IBM Intentia Benchmark Report

IBM System i5

iSeries ERP Intentia Team

January 2006

Introduction

This paper describes testing that was done which shows flexibility, integrability, and scalability of new System i5 hardware and software using Intentia's applications. To demonstrate the ability, tests were run using Intentia's One Box solution. Intentia's One Box solution consists of three Intentia applications running simultaneously on the same system, "One Box". The scenario was as follows: simulated users entered orders through Movex Workplace and Net Extension into Movex Business Engine, which includes full back-end processing to invoice the orders. The test team then ran these applications on the POWER5 550-7463 running the i5/OS® V5R3 operating system and running the new i5/OS V5R4 operating system using the classic JVM. These applications were also run on a new System i5 550-7155 running the new i5/OS V5R4 operating system using the classic JVM.

All tests achieved excellent results, including subsecond response times and at least 1,000 order lines processed per minute. Overall, the new i5/OS V5R4 operating system showed slightly better runtime performance than V5R3. Also the new 550-7155 shows ~17% improvement in runtime performance which is inline with the higher Commercial Processing Workload (CPW) rating, the new model 550-7155 has.

The advantages of the new model 550-7155 were further demonstrated by showing the scalability running the same applications with one, two and four processors. The four-processor server was able to process more than 4,000 order lines per minute, demonstrating the capability of the model 550-7155 to handle increased application demands as a business grows.

This report is a demonstration of the unique capabilities of the System i5:

- IBM POWER5™ technology with its superior scaling and integration demonstrates that processor speed is not everything.
- The ability to run multiple complex workloads even on a small single processor system.
- The integration strength of i5/OS, DB2® UDB for System i5, Java, and WebSphere Application Server demonstrates the ability of i5 systems to support new application models.
- The consolidation and integration of a leading ISV solution to a "One Box" solution provides customer value in the small business market. A single System i5 can be used for both back-end and complementary front-end applications to replace a group of heterogeneous servers, with significant price/performance and Total Cost of Ownership (TCO) gains over the previous generation technology.
- On Demand capability is available for small and medium businesses to provide capacity for peak loads and future growth.
- Flexibility of System i5 to handle workloads on even small environments and grow as your business grows.

Statement of Approval

Intentia has reviewed, verified, and approved results for their applications which are shown in this report.

- Lars Strandner, Lead Architect Platforms, Intentia R&D, lars.strandner@intentia.se

Software

Intentia Software:

The tests described in this report used the latest versions of three Intentia products:

Movex Business Engine 12.4.3 SP15 – Business Engine provides the foundation for Intentia's business software. It provides a flexible framework for managing business processes and allows organizations to customize the Intentia solution to meet business needs. Although Movex Business Engine has its roots in the OS/400 and RPG platforms, the current version is built with Java technology, providing additional flexibility and a solid platform for the future.

Movex Workplace 5.2.1 – Movex Workplace is a role-based user interface that combines portal and Web technology with predefined work flows. These predefined work flows can be modified and combined with company-specific components and work flows. Movex Workplace provides employees with fast, easy access to work-related information and applications, thereby helping increase their productivity and efficiency. Workplace is built on top of IBM WebSphere Application Server V5.1.

Movex Net Extension 5.2.1 – Movex Net Extension is a state-of-the-art interface to all the powerful collaboration applications that comprise Movex. It is a thin client built to run as a component of Movex Workplace. Because it is based on open standards, it can easily be integrated with other systems and solutions as well as being fully adaptable to new platforms and technologies that are likely to emerge in the future. Net Extension also runs on IBM WebSphere Application Server V5.1.

IBM Software:

The tests described in this report used the following IBM software:

WebSphere Application Server Base v5.1.1.7 for OS/400
WebSphere Application Server provides a J2EE-compliant environment that allows you to manage server-side Java components. These Java components can add complex business logic and dynamic functions to static HTML Web pages and to standalone Java application clients.

i5/OS V5R3 and V5R4
IBM System i5 servers run many applications that clients have today while adapting quickly and easily to accommodate applications that may be needed in the future. The primary operating system, the i5/OS, due to its breadth and richness of integrated functions, offers great versatility and operational efficiency. It does this by natively and concurrently supporting applications built in RPG, COBOL, C, C++, Java, WebSphere and Domino.

i5/OS is fully integrated right out of the box. This means that relational database, communication and networking capabilities, online help, Web enablement technologies, easy enterprise management and much more are fully integrated into the operating system and the machine. The user communicates with all components of i5/OS using a single command language or a simple unified graphical user interface (GUI).

PTFs/Fixes required.

The following group PTFs were applied on the systems:

PTF Group	Level
SF99503	6
SF99295	4
SF99285	16
SF99269	7
SF99173	2
SF99099	6

In addition to the fixes above one fix from Intentia was required for the class below:

MvxPool.class - Error alert - 20050519/0184

This Intentia change corrects a memory leak that was causing degraded performance.

Database

The IBM test team configured the Movex Business Engine database with the following data:

- Customers: 200,017 (OCUSMA table)
- Items: 100,856 (MITMAS table)
- Customer locations: 2,000

This database contained 3,045 physical files and 8,012 logical files; the total size of the database library (not including journals and journal receivers) was 5.47 GB at the beginning of the run. In the scalability tests, the database library grew to 15.42 GB on the 4-way. The database increased by a smaller amount on the 2-way and 1-way.

The test Movex Workplace database was created with the standard Workplace installation program, and then populated with 2,001 additional users. During the benchmark runs, each virtual user logged in as one of these users. The Workplace tree was populated with Movex programs by importing the MOVEX_DEMO_GB.xml file included in the Workplace installation.

The Workplace database contained 3 tables, 19 indexes, and 305 stored procedures. The total size of the database library was 92MB at the beginning of the run. The Workplace database did not change in size significantly during the course of a run.

Business Flow

The IBM test team used a load generation tool to simulate users accessing Movex Workplace through a Web browser. Each user logged in to Workplace and then entered a series of orders through Movex Net Extension, which was connected to Movex Business Engine on the same server. Each order consisted of five order lines. At the end of the run, each virtual user logged out.

Movex Workplace and Net Extension were running inside a single instance of WebSphere Application Server V5.1. Users connected to an Apache server running on the same server, which then passed the requests to WebSphere.

The test team configured Movex Business Engine to fully process each order after it was entered, including the following steps:

- Checking agreements
- Checking item aliases
- Checking buying groups
- Checking order charges
- Checking assortments
- Automatic shipment connection
- Automatic route selection
- Automatic loading dock selection
- Price lookup through multiple levels

The Movex AutoJobs perform all of these steps through background batch processing; therefore, users do not have to wait for these steps to complete before continuing with the next order. The test team tuned the Movex AutoJobs so that they completed processing orders at about the same rate that new orders were entered. This tuning helped ensure that the measured throughput could be maintained over an extended period of time. Because the AutoJobs ran in the background, the system could handle periods of higher peak utilization; during such periods, the AutoJobs would temporarily fall behind but would be able to catch up later during periods of lower utilization.

Figure 1 shows an overview of the major system components involved in the test.

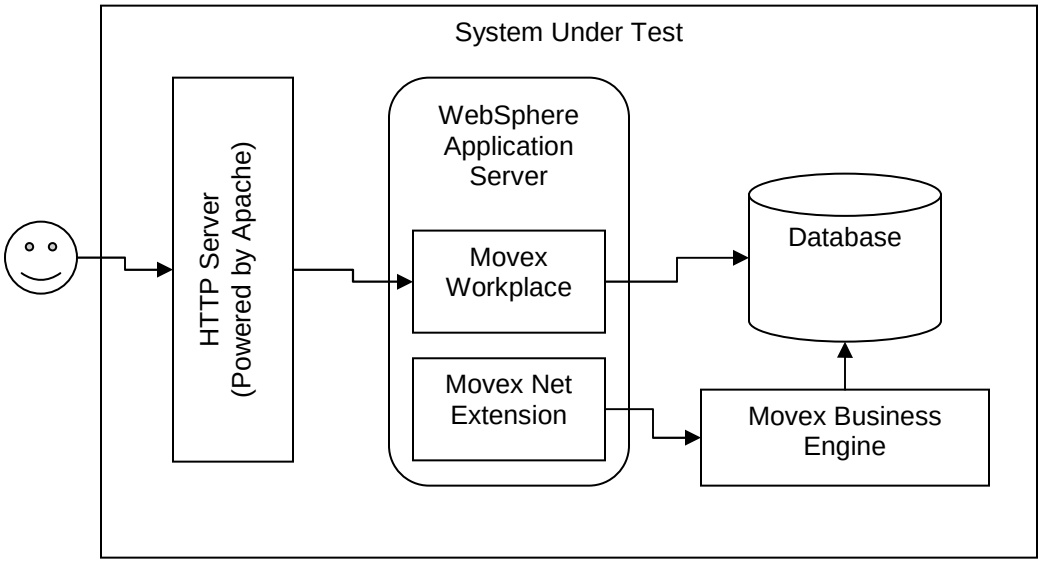


Figure 1. Major system components in System i5 Intentia benchmark test

Benchmark Methodology

The IBM test team configured the load generation tool to simulate a small number of virtual users entering orders at a fast rate. Each user was configured to enter 900 orders during the run. To maximize throughput, a series of practice runs were made on each server to choose the optimal number of users for that server.

After logging in, the user performed an order entry operation consisting of seven steps:

1. Create a new order
2. Enter order line 1
3. Enter order line 2
4. Enter order line 3
5. Enter order line 4
6. Enter order line 5
7. Close the order

The virtual users were configured to wait an average of one second between each step. This time period—the *think time*—includes the time required for the browser to render the page as well as the time required for the user to think about what to do next, to type in new information, and to submit the form back to the server. One-second think time is significantly faster than a real-world user would normally perform each step. Therefore, the small number of virtual users in the test represents a much larger number of real-world users.

Because full order processing consists of both an interactive and a batch component, the primary metric for this benchmark is *number of invoiced order lines per hour*, rather than the number of order lines entered per hour. An invoiced order line has completed all of the interactive and batch processing required for that order. To measure the number of invoiced order lines, the OOLINE table in the Movex database was monitored for order lines with a status of “77,” indicating that processing was complete for that line.

The number of invoiced order lines was counted once every minute throughout the benchmark test. Once the run was complete, the number of invoiced order lines per hour over a particular measurement interval was calculated from this data. The measurement interval was defined to be a 90 minute period beginning 15 minutes after the run started. This definition gives a more accurate view of the relative performance when comparing systems with significantly different performance characteristics, since the ramp-up period for each configuration will be somewhat different, making comparisons difficult.

To demonstrate that the results were repeatable, each result consisted of two runs with identical parameters.

Warm-up/Ramp-up Phase

For each run that was done a warm-up and ramp-up phase was performed. The warm-up phase consisted of 1 virtual user which does 10 iterations of the above defined scenario. This ensures all jobs have started and allows the JVM to warm-up by ensuring all the classes that will be used are loaded and any JSP or servlets have been initialized. Thus the warm-up phase can help prevent any timeouts or virtual users failing, as a result of slow responses due to first touch situations, during the run time phase.

After the warm-up is completed the run is then started. We now enter into the ramp-up phase. The virtual users are not started at the same time. Instead one virtual user is started every 5 seconds. The time it takes for all virtual users to have started is referred to as its ramp-up time. Having all virtual users start at the same time can overwhelm the system and cause jobs to back up and time outs or other errors may occur. A large number of users all logging in at the same time is an unrealistic real life scenario. Thus using a ramp-up of the uses is not only more similar to a real work scenario it also avoids overwhelming the system under test.

Note: That ramp-up times may vary depending on the size of the server. Slower systems or system with smaller number of processors may require longer ramp-up times in order to avoid errors from overwhelming the system. For example, for testing with only 1 processor the warm-up phase was increased to 100 iterations. This was the only test where the warm-up phase was modified.

Tuning:

- The just-in-time (JIT) compiler was used for all Movex Business Engine Java Virtual Machine™ (JVM™) environments.

- Class reloading was disabled in both Workplace and Net Extension. Class reloading is normally enabled during development but should be disabled (or set to a high reload interval) in production environments.

- The number of Web container threads used for Workplace and Net Extension was changed to 15. (The default is 80.) This limited the number of requests processed concurrently by Workplace, reducing contention, and therefore improving the average response time experienced by users.

- Transport planning was turned off.

- The Minimum and Maximum Heap Sizes were tuned for each of the Movex JVMs to minimize overhead caused by garbage collection.

- Below is the subsystem settings that were used for each subsystem. These were used for all tests expect the test done in the low end testing section.

```
#  Supervisor
Supervisor_MaxJobs=0
Supervisor_MaxHeap=360m
Supervisor_MinHeap=24m
Supervisor_Jit=jitc

#  Autojob
Auto_MaxJobs=45
Auto_MaxHeap=1560m
Auto_MinHeap=256m
Auto_Jit=jitc

#  Interactive
Interactive_MaxJobs=250
Interactive_MaxHeap=1560m
Interactive_MinHeap=256m
Interactive_Jit=jitc

#  Batchjob
Batch_MaxJobs=15
Batch_MaxHeap=640m
Batch_MinHeap=24m
Batch_Jit=jitc

#  Apijob
Api_MaxJobs=15
Api_MaxHeap=640m
Api_MinHeap=24m
Api_Jit=jitc
```

System Configurations:

To gauge the performance of Intentia software on the System i5 model 550s the IBM test team configured the server with the following resources:

System i5 model 550-7463
Processors: 4
CPW rating: 12,000
Main storage: 16384MB
Disk: 12 arms, 15k rpm, 35GB capacity
Disk configuration: Single ASP with device parity protection
Disk IOP: Disks spread across one 2780 IOP
Network: 100Mbps Ethernet, full duplex

System i5 model 550-7155
Processors: 4
CPW rating: 14,000
Main storage: 16384MB
Disk: 12 arms, 15k rpm, 35GB capacity
Disk configuration: Single ASP with device parity protection
Disk IOP: Disks spread across one 2780 IOP
Network: 100Mbps Ethernet, full duplex

For the scaling tests each of the three measurement sets used a different number of processors. The three measurements sets used an identical configuration for disk, memory, network, operating system, and applications.

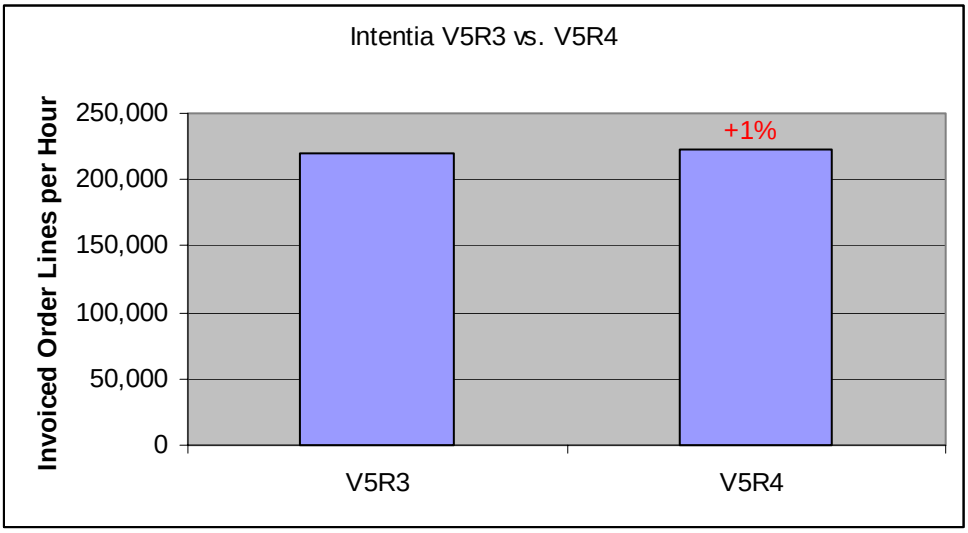
	1-way	2-way	4-way
Processors	1	2	4
CPW Rating	~3,800	~7200	14,000
Main Storage	16 GB	16 GB	16 GB
Disk	12 arms, 15k RPM, 35 GB capacity		
Disk configuration	One ASP with device parity protection.		
Disk IOP:	Twelve disks in ASP 1 using one 2780 IOP.		
Network	100Mbps Ethernet, full duplex		
Operating System	i5/OS V5R4		

All system configurations used security level 40.

Note: One goal was to show the minimum configuration for a 4 way system. Hence 16 GB of memory was the minimum amount required on the 4 way to minimize paging. There was not attempt made to determine the minimum hardware configuration required for the 1 and 2 way configurations. Also the number of disks was not a bottleneck in any of the below tests. This is meant as just a guideline, it still may be possible to achieve similar performance with fewer disk arms, especially for the 1-way and 2-way measurements.

V5R3 vs. V5R4 Results

The tests show that performance is slightly improved with V5R4. Hence, when moving to this new release of i5/OS, you may be able to take advantage of some of the new features available in this release with no significant change in performance expected.



System i5 model 550- 7463 4-way V5R3
The 4-way with V5R3 invoiced 220,849 order lines per hour in one run and 219,575 order lines per hour in the second run. In both runs, 95 virtual users were used.

Response time. Table 1 shows the average response time for each Web browser transaction on the 4-way with V5R3. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.142	0.143	0.17	0.17
Insert Order Line	5	0.086	0.087	0.099	0.99
Close Order	1	0.068	0.07	0.089	0.089

Table 1. Average response times for the 4-way System i5 model 550

System i5 model 550- 7463 4-way V5R4
The 4-way with V5R4 invoiced 222,391 order lines per hour in one run and 223,006 order lines per hour in the second run. In both runs, 95 virtual users were used.

Response time. Table 2 shows the average response time for each Web browser transaction on the 4-way with V5R4. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

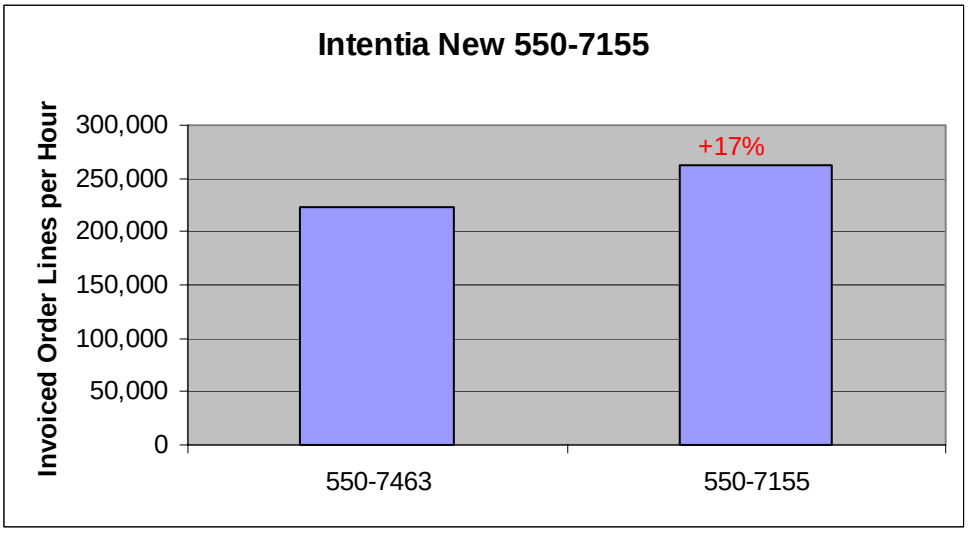
Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.147	0.148	0.18	0.18
Insert Order Line	5	0.092	0.09	0.109	0.109
Close Order	1	0.07	0.071	0.099	0.099

Table 2. Average response times for the 4-way System i5 model 550

CPU Utilization
On all configurations, the CPU(s) experienced 90 to 100% utilization for all of the test.

New Model 550-7155 Results

The tests show that performance is improved by ~ 17% with new model 550-7155. This improvement is inline with the CPW ratings of this new model. Hence, when moving to this new system, a significant change in performance expected.



System i5 model 550-7463 4-way V5R4
The 4-way model 550- 7463 invoiced 222,391 order lines per hour in one run and 223,006 order lines per hour in the second run. In both runs, 95 virtual users were used.

Response time. Table 2 shows the average response time for each Web browser transaction on the 4-way model 550- 7463. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.147	0.148	0.18	0.18
Insert Order Line	5	0.092	0.09	0.109	0.109
Close Order	1	0.07	0.071	0.099	0.099

Table 2. Average response times for the 4-way System i5 model 550-7463

System i5 model 550- 7155 4-way V5R4
The 4-way model 550- 7155 invoiced 262,606 order lines per hour in one run and 261,071 order lines per hour in the second run. In both runs, 112 virtual users were used.

Response time. Table 1 shows the average response time for each Web browser transaction on the 4-way model 550- 7155. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

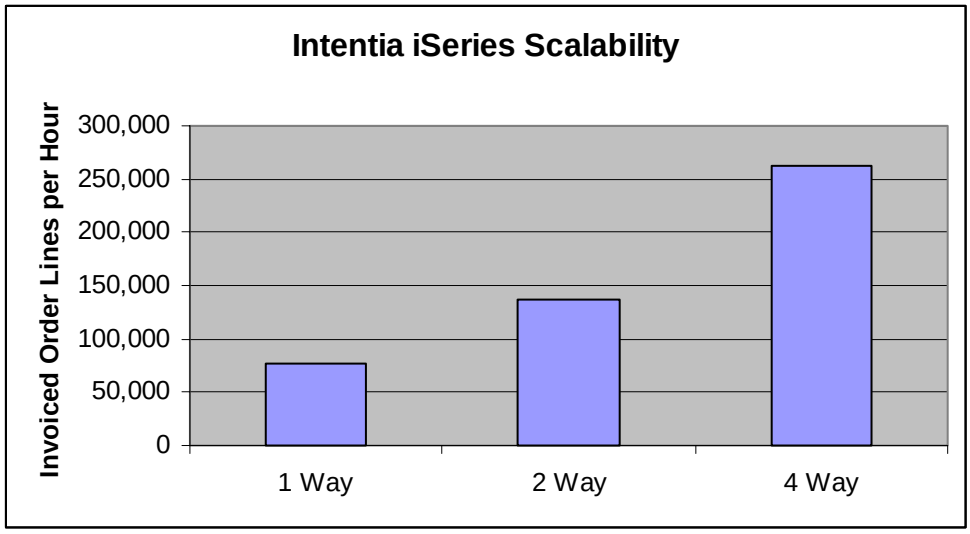
Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.142	0.136	0.18	0.17
Insert Order Line	5	0.087	0.083	0.099	0.099
Close Order	1	0.069	0.065	0.089	0.089

Table 1. Average response times for the 4-way System i5 model 550- 7155

CPU Utilization
On all configurations, the CPU(s) experienced 90 to 100% utilization for all of the test.

Scaling Results

The scalability tests showed excellent scalability as processors were added to this configuration, demonstrating the ability of the new 550-7155 to grow along with your business. Throughput increased dramatically with each additional processor, and response time remained excellent for each of the configurations tested.



System i5 model 550- 7155 1-way V5R4
The 1-way invoiced 76,928 order lines per hour in one run and 76,157 order lines per hour in the second run. In both runs, 31 virtual users were used.

Response time. Table 2 shows the average response time for each Web browser transaction on the 1-way. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.143	0.137	0.18	0.18
Insert Order Line	5	0.084	0.081	0.109	0.099
Close Order	1	0.071	0.066	0.099	0.099

Table 2. Average response times for the 1-way System i5 model 550

System i5 model 550- 7155 2-way V5R4
The 2-way invoiced 137,073 order lines per hour in one run and 137,785 order lines per hour in the second run. In both runs, 58 virtual users were used.

Response time. Table 1 shows the average response time for each Web browser transaction on the 2-way. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.138	0.137	0.17	0.17
Insert Order Line	5	0.083	0.081	0.089	0.089
Close Order	1	0.065	0.064	0.099	0.089

Table 1. Average response times for the 2-way System i5 model 550

System i5 model 550- 7155 4-way V5R4
The 4-way invoiced 262,606 order lines per hour in one run and 261,071 order lines per hour in the second run. In both runs, 112 virtual users were used.

Response time. Table 1 shows the average response time for each Web browser transaction on the 4-way model 550- 7155. Response times do not include the average one-second think time for each transaction and they measure the entire length of the run, not just the 90 minute measurement interval.

Step	Number per Order	Average Response Time (seconds)		90th Percentile Response Time (seconds)	
		Run 1	Run 2	Run 1	Run 2
Create Order Head	1	0.142	0.136	0.18	0.17
Insert Order Line	5	0.087	0.083	0.099	0.099
Close Order	1	0.069	0.065	0.089	0.089

Table 1. Average response times for the 4-way System i5 model 550

CPU Utilization
On all configurations, the CPU(s) experienced 90 to 100% utilization for all of the test.

Summary

As the results in this paper have shown i5/OS V5R4 has runtime performance that is slightly improved over i5/OS V5R3. The new model 550-7155 has increased runtime performance by ~17%. The model 550-7155 also has very good scaling as processors are added to this system. All of this also demonstrates the unique capabilities of the System i5 to provide superior scaling, the ability to run multiple complex workloads even on a small single processor system, and the integration strength of i5/OS, DB2® UDB for iSeries, Java, and WebSphere Application Server. This also demonstrates the value of consolidation and integration of the Intentia's ISV solutions to a "One Box" solution providing customer value in the small and medium business market. Thus a single System i5 can be used for both back-end and complementary front-end applications to replace a group of heterogeneous servers, with significant price/performance and Total Cost of Ownership (TCO) benefits.

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