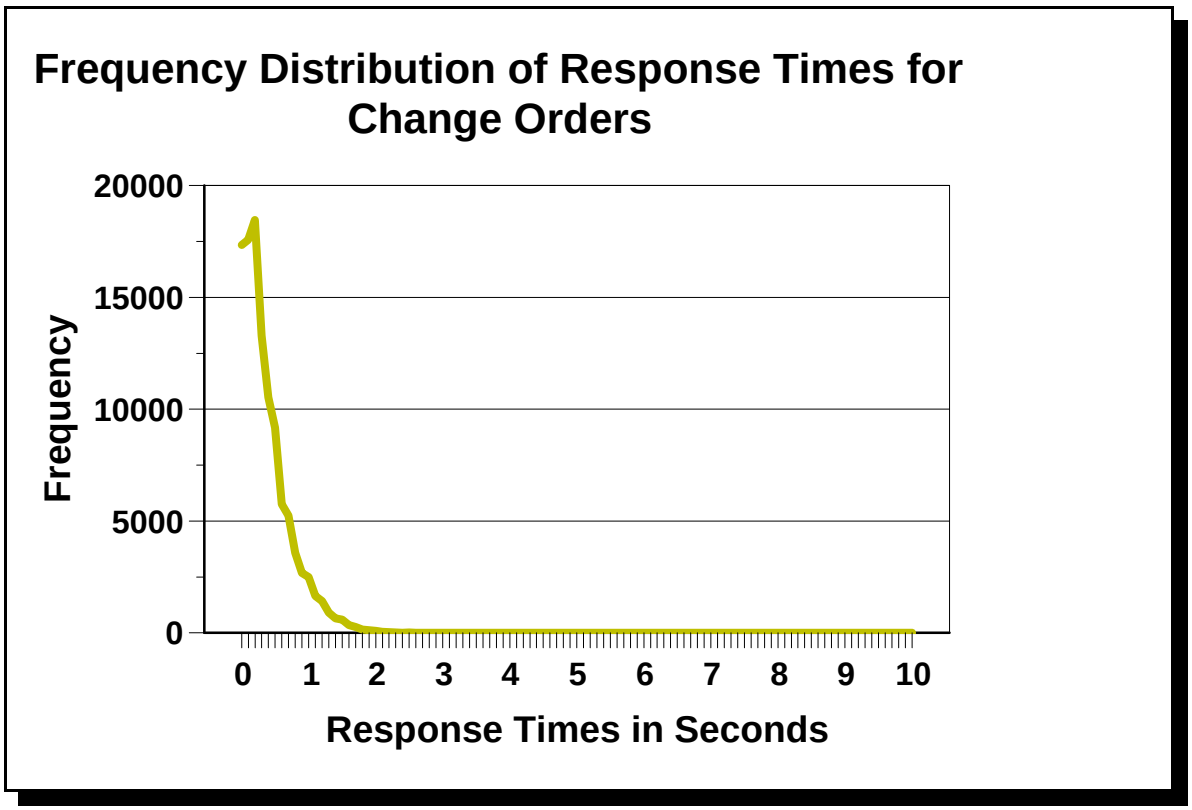
1. Created an environment file in the config directory called websphere.env modeled after the file ri.env.
2. Updated websphere.env with location information for websphere, ports and hostnames for the deployment.
3. Created directory ecperf\src\deploy\websphere and copied the descriptors from ecperf\src\deploy\reference to this new directory
4. ant\bin\ant -Dappserver=websphere -Ddd.util=util.xml.CMP -Ddd.corp=corp.xml.CMP -Ddd.orders=orders.xml.CMP -Ddd.mfg=mfg.xml.CMP -Ddd.supp=supplier.xml.CMP
5. Started the Application Assembly Tool (AAT, a GUI utility for deployment) and opened the ear file created by the ant script.
6. Went through the EJB Modules in sequence and applied the following changes to each bean in the jar (where appropriate):
   - Binding Information (JNDI) for the bean and EJB References
   -Where Clauses for finder methods where appropriate.
   -Updated EJB Resource References
   -Set transaction isolation levels to READ_COMMITTED (Util jar uses REPEATABLE_READ)
   -Deployed the application (option in AAT) which created a top-down map.
7. Saved the ear.
8. For each jar in the ear the file META-INF/Schema/Schema.dbxmi was manually edited to apply meet in the middle mapping to schemas supplied in the ECperf kit.
9. Performed static access analysis using the CMPOpt utility:
   cmpopt ./corp.jar -report -update -ignoreopenfields -ignorenativemethods
   cmpopt ./mfg.jar -report -update -ignoreopenfields -ignorenativemethods
   cmpopt ./orders.jar -report -update -ignoreopenfields -ignorenativemethods
   cmpopt ./supplier.jar -report -update -ignoreopenfields -ignorenativemethods
   cmpopt ./util.jar -report -update -ignoreopenfields -ignorenativemethods
10. Repackaged the ear with the updated jars.
11. Started AAT once again and opened the ecperf ear file.
12. Re-deployed the ears to generate appropriate code that incorporated meet in the middle mapping.
13. Saved the ear, installed it and began testing.

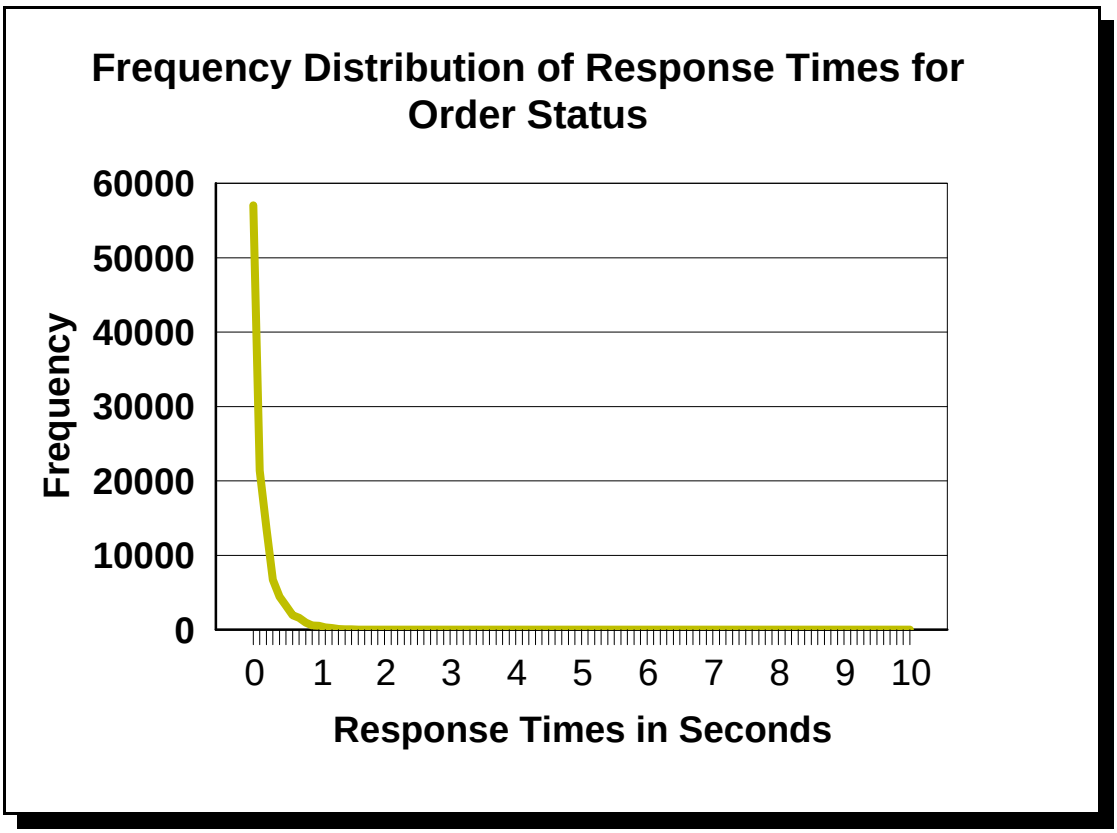
7.4.10 The BBops/min from the reproducibility run must be disclosed (see Clause 4.9.2). The entire output directory from the reproducibility run must be included in the Full Disclosure Archive in a directory named RepeatRun.

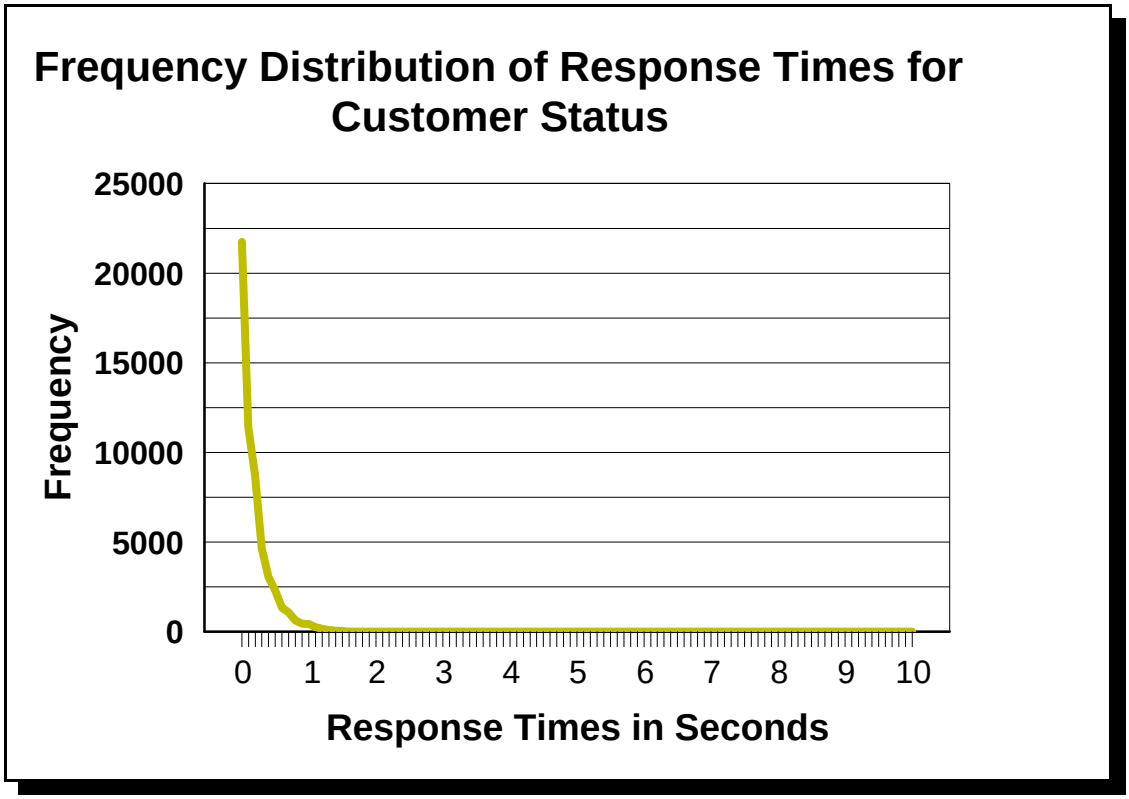
32651.93 BBops/minute.

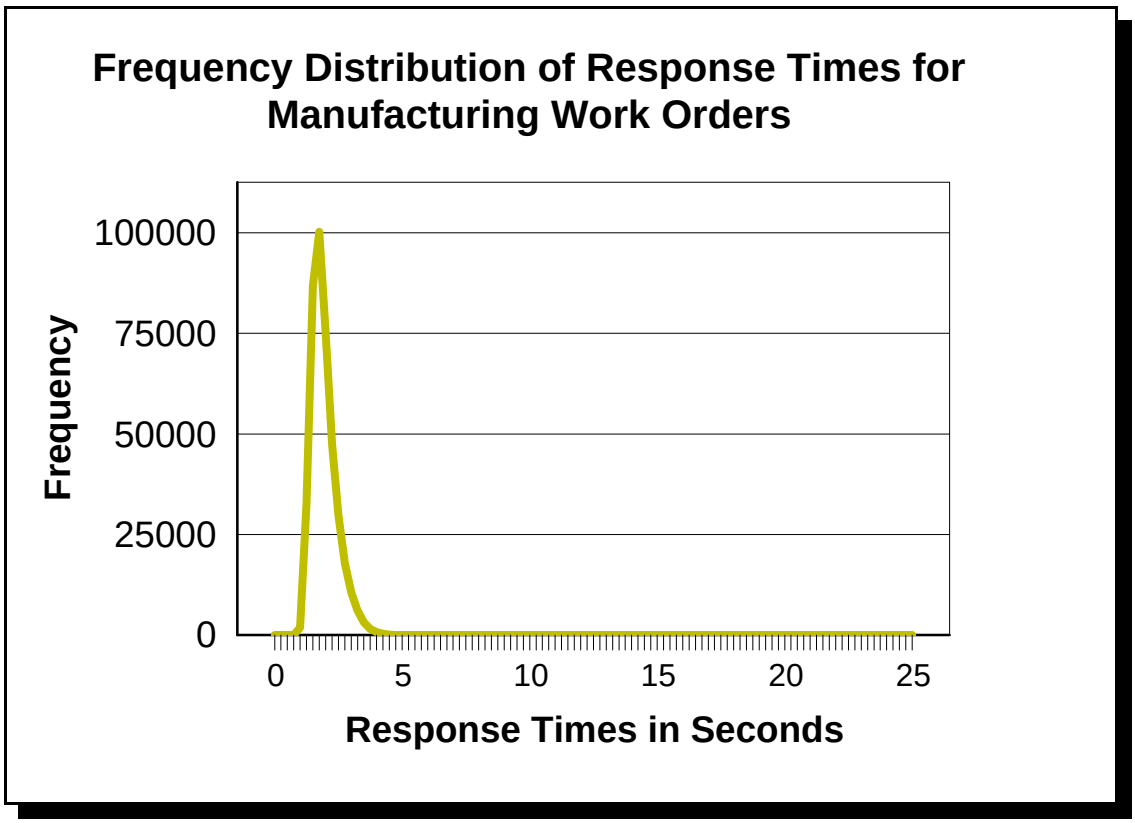
7.4.11 The frequency distribution of response times for all the transactions must be graphed (see Clause 4.10.1).



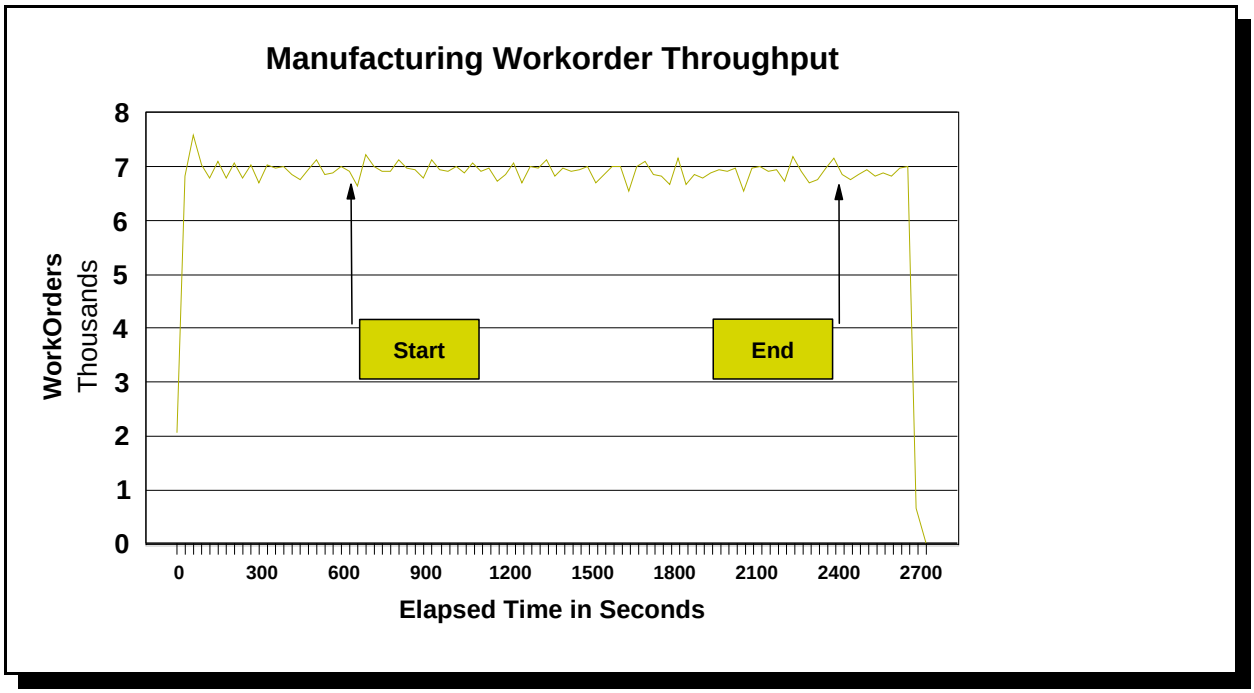



Frequency Distribution of Response Times for Order Status
60000
50000
40000
30000
20000
10000
0
Frequency
0 1 2 3 4 5 6 7 8 9 10
Response Times in Seconds


Frequency Distribution of Response Times for Customer Status
25000
20000
15000
10000
5000
0
Frequency
0 1 2 3 4 5 6 7 8 9 10
Response Times in Seconds


Frequency Distribution of Response Times for Manufacturing Work Orders
Frequency
100000
75000
50000
25000
0
0
5
10
15
20
25
Response Times in Seconds

7.4.12 A graph of the workorder throughput versus elapsed time must be reported (see Clause 4.10.2).



7.4.13 The scripts/programs used to run the ACID tests and their outputs must be included in the Full Disclosure Archive.
The results of the Atomicity tests can be found in the subdirectory called **Atomicity Test** in the Full Disclosure Archive.

7.4.14 If the xerces.jar package in the jars subdirectory of the ECperf Kit was not used, the reason for this should be disclosed. The version and source of the actual package used should also be disclosed.
The xerces.jar package in the jars subdirectory of the ECperf Kit was used.

7.5 Clause 5 SUT and Driver Related Items

7.5.1 If any software/hardware is used to influence the flow of network traffic beyond basic IP routing and switching, the additional software/hardware and settings must be disclosed. See Clause 5.1.1.
No software/hardware is used to influence the flow of network traffic beyond basic IP routing and switching.

7.5.2 The input parameters to the Driver must be disclosed by including the config/run.properties file and bin/driver.sh script used to run the benchmark in the Full Disclosure Archive. If the Launcher package was modified, its source must be included in the Full Disclosure Archive.
The config\run.properties is included in the Full Disclosure Archive. The bin\driver.bat script was Modified to point to the correct jars for WebSphere as well as miscellaneous updates for hostnames and port numbers.

In addition, the emulator.err and delivery.err had to be manually retrieved as the driver failed to retrieve this information. A browser was used and the output pasted into a flat file.

7.5.3 The bandwidth of the network(s) used in the tested/priced configuration must be disclosed.
The Emulator/Driver connection to the switch and the Database connection to the switch both used 1Gbit Ethernet. All other connections used a switched 100Mbit Ethernet network.

7.5.4 The protocol used by the Driver to communicate with the SUT (e.g RMI/IIOP) must be disclosed.
The protocol used was RMI-over-IIOP.

7.5.5 If the Driver system(s) perform any load-balancing functions as defined in Clause 4.12.5, the details of these functions must be disclosed.
The WebSphere Application Server ORB on the driver system balanced requests among Nodes 1 through 9. The methodology was Round-Robin.

7.5.6 The number and types of client systems used, along with the number and types of processors, memory and network configuration must be disclosed.
The following single client system was used:
IBM xSeries 350 (Model 8682-6RY)
4 x 900MHz Pentium III Xeon CPUs with 2MB L2 Cache
4GB RAM, one 18.2GB Disk
1 1Gbit Ethernet interface

7.6 Clause 6 Pricing Related Items

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

Pricing detail for the hardware components is in **Appendix A.**

Hardware **(includes at least 1 year 24x7 support)**

System	Acquisition Price	Support
Ethernet Switch	3,390	426
Nine WebSphere Application Server Nodes	42,966	4,050
Rack Hardware	1,653	300
x330 Cluster Components	357	Inc. in purchase
Database Node	50,368	Inc. in purchase
	$98,734	$4,776

Note: Hardware pricing is independent of software configured or used.

Software

Description	Part No.	Price	Qty	Extended Price	24x7 Support
WebSphere Application Server AE	D5ALTLL	$ 9,429	18	$ 169,722	see Note
IBM DB2 Workgroup Unlimited Edition V7.2	D5B6ZLL	$ 13,174	4	52,696	see Note
Red Hat Linux Professional 7.2	RHF0045US	$ 200	1	200	
Red Hat Linux Support	SER360DWX	$ 1,283	9		11,547
Microsoft Windows 2000 Server - 5 Client	C11-00016	$ 999	1	999	
IBM Support Line for 1 server (DB Node)	SL Enterprise	$ 5,572	1		5,573
Software Total				$ 223,617	$ 17,120

Note: Software pricing based on Passport Advantage Agreement. This is a standard offering from IBM and includes 24x7 software support for IBM WebSphere Application Server and DB2. There is no charge to become a Passport Advantage customer. Microsoft Windows 2000 Server support is covered by the IBM Support Line item above. Pricing is based on the purchase of the one server used as the DB node in the test. This is a standard package offering.

Description	Aquisition Cost	24x7 Support
Hardware Acquisition and 1-year cost of ownership	98,734	4,776
Software Acquisition and 1-year cost of ownership	223,617	17,120
1-Year Hardware/Software Acquisition and Support		**$344,247**
BBops@Std	32581.47	
$/BBops@Std	11	

Pricing sources:
IBM: www.ibm.com
Red Hat: www.redhat.com
Microsoft: www.microsoft.com
Cisco: 1-800-326-1941
Effective dates of pricing: 04/08/2002

7.6.2 The total price of the entire configuration must be reported, including: hardware, software, and maintenance charges. Separate component pricing is recommended.
The total price of the tested configuration is: $344,247 (quoted in US dollars).

7.6.3 The committed delivery date for general availability (availability date) of products used in the price calculations must be reported. When the priced system includes products with different availability dates, the reported availability date for the priced system must be the date at which all components are committed to be available.
WebSphere 4.0.3 will be available April 30, 2002. All other products used in this benchmark are available as of April 30, 2002.

Appendix A - List Prices for SUT Hardware (current as of 2002-04-08)

		xSeries 330		
1	867431X	xSeries 330 Pentium III 1.26GHz/512KB L2,256MB ECC,Ultra160,OPEN,24X,PCI (Rack 1U) (F	$1,729.00	$1,729.00
1		(Std) 200W Power Supply		
1		(Std) 256MB 133MHz SDRAM ECC RDIMM		
1		(Std) 9.6-inch KVM Chaining Cable		
1		(Std) CD-ROM Drive Internal 24X-10X (Variable Speed)		
1		(Std) IBM 1.44MB 3.5-inch Diskette Drive		
2		(Std) Integrated Ethernet 10/100 Mbps		
1		(Std) Integrated Single-Channel Ultra160 SCSI Controller		
1		(Std) Integrated Video Controller - 8MB		
1		(Std) LVD SCSI Cable		
1		(Std) Systems Management Processor		
1		(Std) xSeries 1.26 GHz/133MHZ-512KB Cache Upgrade with Pentium III Processor		
1		(Std) 2-Drop 16-bit SCSI Internal Media Cable		
1	25P2836	xSeries 1.26 GHz/133MHZ-512KB Cache Upgrade with Pentium III Processor (P/N 25P2836)	$999.00	$999.00
3	10K0022	IBM 512MB PC133 ECC SDRAM RDIMM (P/N 10K0022)	$499.00	$1,497.00
1	06P5767	18.2GB 15K-rpm Ultra160 SCSI Hot-Swap SL HDD (P/N 06P5767)	$549.00	$549.00
1	21P2073	3YR Onsite repair 24x7 4-Hour warranty service upgrade (P/N 21P2073)	$450.00	$450.00
		Subtotal for x330		**$5,224.00**
		Rack Components		
1	9306250	NetBAY25 Rack Cabinet	$1,295.00	$1,295.00
2	37L6866	NetBAY Rack Power Distribution Unit (P/N 37L6866)	$179.00	$358.00
1	41L2762	Onsite 24x7 4-Hour warranty service upgrade (P/N 41L2762)	$300.00	$300.00
		Subtotal for Rack		**$1,953.00**
		Components for use with x330 Cluster		
1	06P4792	Cable Chain Technology Cable Kit (P/N 06P4792)	$54.00	$54.00
1	28L3621	IBM Preferred Keyboard (Stealth Black) (P/N 28L3621)	$49.00	$49.00
1	28L3673	Sleek 2-Button Mouse (Stealth Black) (P/N 28L3673)	$25.00	$25.00
1	66274AN	G78 17inch (16 inch Viewable) Monitor - Stealth Black (P/N 66274AN)	$229.00	$229.00
		Subtotal for x330 Cluster components		**$357.00**
		Cisco Catalyst 3524 XL Ethernet Switch		
1	WS-C3524-XL-EN	Cisco Catalyst 3524 XL Ethernet Switch		$2,995.00
1	WS-G5483	GBIC - 1000 BaseT Gigabit Interface	$ 395.00	$395.00
1		SMARTnet 1 year 24x7 4 hour warranty Service (CON-SNTP-WS-C3524)		$426.00
		Subtotal for x330 Cisco Ethernet Switch		**$3,816.00**

	P/N	xSeries 440 DB System	List Price	Net Price
1	86873RX	xSeries 440 with Intel Xeon MP 1600MHz/256KB/1MB ,2048MB ECC	$27,099.00	$27,099.00
2		(Std) 1050W Hot-Swap Power Supply		
1		(Std) 24X Max CD-ROM Drive		
2		(Std) 1.6GHz Xeon MP Processor with 1M L3 cache		
1		(Std) IBM 1.44MB 3.5-inch Diskette Drive		
1		(Std) Integrated 10/100/1000 Ethernet Controller		
1		(Std) Integrated Ultra160 SCSI Controller		
1		(Std) Integrated Video Controller - 8MB		
4		(Std) 512MB PC 133 CL3 ECC SDRAM RDIMM		
1		(Std) 32MB L4 cache		
1		(Std) one year 24x7 warranty service		
2	19K4647	1.6GHz 1M L3 cache upgrade with Xeon Processor MP	$6,199.00	$12,398.00
4	33L3324	512MB PC 133 CL3 ECC SDRAM RDIMM	$499.00	$1,996.00
1	37L6889	ServeRAID-4H Ultra160 SCSI Controller	$2,099.00	$2,099.00
6	06P5767	18.2GB 15K-RPM Ultra160 SCSI Hot-Swap SL HDD	$549.00	$3,294.00
1	35311RU	EXP300 Storage expansion unit	$3,179.00	$3,179.00
1	28L3621	IBM Preferred Keyboard (Stealth Black)	$49.00	$49.00
1	28L3673	Sleek 2-Button Mouse (Stealth Black)	$25.00	$25.00
1	66274AN	G78 17inch (16 inch Viewable) Monitor - Stealth Black (P/N 66274AN)	$229.00	$229.00
		Subtotal for x440		**$50,368.00**