

*Platform Technologies*

# Characterization

## IBM DB2 UDB 7.2, eServer pSeries, and J.D. Edwards OneWorld® Xe HTML Characterization

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**Technology Demographic Table**

<i>Product</i>	OneWorld®
<i>Version</i>	Xe SP17
<i>Platform/OS</i>	IBM eServer pSeries/AIX4.3.3
<i>Industry</i>	All
<i>Application</i>	All
<i>Database</i>	DB2 UDB for Unix 7.2.4 - Enterprise Edition (EE)
<i>Key words</i>	WebSphere, Xe, OneWorld, UDB
<i>Initial Publication Date</i>	January 2002
<i>Revision Date(s)</i>	February 2002

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## Characterization Results

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The IBM DB2 Universal Database (UDB) 7.2.4 and eServer pSeries systems were able to produce 0.98-second response time via web browsers even though the system was processing transactions from over 5400 concurrent users. The IBM eServer pSeries 8-way database system had CPU utilizations of 45%, and the IBM eServer pSeries 8-way Web Server had CPU utilizations of 75% for the HTTP/WebSphere Application Server/JAS systems and 70% for the Application/Web Server allowing room for future growth.

## Executive Summary

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This report describes the scalability and performance results of IBM eServer pSeries servers in an HTML J.D. Edwards OneWorld® Xe SP17 Web environment using the J. D. Edwards interactive Web/HTML characterization.

The test successfully executed up to 5,446 concurrent user sessions in a three-tiered environment. Response times easily met the certification criterion of subseconds, with an actual average response time of 0.98 seconds. The application server under test was configured with 24 processors with 8MB of Level 2 cache and 96 GB memory. There were four web server systems:

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

In the J. D. Edwards characterization environment for the 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 eServer pSeries servers and the advantages of a well-balanced configuration.

## Background Information

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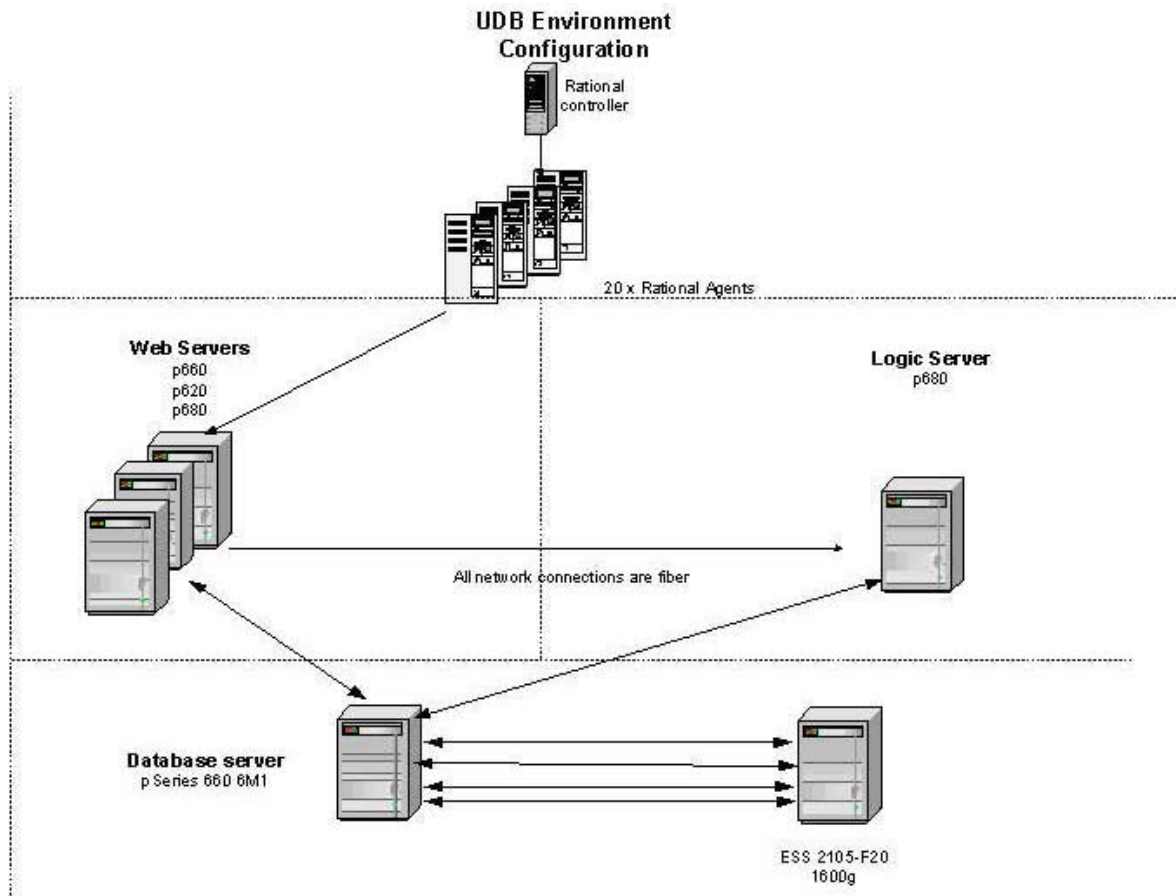
The primary objective of the characterization was to demonstrate the scalability of the eServer pSeries and OneWorld Xe SP17 Web in a WebSphere Application Server HTML environment. A secondary objective was to determine and document the tuning techniques for DB2 UDB 7.2 Fix Pack 4.

## Architectural Design

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

- *Database Server:* IBM DB2 UDB 7.2 Fix Pack 4 database - this database server housed the J. D. Edwards database and service request for information.
- *Application Server:* This serviced OneWorld logic requests.

- *Web Server*: Web servers serviced HTML based transactions from web-based users.
- *Rational Controllers*: These machines controlled the number of users accessing the web server. This is not a normal component of a customer implementation.
- *Web Agents*: These machines were used to simulate web users.



**3-Tier Architecture Diagram**

## Configuration

### Database Server

The eServer pSeries 660 6M1 was configured with 32 GB RAM.

**IBM eServer pSeries 660 Model 6M1 Server**

Component	Model
<b>System</b>	IBM eServer pSeries 660 Model 6M1
<b>Processors</b>	8 – 750 MHz RS64 IV SMP, 8 MB L2 Cache
<b>Memory</b>	32 GB
<b>Disk Internal</b>	2 X 36.4 GB
<b>Disk External</b>	External ESS 2105-F20
<b>Disk Configuration</b>	See ESS configuration
<b>Network</b>	1 Gigabit Ethernet High-Speed Adapter

### Application Server / Web Server

The eServer pSeries p680 was configured with 96 GB RAM.

**IBM eServer pSeries 680 Server**

Component	Model
<b>System</b>	IBM eServer pSeries p680
<b>Processors</b>	24 – 600 MHz RS64 III SMP, 16 MB L2 Cache
<b>Memory</b>	96 GB
<b>Disk</b>	3 X 9.1 GB
<b>Network</b>	1 Gigabit Ethernet High-Speed Adapter

### Web Server

The eServer pSeries 660 6M1 was configured with 16 GB of RAM and 72.8 GB of main storage.

The eServer pSeries 660 6M0 was configured with 16 GB of RAM and 72.8 GB of main storage.

The eServer pSeries 620 6F0 was configured with 16 GB of RAM and 109.2 GB of main storage.

**IBM eServer pSeries 660 Model 6M1 Server**

Component	Model
<b>System</b>	IBM eServer pSeries 660 Model 6M1
<b>Processors</b>	8 – 750 MHz RS64 IV SMP, 8 MB L2 Cache
<b>Memory</b>	16 GB
<b>Disk</b>	2 X 36.4 GB
<b>Network</b>	1 Gigabit Ethernet High-Speed Adapter

**IBM eServer pSeries 660 Model 6M0 Server**

Component	Model
<b>System</b>	IBM eServer pSeries 660 Model 6M0
<b>Processors</b>	8 – 500 MHz RS64 III SMP, 4 MB L2 Cache
<b>Memory</b>	16 GB
<b>Disk</b>	2 X 36.4 GB
<b>Network</b>	1 Gigabit Ethernet High-Speed Adapter

**IBM eServer pSeries 620 Model 6F0 Server**

Component	Model
<b>System</b>	IBM eServer pSeries 620 Model 6F0
<b>Processors</b>	6 – 500 MHz RS64 III SMP, 4 MB L2 Cache
<b>Memory</b>	16 GB
<b>Disk</b>	6 X 18.2 GB
<b>Network</b>	1 Gigabit Ethernet High-Speed Adapter

**Software**

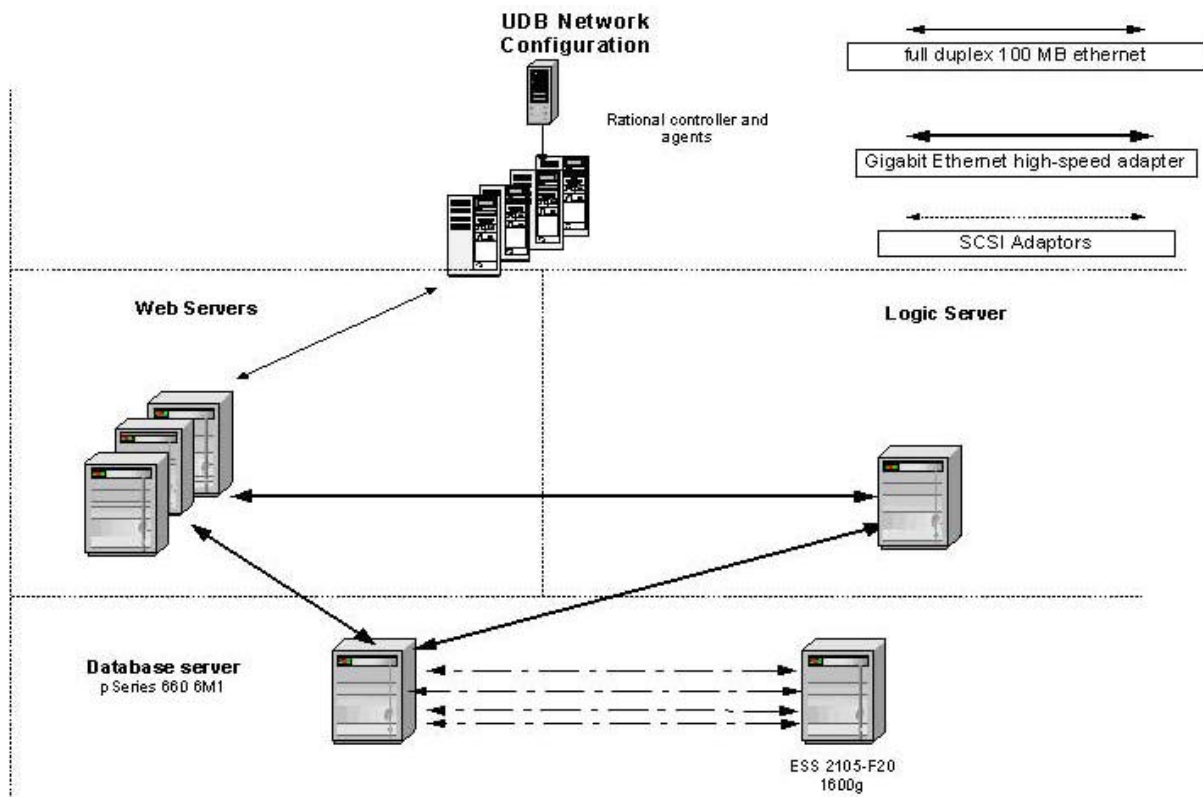
- OneWorld Xe SP 17 + One Off SP17\_004
- SAR 5190165 - IPC Msg Q Cache
- SAR 5670118 - JAS on DB2 UDB SP18\_NETBETA
- SAR 5674899 - JAS Kernel - Statement Reuse Sp18 NETBTA
- SAR 5481430 - OneOff for JAS.JAR SP17\_002 – Virtual Client Clean Up
- Rational Performance Studio 1.5
- WebSphere Application Server 3.5.4

- SP17 Version of the Web/HTML Scripts
- AIX OS/4.3.3.75
- DB2 UDB 7.2 with Fix Pack 4

## Network

Each web server was connected to the application server by one 1 GB ethernet adapter. The 1 GB ethernet connections are point-to-point full duplex over optical fiber cables with a maximum transmission unit (MTU) size of 8996 bytes.

The Rational Agent PCs (simulated web users) were each connected via a dedicated full duplex 100 MB 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.



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## Network Configuration



## Configuration Settings

### Database – DB2 UDB 7.2.4 DB2 Registry Settings

Settings	Initial	Final
DB2TCPCONNMGRS	1	1
DB2_STRIPED_CONTAINERS	ON	ON
DB2_BUFFER_LONG_DATA_WRITES	ON	ON
DB2_RR_TO_RS	ON	ON
DB2COMM	TCPIP	TCPIP
DB2_INDEX_2BYTEVARLEN	ON	ON
DB2_APM_PERFORMANCE	N/A	1,2,3

### Database Manager Settings

Settings	Initial	Final
AUTHENTICATION	SERVER	CLIENT
MAXAGENTS	5000	20000
NUM_POOLAGENTS	1000	16000
NUM_INITAGENTS	1000	12000

### Database Instance Settings

Settings	Initial	Final
DBHEAP	800	8000
CATALOGCACHE_SZ	64	64
LOGBUFSZ	512	512
UTIL_HEAP_SZ	25000	25000
BUFFPAGE	8000	8000
LOCKLIST	2000	40000
APP_CTL_HEAP_SZ	128	512
SORTHEAP	128	128
STMTHEAP	8000	8000
APPLHEAPSZ	6000	6000
PCKCACHESZ	10000	40000

CHNGPGS_THRESH	80	60
NUM_IOCLEANERS	10	40
NUM_IOSERVERS	1	1
SEQDETECT	NO	NO
MAXAPPLS	5000	18000
MAXFILOP	500	500
SOFTMAX	100	50
LOCKTIMEOUT	-1	120
MAXLOCKS	10	20
DLCHKTIME	6000	60000
AVG_APPLS	100	200

### HTTP Server Settings

Settings	Initial	Final
KEEPALIVETIMEOUT	15	40
TIMEOUT	300	400
MAXCLIENT	200	1200

### WebSphere Settings

Settings	Initial	Final
Session Manager Interval Invalidate Time	1800	3600
Max JVM Memory (mx)	256m	1000m
Starting Min JVM Memory (ms)	128M	1000m
Max Connections	2049	150

### JAS.INI Web Server Settings

Settings	Initial	Final
UserSessions	240000	4000000
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	2500
MaxNumberOfResources	N/A	4600
MaxNetConnections	800	2500
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 \$200 million to \$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

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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 3-tiered configuration using the J.D. Edwards Web/HTML interactive characterization 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%, Distribution - 50%, and Financial - 25%.

The test used J. D. Edwards' standard series of seventeen scripts which 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 Characterization Methodology](#) for more information.

The characterization 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
<b>Total Averaged Manufacturing Transactions</b>			<b>8</b>
Distribution	Sales Order Entry	4	4
	Purchase Order Entry	4	4
<b>Total Averaged Distribution Transactions</b>			<b>8</b>
Financial	Journal Entry	4	4
	Voucher Entry	6	6
<b>Total Averaged Financial Transactions</b>			<b>10</b>

For each test, twice as many users process distribution applications as process manufacturing or financial applications. This produces the Financial (25%), Distribution (50%), and Manufacturing (25%) 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:

$$((10 * \text{AvgFIN}) + (16 * \text{AvgDIST}) + (8 * \text{AvgMFG})) / 34$$

## Conclusions and Recommendations

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### Analysis

The IBM DB2 UDB 7.2.4 and eServer pSeries systems were able to produce 0.98-second response time via web browsers even though the system was processing transactions from over 5400 concurrent users. The IBM eServer pSeries 8-way database system had CPU utilizations of 45%, and the IBM eServer pSeries 8-way Web Server had CPU utilizations of 75% for the HTTP/WebSphere Application Server/JAS systems and 70% for the Application/Web Server allowing room for future growth.

## Conclusion

While many applications and previous characterizations have only tested the backend transaction processing capability, this environment provides a flexible web client interface. This characterization was able to test and scale new e-business interface using IBM's DB2 UDB for Unix, WebSphere Application Server and J.D. Edwards Java servlets.

Prior to this characterization, IBM DB2 UDB was not part of J.D. Edwards's database solution; But by using leading edge technology, IBM and J.D. Edwards have demonstrated that DB2 UDB for Unix with J.D. Edwards's OneWorld product can meet and exceed a user's response time expectations.

## Contact Information

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## Appendix A: Detailed Test Results

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### Complete Characterization Results

User Goal		5500
<i>Financials</i>		
H0411E_1	Voucher Entry	.70
H0411E_2		.70
H0411E_3		.67
Average AP		.69
H0911E_1	Journal Entry	.52
H0911E_2		.49
Average GL		.51
<b>AVERAGE FIN</b>		<b>.62</b>
<i>Distribution</i>		
H4210E_1	Sales Order Entry	2.08
H4210E_2		2.08
H4210E_3		2.08
H4210E_4		1.18
Average SO		1.86
H4310E_1	Purchase Order Entry	.97
H4310E_2		.97
H4310E_3		.97
H4310E_4		.93
Average PO		.96
<b>AVERAGE DIST</b>		<b>1.41</b>
<i>Manufacturing</i>		
H3002E_1	Enter Work Order	.77
H31114U_1	Work Order Completions	.40
<b>AVERAGE MAN</b>		<b>.59</b>
<b>AVERAGE RESPONSE TIME</b>		<b>0.98</b>

## Appendix B: Certification Criteria for Published Characterization Results

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These guidelines provide Business Partners with the certification criteria for running a standard J.D. Edwards characterization test. These include either interactive, user-based tests, or transaction-oriented eFulfillment tests, where results are intended to be published with J.D. Edwards Benchmark Advisory Council Certification. Results of tests which adhere to these criteria and pass all audit procedures associated with the version of the test performed, may be certified and published by the J.D. Edwards Benchmark Advisory Council. Criteria include:

- A copy of the test plan must be submitted to Platform Technologies for review and approval prior to beginning the test.
- The tests must be conducted using the full test database and test data as provided by Platform Technologies. No data or indices may be deleted except as part of refreshing the database from J.D. Edwards-provided import files.
- Database, network and system tuning techniques used must be fully disclosed in a test report to be made available in J.D. Edwards' documentation library. This report may be released to any party at the discretion of J.D. Edwards.
- CPU, memory, network, and disk utilization, along with interactive response times must be included in the test report for the highest successful test result.
- Average response time is calculated using the following equation:

$$((10 * \text{avg FIN}) + (16 * \text{avg DIST}) + (8 * \text{avg MFG})) / 34$$

- The counter script provided by Platform Technologies - will calculate batch transaction rates, where applicable.
- The interactive tests must be conducted using test scripts and supporting roles provided by J.D. Edwards. Partners are responsible for licensing the user emulation software required by the J.D. Edwards-developed scripts. Batch tests must be conducted using the B2B batch scripts and UBE data ranges provided by Platform Technologies. These scripts must be run as delivered by J.D. Edwards with no modifications. J.D. Edwards may provide, at its sole discretion, revised scripts if necessary.
- The test must be conducted only using the J.D. Edwards production software as delivered with no modifications. Any updates (i.e. patches and bug fixes) must be obtained from J.D. Edwards and documented. Updates used must be available for general release within 90 days of test publication.
- For Interactive tests, average response times must be repeatable to within 0.1 seconds at the highest successful user count. The average response time will not exceed 2.0 seconds. For eFulfillment tests, the transaction rate must be repeatable to within five percent for the highest successful result.
- For interactive tests, all users must reach the Logoff/Rendezvous point between 50 and 70 minutes of being launched from the Login/Rendezvous point. Randomized individual start times may be included in this 50 to 70 minute measurement window. The amount of time required for reaching the login/rendezvous point may vary according to the number of users under test, *and is not included in the measurement window*. The 60-minute measurement window (plus or minus 10 minutes) will not vary, regardless of the user count.

*The script timer should not start until the users have been released from the login/rendezvous point (the measurement window).*

- For interactive tests, the script failure rate must not exceed 2.5 percent. If desired, 2.5 percent additional users may be started so that the user count equals or exceeds the target level.
- Platform Technologies must audit final test results if formal certification is desired. In addition, any member of the J.D. Edwards Benchmark Advisory Council, at their option, may review the audit materials for verification of compliance. *This additional review may, for confidentiality reasons, be delayed until the test partner publicly announces the test results.* System configuration files, database configuration files, OneWorld® configuration files and Rational (or equivalent software driver tool) timing logs must be turned over to Platform Technologies as part of this review.
- A press release may be issued as long as all parties agree with the results. Each party must approve the wording. All press releases must specify the OneWorld version, OS name and version, certified number of users (or transaction rate), and database name and version.
- All parties are allowed to distribute the documents.



## Appendix C: J.D Edwards Standard Characterization Methodology

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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 WebP 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%, Distribution - 50%, and Financial - 25%.

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:

- Financials
- 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 options 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 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 D: Software Enhancements Discovered**

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### **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 recreating a new one 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.

### **SAR 5654337 - Sets Connect Isolation Level via INI**

This fix provides the ability to set the connect isolation level for DB2 UDB via an INI file setting.

## Appendix E: J. D. Edwards OneWorld®

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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 they can better accommodate the needs of customers and partners.

J.D. Edwards' OneWorld offers applications that streamline back-office fulfillment tasks supply chain, manufacturing, distribution/logistics, and financials/HR. 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 F: IBM eServer pSeries and WebSphere Application Server Product Information

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The IBM eServer pSeries servers are available from enterprise to edge, from small, single application servers to large, massively parallel supercomputers such as the SP. The pSeries represents IBM's UNIX server line and are the most adaptable, flexible, and agile servers in the marketplace. They combine the benefits of UNIX computing with IBM's leading-edge RISC technology in a broad product line - from powerful desktop workstations ideal for mechanical design up to parallel RS/6000 SP systems that can handle demanding scientific and technical computing, business intelligence and Web serving tasks. The platform provides the power to create change and the flexibility to manage it, with a variety of applications that provide real value.

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 G: IBM DB2 UDB 7.2 Fix Pack 4 for UNIX Information

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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 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 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 CRM applications.

Additional information on IBM's data management solutions is available at <http://www.ibm.com/software/data>.

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