IBM DB2 UDB, IBM @server xSeries and J.D. Edwards OneWorld Xe HTML Sizing Test Results

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Sizing test results

The IBM DB2® Universal Database™ 7.2.4 and IBM @server xSeries™ system produced 0.54-second response time via Web browsers even though the system was processing transactions from 1,496 concurrent users. The IBM @server xSeries 8-way database system had average CPU utilization of 25 percent and used 3.91GB of memory. Additional testing was performed using 1-way and 2-way configurations to more accurately size memory and CPU needs for a typical J.D. Edwards OneWorld® Xe customer. This paper focuses on the 1,500 user tests. Web services were provided by an IBM @server pSeries™ 6-way Web server running IBM WebSphere® Application Server. In addition, an IBM @server pSeries 8-way system was used for J.D. Edwards OneWorld Xe services. Finally, Intel®-based workstations and servers were used to simulate the workload and gather performance data.

Executive summary

This report describes the scalability and performance results of the IBM @server xSeries server in an HTML J.D. Edwards OneWorld Xe SP17 Web environment using scripts provided by J.D. Edwards for interactive Web/HTML. The test successfully executed up to 1,496 concurrent user sessions in a three-tiered environment. Response times easily met the sizing criterion of sub-second, with an actual average response time of 0.54 seconds. The application server under test was configured with 24 processors with 8MB of Level 2 cache and 96GB of memory. There were two Web server systems:

One server with eight processors with 8MB of Level 2 cache and 16GB memory
One server with six processors with 4MB of Level 2 cache and 16GB memory
Another Web server running in the application server

In the J.D. Edwards test environment for Xe SP17 Web, actual OneWorld HTML clients were used to generate a real workload against the enterprise and Web servers. By using J.D. Edwards OneWorld clients and enterprise servers, this characterization provides a more realistic measure of performance than if SQL statements were simply captured and replayed against the J.D. Edwards schema.

Complete response times are shown in *Appendix A*: *Detailed test results*. These results reflect the speed and scalability of the IBM @server xSeries and pSeries servers and the advantages of a well-balanced configuration.

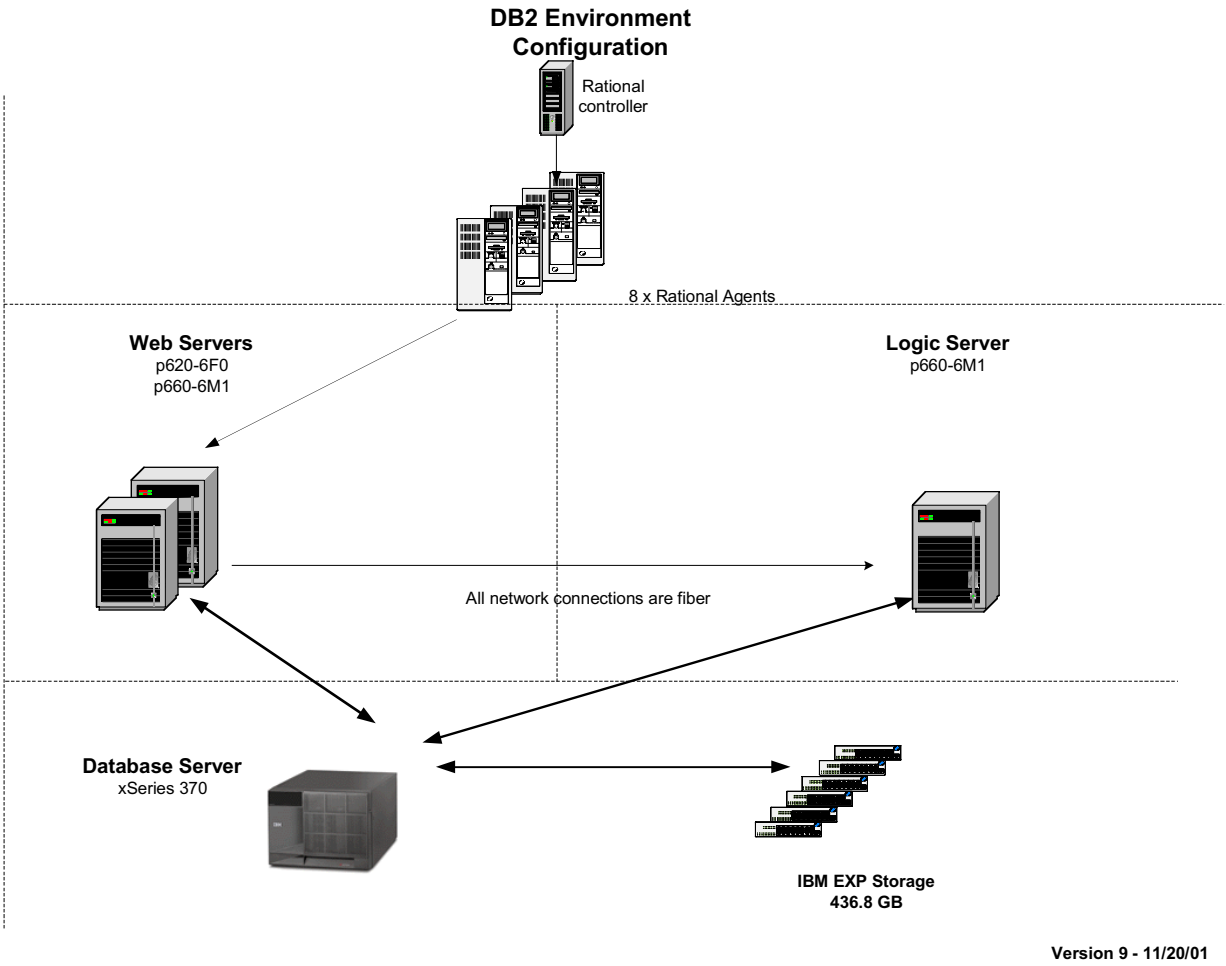
Background information

The primary objective of the test was to gather sizing data for the IBM @server xSeries and OneWorld Xe SP17 Web in a WebSphere Application Server HTML environment. A secondary objective was to determine and document the tuning techniques for DB2 UDB 7.2 Fix Pack 4.

Architectural design

At a high level, the architecture of the benchmark environment consisted of:

Database server: IBM DB2 UDB 7.2 Fix Pack 4 database—This database server housed the J.D. Edwards database and serviced requests for information.
Application server—This serviced OneWorld logic requests.
Web server—Web servers serviced HTML-based transactions from Web-based users.
Rational controller—This machine controlled the number of users accessing the Web server. This is not a normal component of a customer implementation.
Rational agents—These machines were used to simulate Web users.



Three-tier Architecture Diagram

Configuration

Database server

IBM @server xSeries 370

Component	Detail
System	IBM @server xSeries 370 (8681-2RX)
Processors	8 x 700MHz Intel Pentium® III Xeon, 2MB L2 cache
Cache coherency filters	2 x 4X accelerator filters
Memory	8 x 1GB PC100-compliant 3.3v SDRAM RDIMMS
Disk internal	2 x 18.2GB
Disk external	48 x 9.1GB via IBM EXP enclosures
Disk configuration	See *Disk Configuration Detail*
Network	Gigabit Ethernet SX server adapter (fiber)

Physical Slot Detail

1 Bus D	2 Bus D	3 Bus D	4 Bus D	5 Bus D	6 Bus C	7 Bus C	8 Bus B	9 Bus B	10 Bus A	11 Bus A	12 Bus A
Empty	ServeRAID 4M-1	ServeRAID 4M-2	Empty	Empty	Empty	Empty	Gb Ethernet SX	Empty	ServeRAID 3H	ServeRAID 4H	Empty

Disk Configuration Detail

RAID Level	Physical HDD	Controller	External Enclosures	Drive Letter(s)	Function	(GB) Size	(GB) Free
1	2 x 18.2GB	ServeRAID 3H	N/A	C:	OS / Paging	16.94	9.54
10	16 x 9.1GB	ServeRAID 4H	2 x EXP 200	L: / W:	Logs / Backup	40.0 / 27.79	34.03 / 4.89
10	16 x 9.1GB	ServeRAID 4M-1	2 x EXP 15	D: / T:	Data / Temp	50.0 / 17.79	24.35 / 7.96
10	16 x 9.1GB	ServeRAID 4M-2	2 x EXP 15	I: / M	Index / LOBs	50.0 / 17.79	35.64 / 12.04

Windows Settings

Component	Detail
Operating system	Microsoft® Windows® 2000 Advanced Server
Service Pack	2
Boot.INI switches	/3GB /PAE
Application response	Optimize performance for background services
Network server optimization	Maximize data throughput for network applications
Paging Files (4GB)	C: , D: , I: , L:

Application server / Web server

The IBM @server pSeries p660-6M1 was configured with 24GB of RAM.

IBM @server pSeries 660 Model 6M1 Server

Component	Model
System	IBM @server pSeries 660 Model 6M1
Processors	8 – 750MHz RS64 IV SMP, 8MB L2 cache
Memory	24GB
Disk	4 x 18.2GB
Network	1 Gigabit Ethernet high-speed adapter

Web servers

The IBM @server pSeries 660 6M1 was configured with 24GB of RAM and 72.8GB of disk storage.

IBM @server pSeries 660 model 6M1 server

Component	Model
System	IBM @server pSeries 660 model 6M1
Processors	8 – 750MHz RS64 IV SMP, 8MB L2 cache
Memory	24GB
Disk	4 x 18.2GB
Network	1 Gigabit Ethernet high-speed adapter

The IBM @server pSeries 620 6F0 was configured with 16GB of RAM and 36.4GB of disk storage.

IBM @server pSeries 620 model 6F0 server

Component	Model
System	IBM @server pSeries 620 model 6F0
Processors	6 – 500MHz RS64 III SMP, 4MB L2 cache
Memory	16GB
Disk	2 x 18.2GB
Network	1 Gigabit Ethernet high-speed adapter

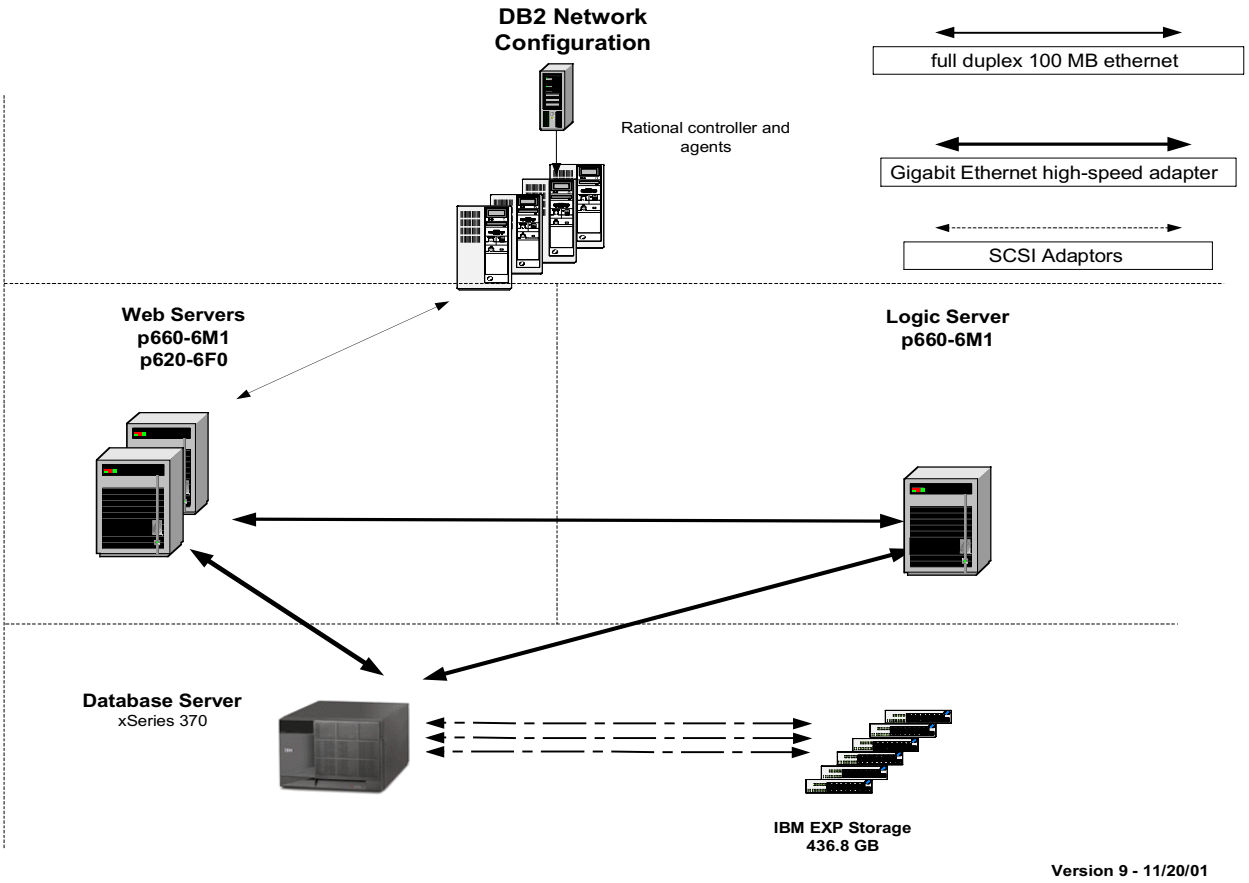
Software

- OneWorld Xe SP 17 + One-off SP17_004
- SAR 5190165 - IPC Msg Q cache
- SAR 5670118 - JAS on DB2 UDB SP18_NETBETA
- SAR 5674899 - JAS Kernel - Statement Reuse Sp18 NETBTA
- SAR 5481430 - One-off for JAS.JAR SP17_002 – Virtual Client Clean Up
- Rational Performance Studio 1.5
- WebSphere Application Server 3.5.4

- SP17 version of the Web/HTML scripts
- IBM AIX® OS/4.3.3.75
- Windows 2000 Advanced Server with SP2
- DB2 UDB 7.2 with Fix Pack 4

Network

Each Web server was connected to the application server by one 1GB Ethernet adapter. The 1GB Ethernet connections are point-to-point full duplex over optical fiber cables with a maximum transmission unit (MTU) size of 8,996 bytes. Rational Agent PCs (simulated Web users) were each connected via a dedicated full duplex 100MB Ethernet link using point-to-point copper cabling, removing the requirement for a high-speed Ethernet switch or hub. This took maximum advantage of the superior system bus performance of the IBM pSeries.



Network Configuration

Configuration settings

Database – DB2 UDB 7.2.4 DB2 registry settings

Settings	Initial	Final
DB2COMM	-	TCPIP

Database manager settings

Settings	Initial	Final
AUTHENTICATION	SERVER	CLIENT
MAXAGENTS	200	5,000
NUM_POOLAGENTS	4	1,500
NUM_INITAGENTS	0	1,500

Database instance settings

Settings	Initial	Final
DBHEAP	600	3,000
CATALOGCACHE_SZ	32	64
LOGBUFSZ	8	512
UTIL_HEAP_SZ	5,000	5,000
BUFFPAGE	250	8,000
LOCKLIST	50	2,000
APP_CTL_HEAP_SZ	128	512
SORTHEAP	256	128
STMTHEAP	2,048	8,000
APPLHEAPSZ	128	6,000
PCKCACHESZ	320	20,000
CHNGPGS_THRESH	60	60
NUM_IOCLEANERS	1	30
NUM_IOSERVERS	3	1
SEQDETECT	YES	NO
MAXAPPLS	40	5,000
MAXFILOP	64	500
SOFTMAX	100	100
LOCKTIMEOUT	-1	60
MAXLOCKS	22	22
DLCHKTIME	10,000	60,000
AVG_APPLS	1	50

HTTP server settings

Settings	Initial	Final
KEEPALIVETIMEOUT	15	40
TIMEOUT	300	400
MAXCLIENT	200	1,200

WebSphere settings

Settings	Initial	Final
Session Manager Interval Invalidate Time	1,800	3,600
Max JVM Memory (mx)	256m	1,000m
Starting Min JVM Memory (ms)	128M	1,000m
Max Connections	2,049	150

JAS.INI Web server settings

Settings	Initial	Final
UserSessions	24,0000	4,000,000
MaxConnection	50	200
MinConnection	0	30
PoolGrowth	5	3
InitialConnections	5	30

Application server settings—two instances of OneWorld on application server

Settings	Initial	Final
MaxNumberOfSemaphores	200	2,500
MaxNumberOfResources	N/A	4,600
MaxNetConnections	800	2,500
MaxKernelProcesses	50	700
Security Kernel	1	30
CallObject Kernel	1	600

Data

The test database models a generic mid- to large-scale customer, matching J.D. Edwards' target market of customers with US$200 million to US$2 billion in annual revenues. It does not reflect any particular customer or industry, but has the flexibility to model a mixture of distribution, manufacturing and financial users. The table sizes required to model a large customer were determined based on the experience of J.D. Edwards field and corporate personnel.

Methodology

The OneWorld Configurable Network Computing environment provides maximum flexibility to move data and logic among clients and servers. This test evaluated OneWorld version Xe SP17 Web in a three-tiered configuration using the J.D. Edwards Web/HTML interactive benchmark workload. The typical business enterprise operates in a mixed-load environment. To simulate real-world conditions, this test ran concurrent users in the following application mix: manufacturing—25 percent, distribution—50 percent, and financial—25 percent.

The test used J. D. Edwards' standard series of 17 scripts that exercise the basic features of OneWorld applications and represent the type of load a typical OneWorld user would generate. Each user script ran approximately one hour, including think time.

Scripts were developed in cooperation with J.D. Edwards' application experts using the knowledge gained from consultants, Conference Room Pilots (CRPs), and go-live experiences in real-world situations. See *Appendix C: J.D. Edwards standard benchmark methodology* for more information. The benchmark results include response times for each vertical application (manufacturing, distribution and financial), as well as an overall average response time for the tested configuration. This reporting strategy provides both application-specific and more general performance results for OneWorld on the system under test. The response times reported for each vertical represent averages. Each user processes many additional transactions, although the average is based only on the number and type of transactions shown in the table below, *Reported transactions processed by vertical*. The completion time for each series of transactions is recorded and all are averaged to produce vertical response times. Overall, averages are calculated using a simple formula that gives equal weight to every transaction processed during the testing run.

Reported transactions processed by vertical

Vertical	Transaction	Number of transactions	Total
Manufacturing	Work Order Entry	4	4
	Work Order Completion	4	4
Total Averaged Manufacturing Transactions			**8**
Distribution	Sales Order Entry	4	4
	Purchase Order Entry	4	4
Total Averaged Distribution Transactions			**8**
Financial	Journal Entry	4	4
	Voucher Entry	6	6
Total Averaged Financial Transactions			**10**

For each test, twice as many users process distribution applications as process manufacturing or financial applications. This produces the financial (25 percent), distribution (50 percent), and manufacturing (25 percent) ratios reported for the tests.

Calculations of the overall average take into account these variables, producing an average in which each transaction is equally weighted. Specifically, the following formula is used:

((10*AvgFIN) + (16*AvgDIST) + (8*AvgMFG))/34

Conclusions and recommendations

Analysis

The IBM DB2 UDB 7.2.4 and IBM @server xSeries systems were able to produce 0.54-second response time via Web browsers even though the system was processing transactions from 1,496 concurrent users. The IBM @server xSeries 8-way database system had CPU utilizations of only 25 percent. The IBM @server pSeries Java™ Application Servers ran the IBM HTTP Server, WebSphere Application Server and OneWorld Xe servlets. An additional IBM @server pSeries system ran J.D. Edwards OneWorld Xe services based on performance benchmark data provided by IBM @server pSeries and J.D. Edwards platform technologies benchmark.

Conclusion

While many applications and previous benchmarks have only tested the backend transaction processing capability, this environment provides a flexible Web client interface. This test environment was able to scale this new e-business interface using IBM DB2 Universal Database for Windows, WebSphere Application Server and J.D. Edwards Java servlets. By using leading-edge technology, IBM and J.D. Edwards have demonstrated that DB2 UDB for Windows with J.D. Edwards OneWorld Xe can meet and exceed a user's response time expectations.

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Appendix A: Detailed test results

Complete Benchmark Results

User Goal		1500
Financials		
H0411E_1	Voucher Entry	.40
H0411E_2		.40
H0411E_3		.37
Average AP		.39
H0911E_1	Journal Entry	.33
H0911E_2		.35
Average GL		.34
AVERAGE FIN		**.37**
Distribution		
H4210E_1	Sales Order Entry	1.04
H4210E_2		1.04
H4210E_3		1.04
H4210E_4		.60
Average SO		.93
H4310E_1	Purchase Order Entry	.58
H4310E_2		.58
H4310E_3		.58
H4310E_4		.57
Average PO		.58
AVERAGE DIST		**.75**
Manufacturing		
H3002E_1	Enter Work Order	.41
H31114U_1	Work Order Completions	.23
AVERAGE MAN		**.32**
AVERAGE RESPONSE TIME (Seconds)		**0.54**

Appendix B: J.D Edwards standard benchmark methodology

The OneWorld Configurable Network Computing environment provides maximum flexibility to move data and logic among clients and servers. This test evaluated OneWorld version Xe SP17 Web in an HTML environment. The typical business enterprise operates in a mixed-load environment. To better simulate real-world conditions, this test ran concurrent users in the following application mix: manufacturing—25 percent, distribution—50 percent, and financial—25 percent. The test used J. D. Edwards' standard set series of three scripts to represent the type of load a typical OneWorld user would generate. Each user script ran approximately one hour, including think time. Scripts were developed in cooperation with J.D. Edwards' application experts using the knowledge gained from consultants, Conference Room Pilots (CRPs), and go-live experiences in real-world situations.

The basic steps in our scripting methodology are:

1. Define position descriptions that describe typical users in each industry area.
2. Define which programs those positions use most.
3. Create program scripts using the appropriate scripting tool for the test.
4. Run scripts according to project requirements.

In order to facilitate the completion of these steps, the following process is used in developing scripts and test plans. :

Scripts are categorized according to the vertical applications they represent:

- Financial
- Distribution
- Manufacturing

For each vertical, the following were determined:

- The characteristics of a typical OneWorld user of that application: who they are, what job description they have, and how they might use OneWorld on the job to accomplish their objectives.
- Primary applications most used by these users.
- Representative multiple applications for a full industry process—for example, in a recent virtual test for Financials, scripts were provided for Standard Voucher Entry, Supplier Ledger Inquiry, Standard Receipts Entry, Journal Entry, and Trial Balance/Ledger Comparison.

For each script, the following were defined:

- Keystrokes followed in executing transactions. Our application experts take advantage of observation, research and considerable industry knowledge to define the typical usage by a person performing the job tasks identified.
- Think times, or the times an actual user might pause between keystrokes. These times have to be calculated when virtual client testing is used in order to simulate real-world user activity. Think times are discussed in detail in the next section.
- Typical processing option setup values, which are generally set once by businesses when they first install the software. These options are constants that are used throughout a suite of OneWorld applications—for example, General Accounting Constants or Next Numbers.
- Any assumptions made, such as multi-currency settings.
- Application-specific setup and constants, such as automatic accounting instructions.

Determining pace

Pacing refers to the rate of the script as it runs through a test. A test script typically includes multiple concatenated program scripts, representing programs in each of the vertical areas of finance, distribution and manufacturing. Pacing is determined per program subset script using basic estimates of the time that it takes a single user to complete one document or transaction within the program being scripted. The pacing spreadsheet then calculates the minimum number of documents that would be generated per script, multiplied by the amount of time a typical user would take, and then adds time for exits to other programs such as Address Book Name Search, if such exits are intrinsic to the script. Using this formula, a basic time is computed for one run of that program script. Some scripts always run multiple times, so an additional calculation is included for the additional runs. Since tests typically run one hour, think time is then added to account for the difference.

Appendix C: Software enhancements used

SAR 5190165 - IPC Msg Q Cache

Currently, OW jobs do not cache the IPC handles for message queues. In addition, the locking associated with the message queues is too contention-intensive (i.e., the locks are held longer than necessary and degrade performance).

SAR 5670118 - JAS on DB2 UDB SP18_NETBETA

- Added three JDBC connection properties: patch1, patch2 and LobCacheSize.
- Allowed *JAS.ini* set up JDBC Connection Isolation Level. If not setup at *jas.ini*, default is *Read_Committed*.

SAR 5674899 - JAS Kernel - Statement Reuse Sp18 NETBTA

This fix modifies all static SQL queries in JAS to use Prepared Statements instead of Statements. This makes the database cache queries and avoid the overhead of re-creating a new query every time.

SAR 5481430 – JAS.JAR – Virtual Client Cleanup

This fix cleans up the runtime virtual client connections after a user signs out. Before this fix, the connections were left active, which used up WebSphere resources.

Appendix D: J. D. Edwards OneWorld

J.D. Edwards OneWorld is a network-centric, object-oriented, multinational software package. It provides customers with the flexibility to quickly adapt business processes to meet market demands, as well as the ability to capitalize on the latest functionality and lower costs offered by emerging technologies. OneWorld, introduced in 1996, provides true distributed object architecture and an advanced business-rules engine that transcend traditional client/server technology. In the fall of 2000, OneWorld Xe, the latest J.D. Edwards enterprise software suite for collaborative commerce, was released. OneWorld Xe provides unmatched quality and power in automating business processes and communication. The cornerstone of unprecedented efficiency, OneWorld Xe provides a flexible architecture, pre-integrated applications and interoperability to enable true collaboration. OneWorld Xe consists of all the OneWorld tools and applications, ActivEra Solutions Accelerator-process modeling and visualization tools, AutoPilot OneWorld Scripting Tool, and OneWorld Extended Process Integration (XPI). With J.D. Edwards' flexible, component-based solutions, businesses can change their system without programming, which means that they can better accommodate the needs of customers and partners. J.D. Edwards OneWorld offers applications that streamline back-office fulfillment tasks, such as supply chain, manufacturing, distribution/logistics, and financials/human resources. OneWorld's unique, network-centric architecture separates business functionality from underlying operating systems, communications and database technologies, enabling organizations to embrace new technologies without rethinking or reengineering existing information flow. OneWorld's architectural foundation, advanced graphical user interface, integrated toolset and platform-neutrality deliver the stability and flexibility necessary to deal with ever-changing business needs.

Appendix E: IBM @server xSeries, DB2 and WebSphere Application Server product information

IBM @server xSeries servers are available in a range of products, from small, appliance servers to large, rack-optimized, 8-way-capable systems like the xSeries 370 and Enterprise X-Architecture™ xSeries 440. The xSeries represents the "industry standard," Intel-based server line from IBM, and continues to exploit the price-performance segment of the new IBM @server generation. They combine the benefits of the latest processors from Intel, while incorporating the best qualities from the other IBM @server servers.

IBM DB2 Universal Database is multithreaded on Windows-based systems and multi-processed on UNIX® systems. On Windows, agents are threads under the db2sysc (system controller) process. There is a 3GB memory limit for the db2sysc process. To avoid reaching the 3GB limit, we used two databases under two separate instances. This enabled us to take advantage of the Windows environment by using up to 6GB of memory for DB2 since this was a dedicated database server. For UNIX-based environments, agents are processes and there is no 3GB limit, so both databases are typically run in one instance.

WebSphere Application Server Advanced Edition is a powerful Java-based development and deployment environment for e-business applications. WebSphere Application Server Advanced Edition provides companies with an open, standards-based Web server deployment platform with support for scaling Web sites into security-enhanced, transactional-based e-business application sites, and offers sophisticated tools to simplify distributed, component-based application development. It also greatly simplifies the separation of business applications from underlying system services.

Appendix F: IBM DB2 UDB 7.2 Fix Pack 4 for Windows information

DB2 Universal Database version 7 delivers powerful e-business benefits. As the foundation for e-business, DB2 UDB is the industry's first multimedia, Web-ready relational database management system, strong enough to meet the demands of large corporations and flexible enough to serve medium-sized and small e-businesses. DB2 UDB combines integrated power for business intelligence, content management, enterprise information portals and e-business with industry-leading performance and reliability to drive the most demanding industry solutions. Along with Internet technology, DB2 UDB makes information easily accessible, available and secure. There are more than 60 million DB2 UDB users from nearly one-half million companies worldwide relying on IBM data management solutions.

DB2 UDB allows choice. It runs on both IBM and non-IBM hardware supporting multiple operating systems including Windows (XP, 2000, NT, ME, 98, 95), AIX, Linux, Sun's Solaris operating environment, OS/2®, HP-UX and NUMA-Q®.

Highlights of DB2 UDB version 7 include:

- The first database product certified for Microsoft Windows 2000 Server.
- The first relational database management system (RDBMS) with integrated in-memory text search capabilities delivered with the new DB2 Net Search Extender.
- Deeper support for XML including tools to assist with parsing XML documents into parts stored in DB2 tables.
- Optimized and simplified access to federated data sources. Data in any DB2 database, in object linking and embedding (OLE) DB data sources, and now in Oracle databases can be accessed with distributed queries.
- Native interface to OLE DB data sources is now available. DB2 can serve as both an OLE DB consumer and provider.
- DB2 is the database for the Web generation and the Web is the platform of choice for distributing business information to the enterprise and beyond.
- The Data Warehouse Center implements the Object Management Group Common Warehouse Metadata Interchange, the new standard for integrating diverse tools into business intelligence solutions.
- DB2 Warehouse Manager, a new feature of DB2, uniquely integrates governing, resource management, and usage tracking.
- DB2 OLAP Server™, now with Hyperion Essbase Version 6, scales to handle the analytical requirements for demanding e-commerce and customer relationship management (CRM) applications.

Additional information on data management solutions from IBM is available at:
ibm.com/software/data

Appendix G: System summary—IBM @server xSeries 370 database server

System Information report written at: 03/21/2002 01:38:55 PM
[System Summary]

Item	Value
OS Name	Microsoft Windows 2000 Advanced Server
Version	5.0.2195 Service Pack 2 Build 2195
OS Manufacturer	Microsoft Corporation
System Name	DENXS370
System Manufacturer	IBM
System Model	IBM Server -[8681]-
System Type	X86-based PC
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
Processor	x86 Family 6 Model 10 Stepping 1 GenuineIntel ~700MHz
BIOS Version	IBM BIOS Ver 6.0
Windows Directory	C:\WINNT
System Directory	C:\WINNT\System32
Boot Device	\Device\Harddisk0\Partition1
Locale	United States
User Name	DENXS370\db2admin
Time Zone	Mountain Standard Time
Total Physical Memory	8,125,752 KB
Available Physical Memory	6,179,328 KB
Total Virtual Memory	32,884,436 KB
Available Virtual Memory	28,803,548 KB
Page File Space	24,758,684 KB
Page File	C:\pagefile.sys
Page File	D:\pagefile.sys
Page File	I:\pagefile.sys
Page File	L:\pagefile.sys

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