

Full Disclosure Report

ECperf Benchmark

**IBM® WebSphere® Application Server
Advanced Edition, Version 4.0.3**

**IBM @server x330 Cluster
Microsoft® Windows® 2000
Advanced Server**

IBM DB2® Enterprise Edition V7.2

**IBM @server p660 Database
IBM AIX 5L v5.1**

June 17, 2002

First Printing

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Revision History:

2002-06-17: Initial submission.
2002-07-08: 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 priced configuration includes: a 2nd internal 18.1GB Hard disk in the p660 which was not present in the measured configuration.

PRICED CONFIGURATION:

Application Server System Configuration:

WebSphere Application Servers (twelve systems):

IBM xSeries 330 (Model 8674-32X)
2 x 1.266GHz Intel® Pentium® III CPUs with 512KB L2 Cache
2 GB RAM
Microsoft® Windows® 2000 Advanced Server
J2RE 1.3.1 IBM build cn131w-20020403 ORB130
WebSphere Application Server, Version 4.0.3, Advanced Edition

Database Server Configuration:

IBM pSeries 660 (Model 7026-6M1)
8 x 750MHz IBM RS64 IV Processors with 8MB L2 Cache
16GB RAM
IBM AIX 5L v5.1 ML2
DB2 Enterprise Edition V7.2 FP 6

Number and type of disk units:

xSeries 330 Application Servers:
EIDE controller
1 - 40GB 7200 RPM disk

pSeries 660 Database Server:
Ultra SCSI Interface
2 - 18.2GB 15K RPM disk

Two SSA Disk Controllers with 16 and 4 SSA drives respectively (36.4GB 10K RPM, total 20 SSA disks)

Number of LAN connections used: A single switched LAN connecting Driver/Emulator to the Application Server nodes; a second switched LAN connecting the Application Server Nodes to the database system.

ECperf - WebSphere Application Server and DB2

Network 1: Connection of Driver/Emulator to SUT (14 Interfaces - 1 Driver, 1 Emulator, 12 WebSphere SUT Nodes)

The Driver was connected to the first Cisco switch using a 1Gb adapter. The Emulator was connected using a 10/100Mbit Ethernet adapter to this same switch. Each WebSphere Application Server (xSeries 330) used first (of two) onboard 10/100 Ethernet ports to connect to this Cisco 10/100/1000Mbit switch.

Network 2: Connection of SUT to Database (13 Interfaces - 1 Database, 12 WebSphere SUT Nodes)

The second 10/100 onboard Ethernet port from each WebSphere SUT Node was connected via a second Cisco 10/100/1000Mbit switch. The DB node (pSeries 660) was connected with a 1Gb adapter to this switch.

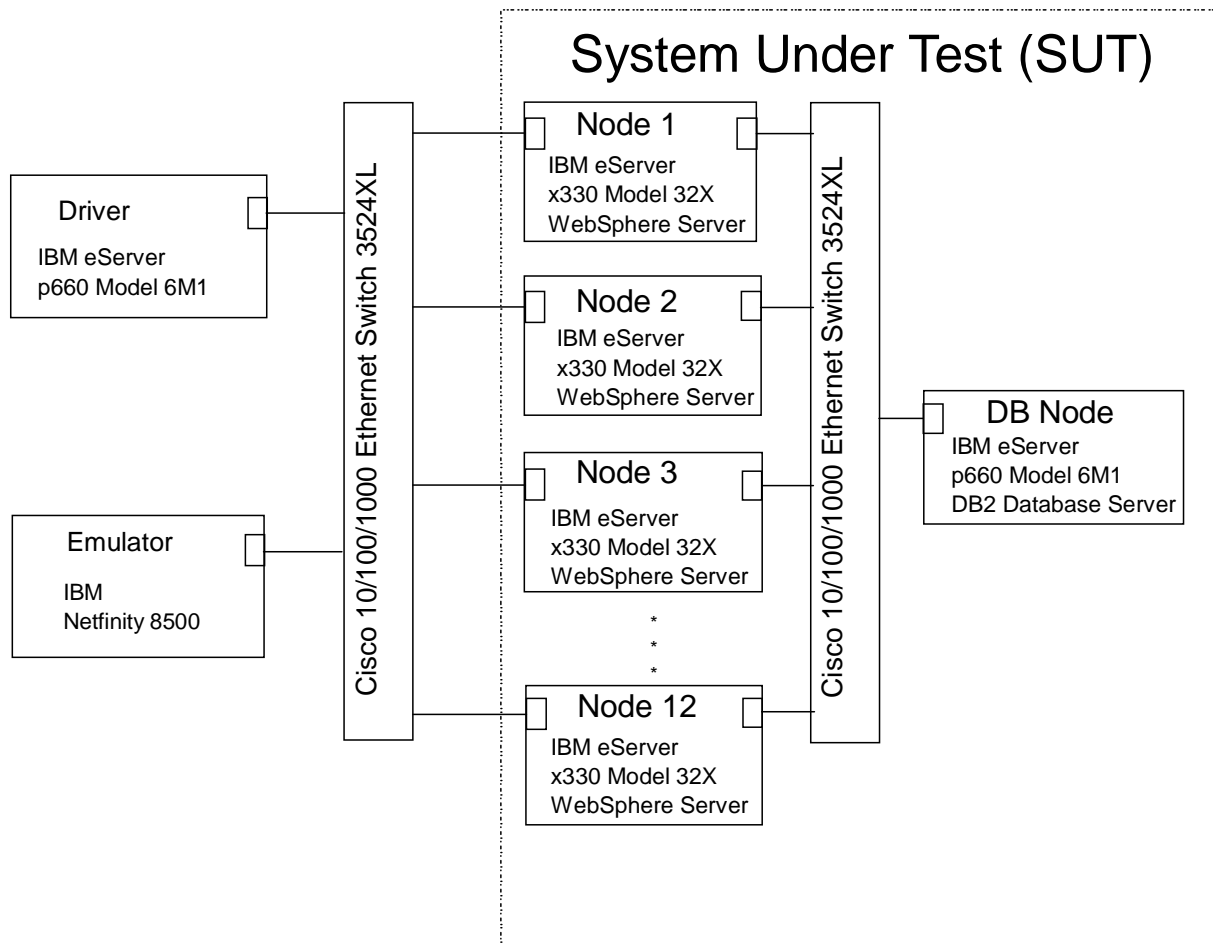


Figure 7.2.1: Network Description

7.3 Summary Statement

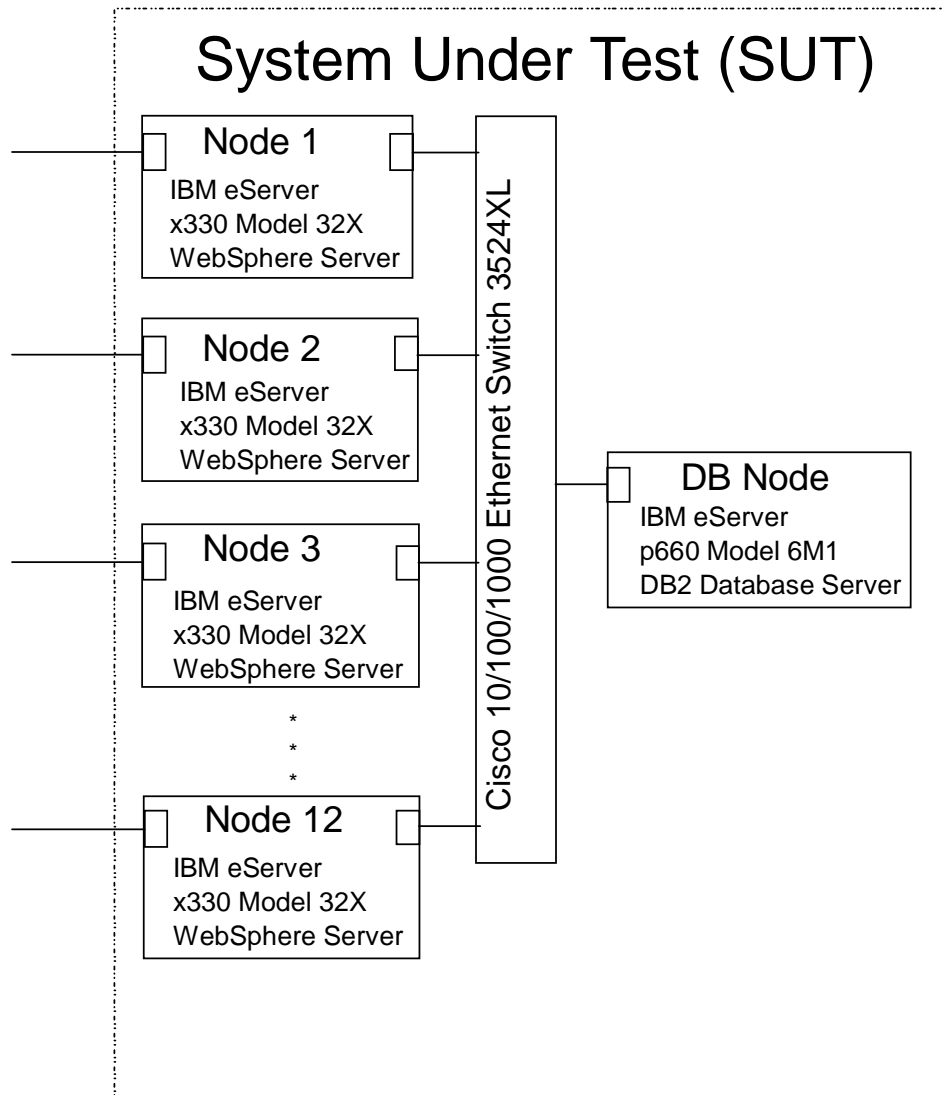
7.3.1 The Summary Statement is a high-level view of the ECperf benchmark configuration and run results. An example of the Summary Statement is presented in Appendix B. The Summary Statement must include all of the information contained in this example in the same format for the benchmark being reported.

IBM Corporation: xSeries 330 Cluster with pSeries 660 Database Server
WebSphere Application Server Advanced Edition Version 4.0.3
DB2 Enterprise Edition V7.2

Metrics: 44294.97 BBops/min@Std \$23/BBops/min@Std

Availability Date: All SUT components are currently available.

Bean Deployment Mode: CMP only



Configuration:

Figure 7.3.1: System Under Test

System	Software	CPUs	Memory	Disk
Nodes 1 through 12 IBM xSeries 330 Model 8674-32X	WebSphere Application Server Advanced Edition Version 4.0.3 Microsoft Windows 2000 Advanced Server SP2 J2RE 1.3.1 IBM build cn131w-20020403 ORB130	2 x 1.266GHz Pentium III 512KB L2 Cache	2GB	Internal: 1x 40GB
DB Node IBM pSeries 660 Model 7026-6M1	IBM DB2 Enterprise Edition V7.2 FP 6 IBM AIX 5L v5.1 ML2	8 x 750MHz RS64 IV IBM Processors 8MB L2 Cache	16GB	Internal: 2 x 18.2GB External 20 x 36.4GB

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 = 430
rampUp (in seconds) = 600
rampDown (in seconds) = 300
stdyState (in seconds) = 1800
triggerTime (in seconds) = 600
numOrdersAgents = 1, numMfgAgents = 1
dumpStats = 0
Benchmark Started At : Mon Jun 17 01:10:04 CDT 2002

Orders Summary report is in : Orders.summary
Orders Detailed report is in : Orders.detail
Orders Transaction Rate : 25513.10 Transactions/min

Manufacturing Summary report is in : Mfg.summary
Manufacturing Detail report is in : Mfg.detail
Manufacturing Rate : 18781.87 WorkOrders/min

ECperf Metric : 44294.97 BBops/min
```

Contents of Orders.summary:

Orders Summary Report					
Version : ECperf 1.0 Update 2					
Orders Transaction Rate : 25513.10 Transactions/min					
TRANSACTION MIX					
Total number of transactions = 765393					
TYPE	TX. COUNT	MIX	REQD. MIX.(5% Deviation Allowed)		
----	-----	---	-----		
NewOrder:	383208	50.07%	50%	PASSED	
ChangeOrder:	152723	19.95%	20%	PASSED	
OrderStatus:	152746	19.96%	20%	PASSED	
CustStatus:	76716	10.02%	10%	PASSED	
ECPerf Requirement PASSED					
RESPONSE TIMES	AVG.	MAX.	90TH%	REQD.	90TH%
NewOrder	0.519	12.765	1.300	2	
ChgOrder	0.338	8.205	0.800	2	
OrderStatus	0.154	6.526	0.500	2	
CustStatus	0.207	6.544	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	4.973	5.037	0.000	25.000	PASSED
ChgOrder	4.975	5.005	0.000	25.000	PASSED
OrderStatus	4.977	4.985	0.000	25.000	PASSED
CustStatus	4.995	5.008	0.000	25.000	PASSED
MISC. STATISTICS					
Average items per order			28.464		
Widget Ordering Rate			363581.633/min	PASSED	
Percent orders that are Large Orders			9.99	PASSED	
Average items per Large order			149.838	PASSED	
Largeorder Widget Ordering Rate			191218.633/min	PASSED	
Average items per Regular order			14.991	PASSED	
Regular Widget Ordering Rate			172363.000/min	PASSED	
Percent orders submitted from Cart			50.12	PASSED	
Percent ChgOrders that were delete			10.10	PASSED	
LITTLE'S LAW VERIFICATION					
Number of users = 2150					
Sum of Avg. RT * TPS for all Tx. Types = 2133.500993					

Contents of Mfg.summary:

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

Total Number of WorkOrders Processed : 563456
Number of WorkOrders as a result of LargeOrders : 100267
Total WorkOrders Production Rate : 18781.87 WorkOrders/min
LargeOrders Production Rate : 3342.23 LargeOrders/min

Total Widget Manufacturing Rate : 341274.70 widgets/min
LargeOrderLine Widget Rate : 167574.07 widgets/min PASSED
PlannedLines Widget Rate : 173700.63 widgets/min PASSED

RESPONSE TIMES          AVG.          MAX.          90TH% REQD. 90TH%
                        1.697         5.982         2.500         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 : Mon Jun 17 01:20:04 CDT 2002
Study State Ended at : Mon Jun 17 01:50:04 CDT 2002
Orders Domain Transactions

New Order Transaction validation
Condition : New Order TxCount <= New Order DB Count
New Order Tx Count 323348
New Order DB Count 327914
Orders Transaction validation PASSED

Corp Domain Transactions

Corp Customer Transaction validation
Condition : Final Corp Customer Count >= Initial Count
Initial Corp Customer Count = 32250
Final Corp Customer Count = 174830
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 563456
Work Order DB Count 564281
Work Order Transaction validation PASSED

Supplier Domain Transactions

Purchase Order (PO) Transaction validation
Condition : PO DB Count <= Emulator TxCount
Emulator Tx Count = 5455
PO DB Count = 5455
PO Transaction validation PASSED

Purchase Order Line (POLine) Transaction validation
Condition : New POnline DB Count >= Delivery Servlet Tx Count
Delivery Servlet Tx Count = 5494
New POnline DB Count = 5501
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.

IBM WebSphere Application Server Advanced Edition, Version 4.0.3

IBM DB2 Enterprise Edition, Version 7.2 FP 6

Microsoft Windows 2000 Advanced Server SP2

IBM AIX 5L v5.1 with update ML 5100-02

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.

Microsoft Windows 2000 Advanced Server (WebSphere nodes):

“My Computer\HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\Tcpip\Parameters”

TcpTimedWaitDelay = 0x0000001e

MaxUserPort = 0x00008000

- 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
- Set Minimum connection pool size to 50
- Set Maximum connection pool size to 200
- Enabled connection pool allocation beyond maximum

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.OrbThreadPoolGrowable=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.sh 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

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 430.

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 sub-directory 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 20 disks; 16 of these were used for the log and 4 for the tables. The tables were striped across 4 disks in a RAID-0 configuration, while the log files were placed on 16 mirrored disks in a RAID-10 configuration.

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 commands were 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 ecpref\src\deploy\websphere and copied the descriptors from ecpref\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:

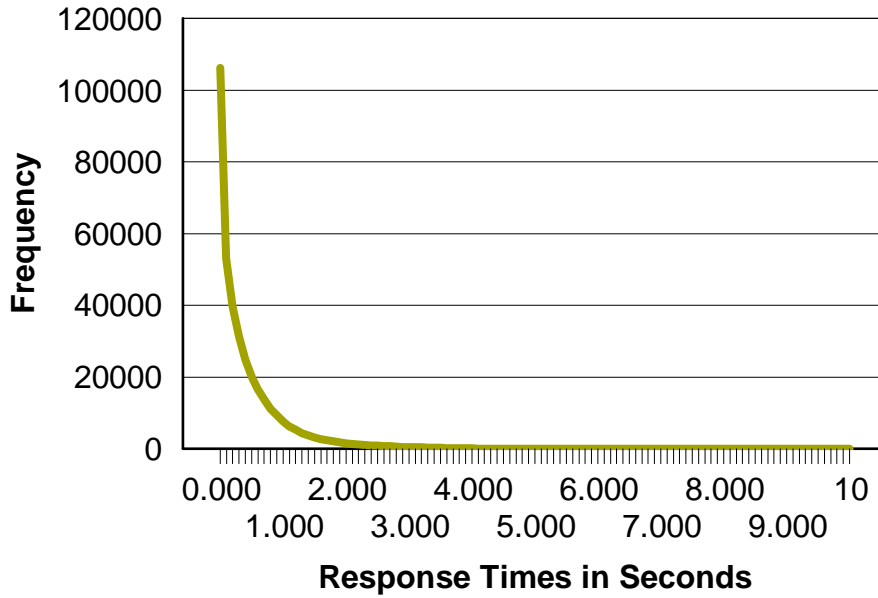
```
cmpopt ./corp.jar -report -update -ignoreopenfields -ignoreactivemethods
cmpopt ./mfg.jar -report -update -ignoreopenfields -ignoreactivemethods
cmpopt ./orders.jar -report -update -ignoreopenfields -ignoreactivemethods
cmpopt ./supplier.jar -report -update -ignoreopenfields -ignoreactivemethods
cmpopt ./util.jar -report -update -ignoreopenfields -ignoreactivemethods
```
10. Repackaged the ear with the updated jars.
11. Started AAT once again and opened the ecpref 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.

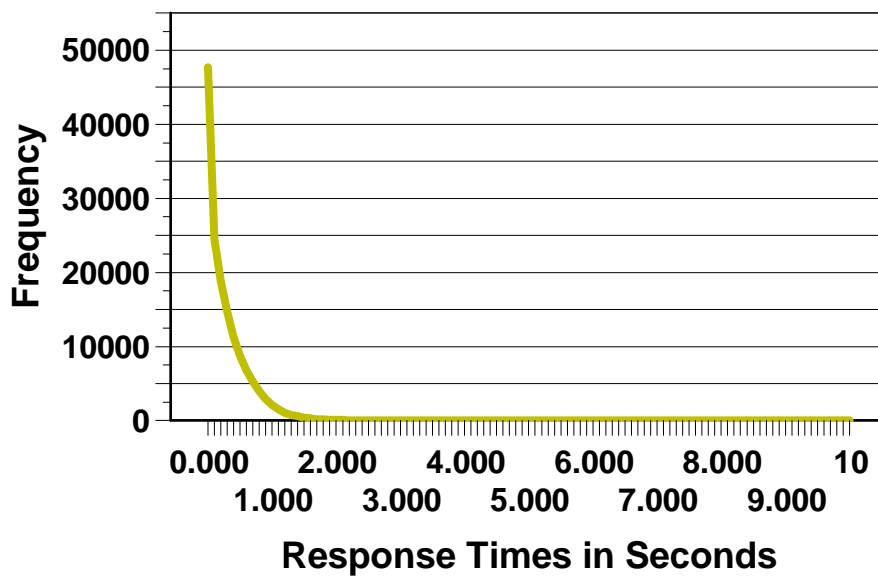
44499.97 BBops/minute.

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

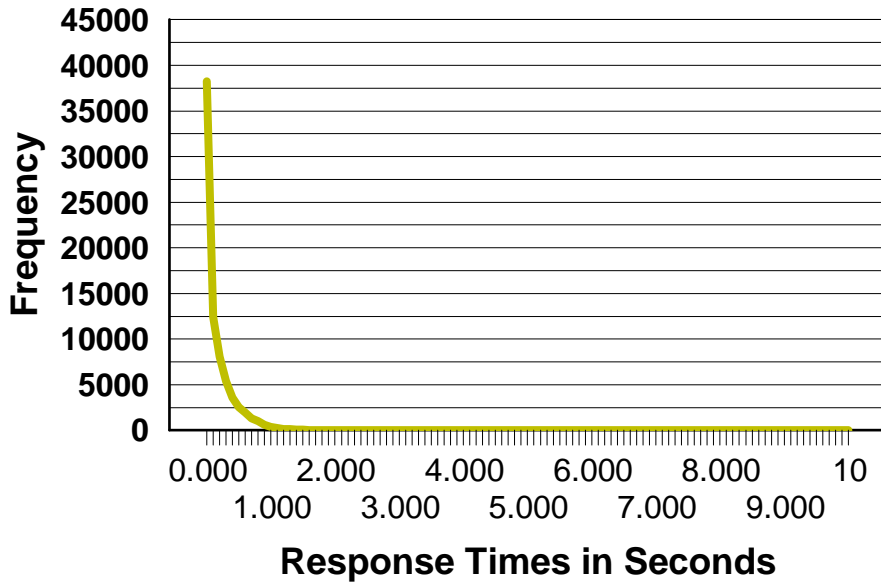
Frequency Distribution of Response Times for New Orders



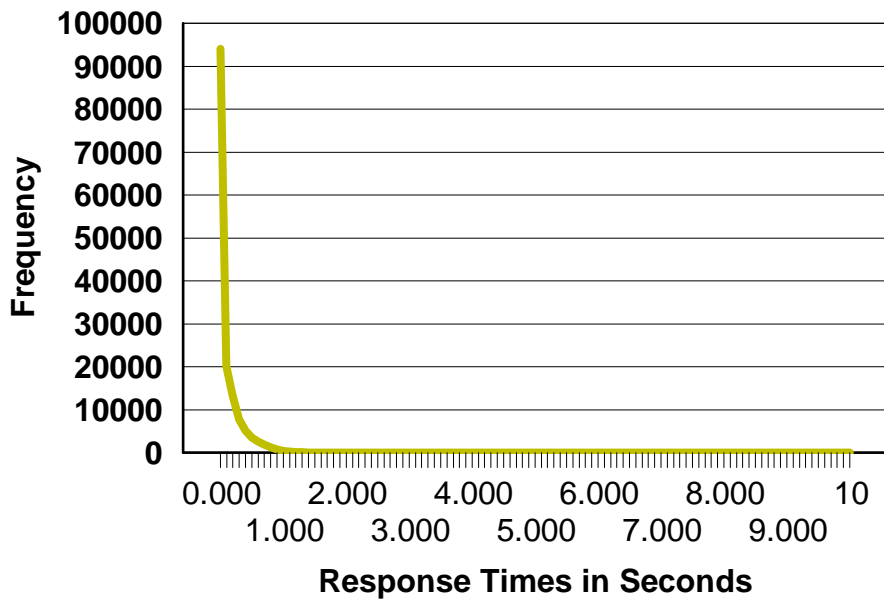
Frequency Distribution of Response Times for Change Orders

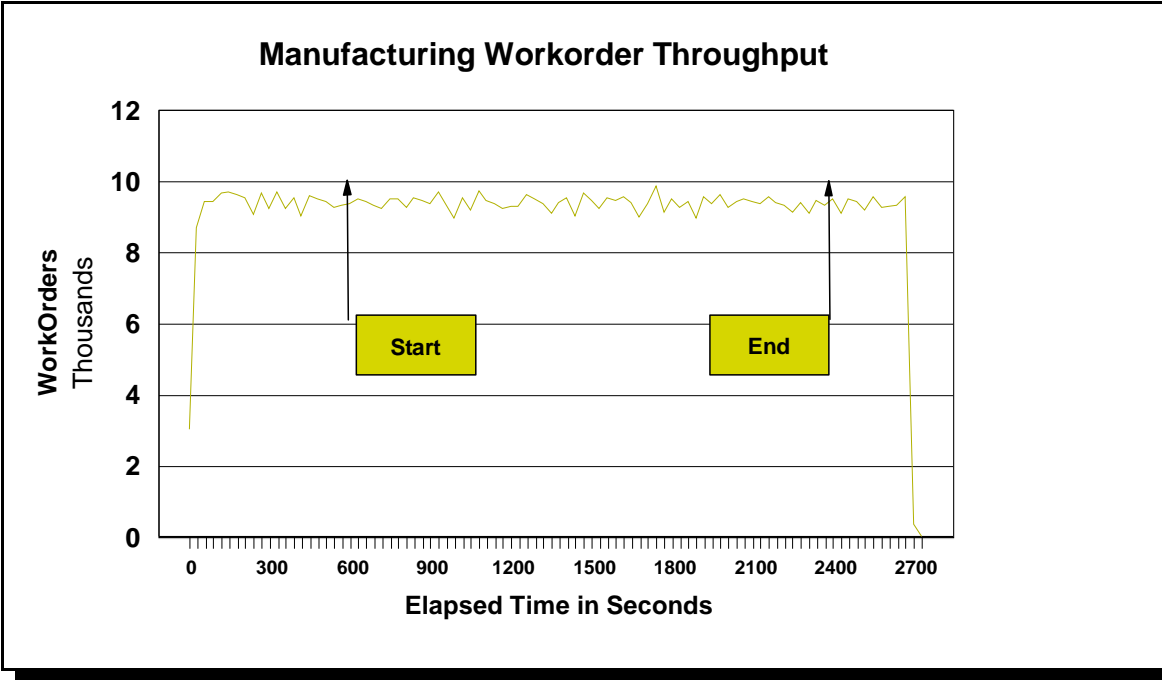
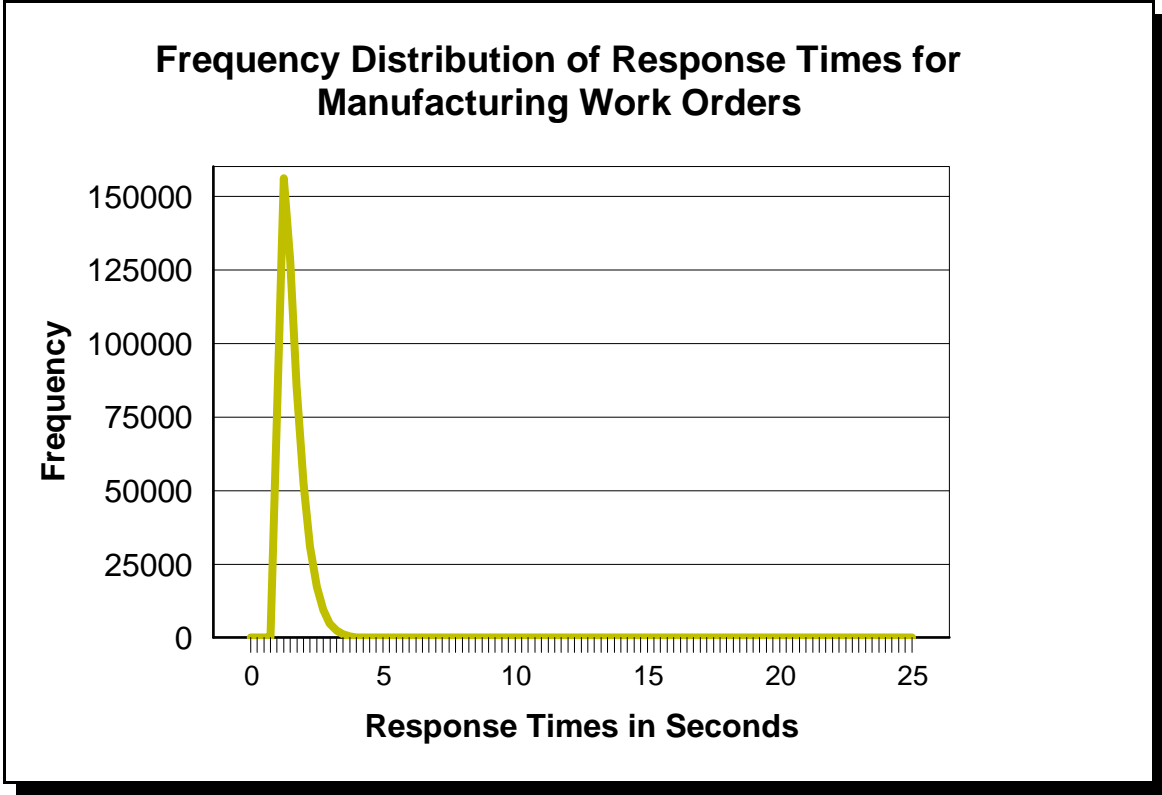


Frequency Distribution of Response Times for Customer Status



Frequency Distribution of Response Times for Order Status





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.sh script was Modified to point to the correct jars for WebSphere as well as miscellaneous updates for hostnames and port numbers.

7.5.3 The bandwidth of the network(s) used in the tested/priced configuration must be disclosed.

The Database connection to the switch used 1Gb Ethernet. The Driver used a 1Gb Ethernet connection. All other connections used a switched 100Mb Ethernet network.

7.5.4 The protocol used by the Driver to communicate with the SUT (e.g., RMI/IOP) must be disclosed.

The protocol used was RMI-over-IOP

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 12. 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 two client systems were used:

Emulator

IBM Netfinity 8500
4 x 700MHz Pentium III Xeon® CPUs with 2MBL2 Cache
4GB RAM, one 18.2GB Disk, 100Mb Ethernet interface

ECperf - WebSphere Application Server and DB2

Driver

IBM pSeries 660 (Model 7026-6M1)
8 x 750MHz IBM RS64 IV Processors with 8MB L2 Cache
16GB RAM
1Gb 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
Twelve WebSphere Application Server Nodes	58,476	5400
Rack Hardware	1,653	300
xSeries 330 Cluster Components	357	Inc. in purchase
pSeries 660 Database Node	480,505	Inc. In purchase
	\$544,381	\$6,126

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	24	\$ 226,296	see Note
IBM DB2 Enterprise Edition V7.2	D5B57LL	\$ 18,489	8	147,912	see Note
IBM AIX 5L v5.1	5765-E61	\$ N/C	1	Inc in p660 price	
IBM AIX Support	TS AIX 24X7		1		3,494
Microsoft Windows 2000 Advanced Server	C10-00010	\$ 3999	12	47,988	
IBM Support Line for 20 servers (App Nodes)	SL Enterprise	\$ 12,472	1		12,472
Software Total				\$ 422,196	\$ 15,966

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 12 application server nodes as used in the test. This is a standard package offering.

Hardware Acquisition and 1-year cost of ownership	544,381	6,126
Software Acquisition and 1-year cost of ownership	422,196	15,966
1-Year Hardware/Software Acquisition and Maintenance		\$988,669
Cost of ownership		
BBops@Std	44294.97	
\$/BBops@Std	23	

Pricing sources:

IBM: www.ibm.com

IBM: 1-800-426-2255 (IBM Direct - ask for pSeries pricing)

Microsoft: www.microsoft.com

Cisco: 1-800-326-1941

Effective dates of pricing: 06/17/2002

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: \$988,669 (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.

All products used in this benchmark are currently available.

Appendix A - List Prices for SUT Hardware (current as of 2002-06-17)

				<u>xSeries 330</u>	
Qty	Product	Description		Each	List Price
1	867432X	xSeries 330 Pentium III 1.26GHz/512KB L2,256MB ECC,EIDE,OPEN,24X,PCI		\$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 Video Controller - 8MB			
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		(Std) 20.4 GB EIDE Hard Disk			
-		The standard 256MB Dimm and 20.4 GB Hard Disk have been deleted		\$0.00	\$0.00
1	25P2836	xSeries 1.26 GHz/133MHZ-512KB Cache Upgrade with Pentium III Processor		\$999.00	\$999.00
4	10K0022	IBM 512MB PC133 ECC SDRAM RDIMM (P/N 10K0022)		\$499.00	\$1,996.00
1	22P7157	40GB 7200 RPM ATA/100 (EIDE) Hard Drive		\$149.00	\$149.00
1	21P2073	3YR Onsite repair 24x7 4-Hour warranty service upgrade (P/N 21P2073)		\$450.00	\$450.00
<u>Subtotal for x330</u>					<u>\$5,323.00</u>
<u>Rack Components</u>					
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
<u>Subtotal for Rack</u>					<u>\$1,953.00</u>
<u>Components for use with x330 Cluster</u>					
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
<u>Subtotal for x330 Cluster components</u>					<u>\$357.00</u>
<u>Cisco Catalyst 3524 XL Ethernet Switch</u>					
1	3524-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
<u>Subtotal for x330 Cisco Ethernet Switch</u>					<u>\$3,816.00</u>

<u>pSeries 660</u>				
Qty	Product	Description	Each	List Price
1	7026-6M1	pSeries 660	\$ 3,893.00	\$3,893.00
1	2624	32x Speed CD-ROM	\$ 375.00	\$375.00
1	2934	Async Terminal/Printer Cable (EIA-232)	\$ 45.00	\$45.00
1	2975	10/100/1000 Base-T Ethernet PCI Adapter	\$ 1,600.00	\$1,600.00
2	3102	18.2 GB 10K RPM Ultra SCSI Hard Disk Drive	\$ 1,160.00	\$2,320.00
2	3142	Remote I/O Cable - 3m	\$ 595.00	\$1,190.00
2	4073	Memory Board, 32-position	\$ 1,500.00	\$3,000.00
2	4136	8192 MB Memory (8x1024MB DIMMs)	\$ 40,960.00	\$81,920.00
2	5213	4-Way RS64 IV 750MHz Processor Card, 8MB L2 Cache	\$ 105,350.00	\$210,700.00
1	5259	Processor Frequency Regulator, 750 MHz	\$ 250.00	\$250.00
1	5992	System Control and Initialization Cable	\$ 75.00	\$75.00
1	6132	CEC to Primary I/O Drawer Power Control Cable, 3m	\$ 95.00	\$95.00
1	6164	RS64 IV Processor Power Regulator	\$ 2,600.00	\$2,600.00
2	6230	Advanced SerialRAID Plus Adapter	\$ 3,000.00	\$6,000.00
2	6235	32 MB Fast-Write Cache Option Card	\$ 575.00	\$1,150.00
1	6283	Redundant AC Power Supply, I/O Drawer, 595W	\$ 725.00	\$725.00
1	6284	Redundant AC Power Supply, CEC, 1100W	\$ 750.00	\$750.00
1	6324	Primary I/O Drawer, 5 EIA	\$ 8,000.00	\$8,000.00
1	6540	IPL Disk Mounting Hardware, Cables, Terminator	\$ 100.00	\$100.00
1	3153-BG3	InfoWindow II ASCII Display Station (Green/RS232)	\$ 577.00	\$577.00
1	7014-T00	Enterprise Rack - 36 EIA	\$ 3,100.00	\$3,100.00
1	6088	Front Door for 1.8m Rack, Black	\$ 450.00	\$450.00
2	6098	Side Panel for 1.8 or 2.0m Rack, Black	\$ 150.00	\$300.00
2	7133-D40	Advanced SSA Disk Subsystem (Rack-Mounted)	\$ 12,750.00	\$25,500.00
2	8022	50/60Hz AC, 300 VDC Power Supplies	\$ 2,000.00	\$4,000.00
2	8031	Raven Black Drawer Cover	\$ 250.00	\$500.00
20	8536	One 10K/36.4GB Advanced Disk Drive Module	\$ 5,900.00	\$118,000.00
2	8801	1m Advanced SSA Cable	\$ 60.00	\$120.00
2	8802	2.5m Advanced SSA Cable	\$ 65.00	\$130.00
1	9910-P33	Powerware 5125 3000VA, 200-240V - Rackmount	\$ 2,840.00	\$2,840.00
1	6630	Rail Kit	\$ 150.00	\$150.00
1	5765-E61	AIX 5L V5.1	N/C	N/C
1	1004	Media Process Charge 5692-A5L OTC	\$ 50.00	\$50.00
<u>Subtotal for p660</u>			-	<u>\$480,505.00</u>