Oracle's JD Edwards EnterpriseOne IBM POWER7 performance characterization

Diane Webster
IBM Oracle International Competency Center
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Abstract

This paper describes the results of recent performance characterization tests which demonstrate the scalability of Oracle's JD Edwards EnterpriseOne on IBM POWER7™ processor-based servers running IBM i. The POWER7 results show near linear scalability across measurements of 1000, 2000, 3000 and 4000 interactive HTML users on a twelve-core configuration with average response times below 0.2 seconds. This paper also shows that interactive response time remains below 0.2 seconds when 4000 users are run with various batch workloads. These results demonstrate the superior work management capabilities of IBM i which does not sacrifice the performance of interactive users while still providing excellent batch throughput – all in a single partition.

These results demonstrate the commitment of IBM and Oracle to providing customers with an integrated, scalable, and easy to manage environment based on the latest Power® Systems processor technology and a robust software solution including the use of IBM PowerVM™, DB2® for i, and WebSphere® Application Server.

Introduction

This paper presents and analyzes the results of performance characterization tests based on the combination of an IBM Power® 740 server running IBM i 7.1 and JD Edwards EnterpriseOne 9.0.2.

The performance characterization includes a combination of a heavy interactive workload running concurrently with a significant amount of batch processing. In order to first establish a baseline to compare interactive performance and these batch workloads, results are presented for 1000, 2000, 3000 and 4000 interactive users running with no batch transactions. Then an analysis is done to compare the impact of short-running and long-running batch jobs on end user response time and server resource usage.

These measurements take advantage of the latest IBM technology including IBM i 7.1, the IBM Technology for Java™ JVM, and the IBM technology stack which includes DB2 and WebSphere Application Server 7.

Test design

The first goal of the performance charaterization tests is to understand the scalability with an increasing number of interactive users. The user workload was generated with the LoadRunner load generation software using the JD Edwards EnterpriseOne Day in the Life (DIL) test kit. The kit covers five major JD Edwards EnterpriseOne modules and uses 17 different applications. The applications used are listed in Figure 1 below.

	Application
1	P03B102 (Apply Receipts)
2	P0411 (Supplier Ledger Inquiry)
3	P051191 (Daily Time Entry)
4	P17500 (Case Management Add)
5	P31114 (W.O. Completion)
6	P3411 (MRP Messages (WO Orders))

7	P3411 (MRP Messages (OP Orders))
8	P3411 (MRP Message (OT Orders))
9	P4113 (Inventory Transfer)
10	P42101 (S.O. Entry – 10 line items)
11	P42101 (S.O. Update)
12	P4310 (P.O. Entry – 25 line items)
13	P4312 (P.O. Receipts)
14	P4314 (Voucher Match)
15	P4915 (Ship Confirm – Approval only)
16	P4915 (Ship Confirm – Confirm/Ship only)
17	P4915 (Ship Confirm – Confirm and Change entry)

Figure 1: Interactive applications from DIL kit

After the baseline performance for the interactive users is determined, the second goal is to measure the impact to the interactive users when running with various types of universal batch engines (UBEs) and different numbers of active batch job streams.

NOTE: For the purpose of the tests described in this paper, we will define active batch job streams as the total number of UBEs that are run concurrently in the IBM i batch job queues. For example, if the MAXACT parameter for QBATCH is set to 4, there will be four active batch streams for that queue.

We classify two main types of UBEs: long running and short running. Long-running UBEs are usually update-intensive, and create large reports. Short-running UBEs which typically complete in less than five minutes are typically read-only. Due to the quick runtime, short-running UBEs include a large percentage of “start-up” activity. The startup activity includes not only job initiation, but also job startup processing by the JD Edwards EnterpriseOne server jobs. Long-running batch jobs, on the other hand, generally use record locks for database write operations and make heavy use of journaling to record their database activity. The goal of this paper is to develop a better understanding of how these two job types may impact interactive users as the UBE workload increases.

The short-running UBEs in the test include a variety of integrity reports and general inquiry reports listed in Figure 2.

	Short running UBEs
1	R0004P (UDC Records Types Print)
2	R0006P (Business Unit Report)
3	R00067 (Business Unit Translation Report)
4	R0008P (Date Patterns Report)
5	R0010P (Company Constants Report)
6	R0012P1 (AAI Report)
7	R0014 (Payment Terms Report)

8	R0018P (Tax Detail Report)
9	R00425 (Organization Structure Report)
10	R01402W (Who's Who Report)
11	R03B155 (A/R Summary Analysis)
12	R03B31 (Activity Log Report)
13	R03B461 (Collection Report)
14	R04413 (Open A/P Summary Report)
15	R04602 (Supplier Analysis Report)
16	R09017 (Account Translation Report)
17	R09410 (Trial Balance Report)
18	R098201 (Annual Close Report)
19	R41411 (Select Items for Count 1 item)
20	R41542 (Item Ledger As Of Record Generation)
21	R42072 (Price Category Print)
22	R46990 (Warehouse Location Integrity)
23	R48096 (Cost Plus Markup Listing)

Figure 2: Short running batch processes

The long running UBEs include eight of the most frequently used batch processes which are listed in Figure 3 below:

	Long running UBEs
1	R09801 (GL Post)
2	R31801A (MGF Acct Journal)
3	R31410 (Work Order Processing)
4	R42520 (Print Pick Slips)
5	R42565 (Sales Order Invoicing)
6	R42800 (Sales Order Update)
7	R43500 (Purchase Order Print)
8	R4981 (Freight Update)

Figure 3: Long running batch processes

Test environment

The test environment used a single 12-core Power 740 Solution Edition system for an "all in one" configuration. In an "all in one" configuration, the web server, enterprise server and database server reside within a single IBM i partition as shown in Figure 4.

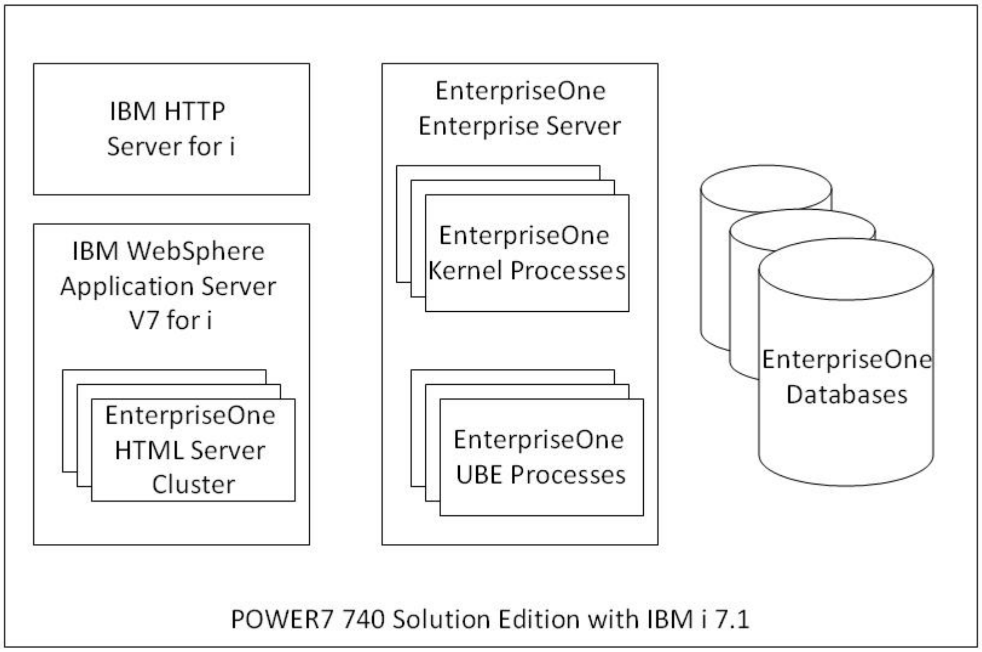

Figure 4: "All in One" configuration on IBM i

The hardware and software configuration details for the 12-core system are shown in Figure 5.

12-core Power 740 Solution Edition configuration	
Processor Technology Clock Rate CPW	Power7 3.7 GHz 77,200
Memory	192 GB
Disk Arms HDD SDD	 48 (RAID-5) 8 (mirrored)
Software Operating System WebSphere Network Deployment Edition EnterpriseOne	 IBM i 7.1 7.0.17 9.02/8.98.4.5

Figure 5: Hardware and software configuration

Power 740 interactive scalability

To measure the scalability of the server with an interactive user workload, two scenarios were run with 1000, 2000, 3000 and 4000 users. The first scenario used a static configuration. The JD Edwards EnterpriseOne configuration was not changed as the number of users increased. Each test was run with eight JD Edwards EnterpriseOne HTML server instances, or JVMs, and 160 call object kernels. Network Deployment Edition of WebSphere was used to allow all eight instances to be managed in a single WebSphere cluster.

In the second scenario, the configuration changed as the number of users changed. The ratio of call object kernels to users was a constant 25 users per call object kernel. Similarly, the number of JVMs in the WebSphere ND cluster increased as the number of users increased. Each HTML instance supported 500 users. Figure 6 below shows the number of call object kernels and JVMs used with each user count.

Number of users	Number of call object kernels	Number JD Edwards EnterpriseOne JVMs in the Websphere cluster
1000	40	2
2000	80	4
3000	120	6
4000	160	8

Figure 6: Cal object kernels and JVMs by user count

NOTE: The number of security kernels and JDENET processes were also changed proportionally as the user counts increased.

Test results

The graph in Figure 7 compares the response time for the two scenarios. The average response time ranges from 0.085 to 0.127 seconds and is essentially identical.

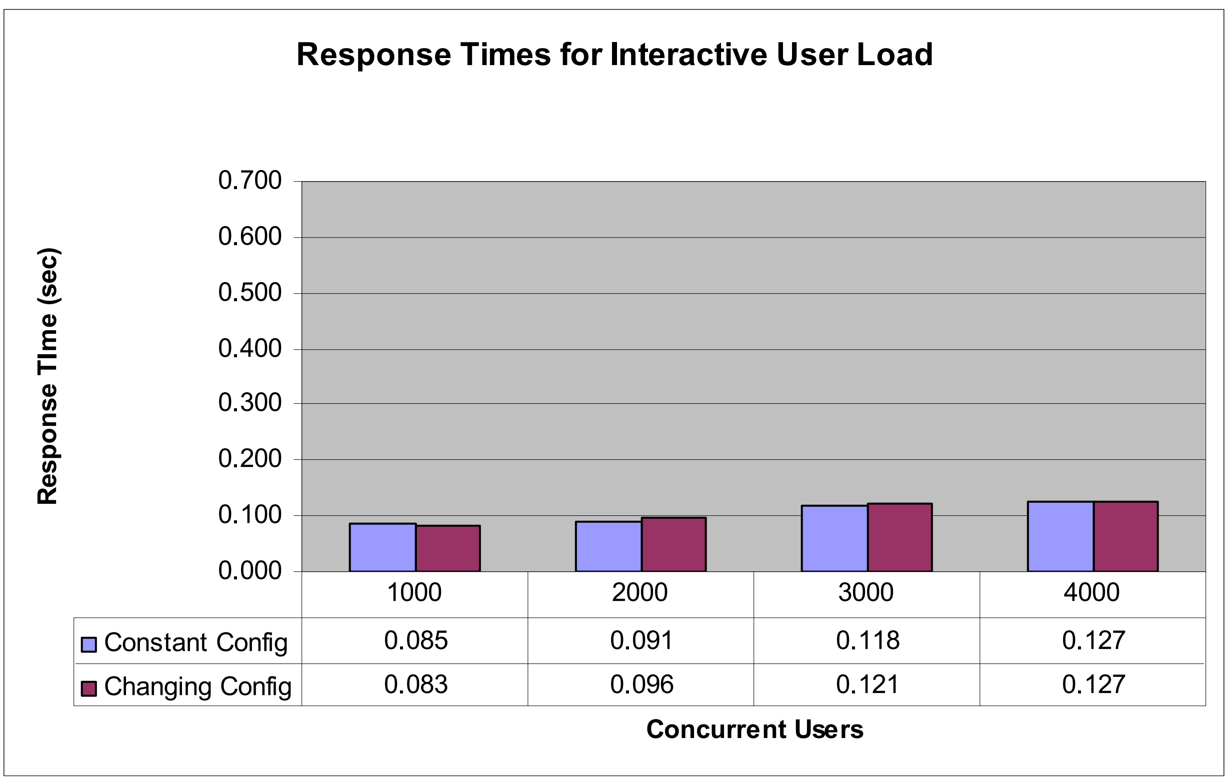

Figure 7: End user response time

Figure 8 shows that the CPU utilization of both scenarios is also virtually identical.

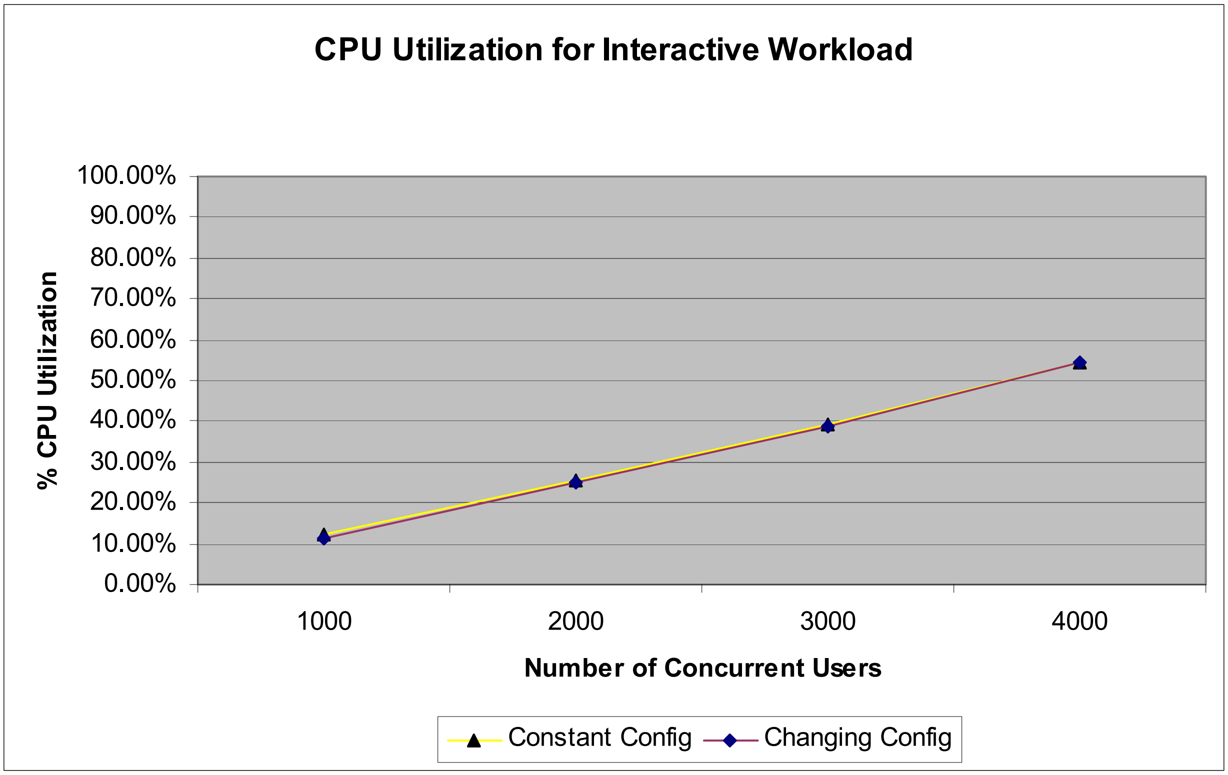

Figure 8: CPU utilization

In Figure 9, the CPU utilization is broken down in the general application components, web, logic, and database. The web component includes both the IBM HTTP Server as well as WebSphere. The logic component is made up of all the enterprise server kernel processes used by JD Edwards EnterpriseOne. The database component includes all database jobs used by both the web and logic components. The data allows for a comparison of the CPU utilization as the number of Websphere JVMs and call object kernels increase, and users increase.

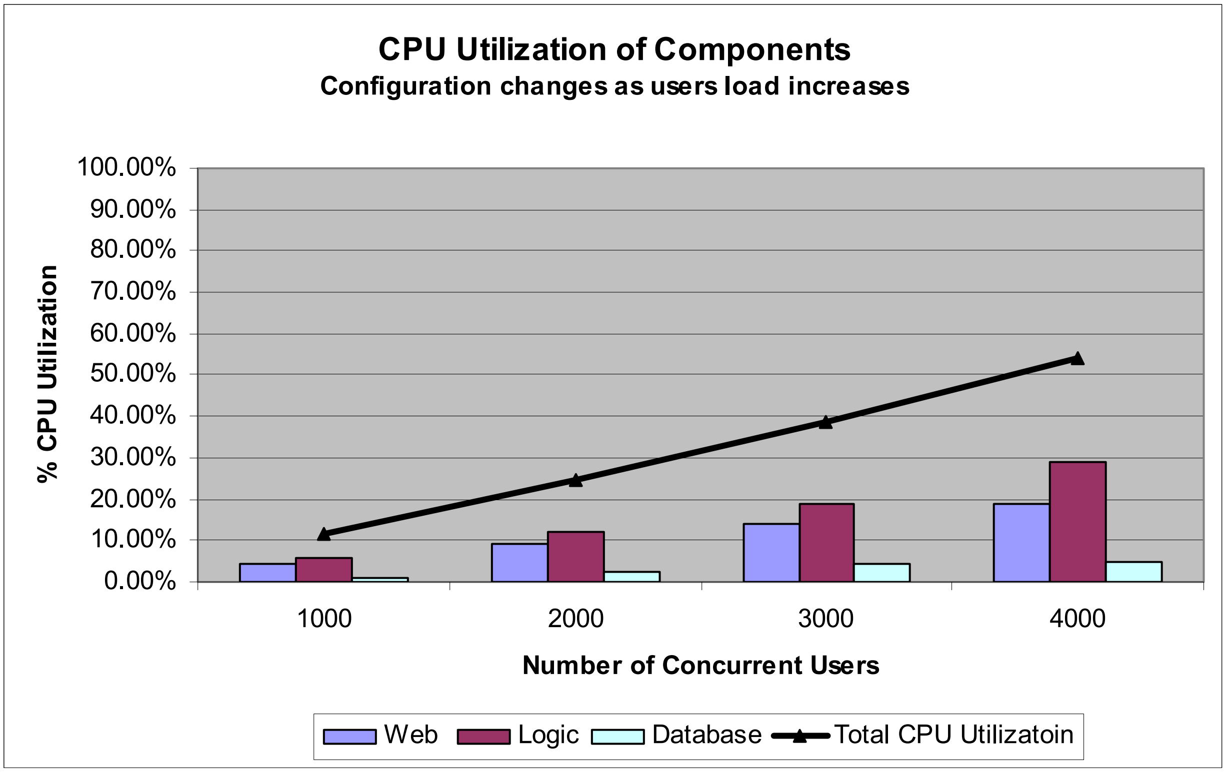

Figure 9: CPU utilization by component

Conclusion

From the two scenarios we see that:

- As the number of users increase, we have near constant response time below 0.13 seconds.
- As the number of WebSphere instances in a cluster increases, we have linear growth in CPU utilization of the web component.
- As the number of call object kernels increase, we have also near linear growth in the logic component.
- The total CPU utilization in both scenarios is linear.

Comparison of short and long-running batch impact

As mentioned previously, the UBEs in the DIL kit have different characteristics. Therefore, it is likely that they will have a different impact to system resource utilization and end user response time. To understand this, the next series of tests compare the scenario where each batch type runs concurrently with 4000 interactive users. The first test ran eight concurrent short-running batch jobs with 4000 users, and the second test ran eight concurrent long-running batch jobs with 4000 users.

Test results

The graph in Figure 10 compares the response time and CPU utilization for each type of UBE workload, short-running and long-running. In this case, the web and logic components are broken out. The batch component includes the logic component of the UBEs and the database component includes the database activity for the web, logic and batch components.

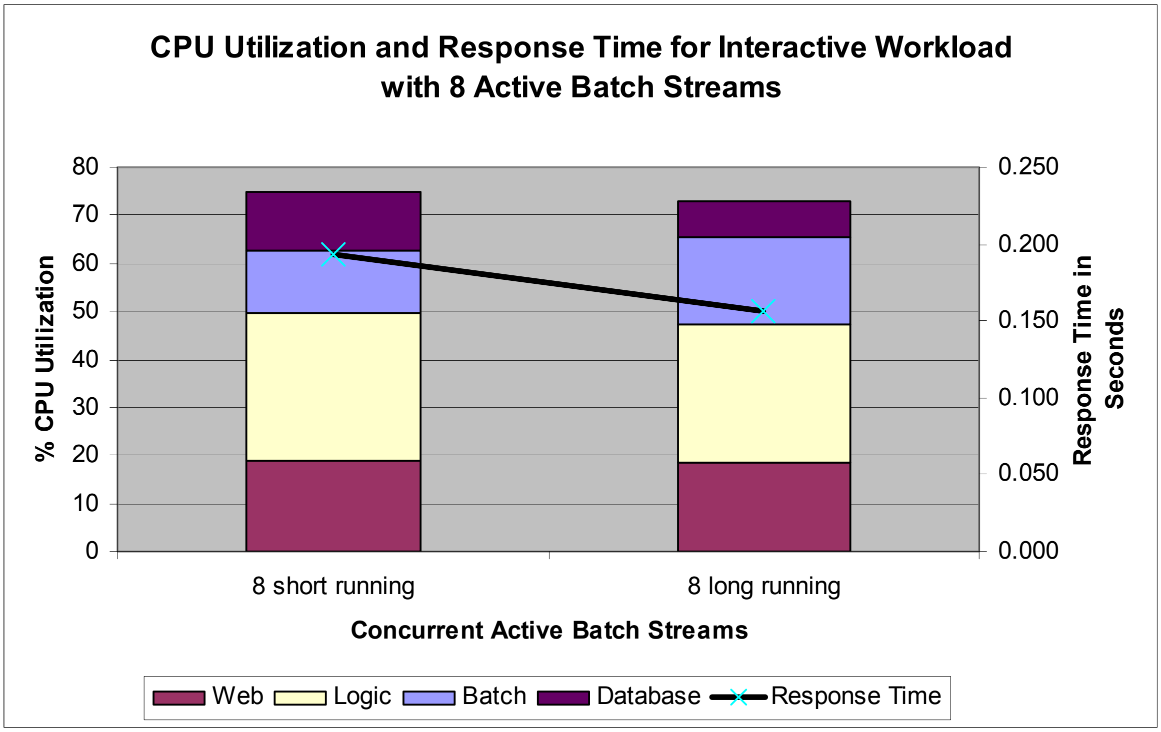

Figure 10: Interactive response time with eight concurrent short and long running batch job streams

The interactive user response time while running short-running UBEs is slightly higher than when running the same number of concurrent long-running UBEs, 0.19 seconds as compared to 0.16 seconds.

The graph in Figure 10 also shows the comparison of CPU utilization for the two scenarios. Total CPU utilization is nearly the same in both cases. However, the CPU used for the batch component is significantly higher in the long-running UBE test while the database CPU utilization is higher in the short-running UBE test.

Further analysis of the two scenarios shows that the long-running UBEs perform a higher number of logical database I/Os than short running UBEs. A logical I/O occurs when data is transferred between the system and application memory buffers. This metric indicates how much work batch jobs (or other jobs) perform during any given time period. The short-running UBEs process few logical I/Os, but they have a higher CPU cost. This can be explained by understanding additional details about the UBEs. Several of the short-running UBEs have a very high number of random I/Os against the F0115 and F0901D tables. Additionally, the long-running UBEs process a significant amount of sequential data. Random database reads are move expensive than sequential database reads, as a result, more CPU is used to process the database requests for the short-running UBEs.

To establish a baseline for the UBE throughput, two different measurements were tracked. For the short-running UBEs, the number of UBEs processed per minute was measured. During the tests, 65 short-running UBEs were processed per minute. For the long-running UBEs, the number of records processed per minute were tracked. R09801, which is one of the long-running UBEs, is used to determine relative long-running UBE throughput. This UBE is run in all long-running batch scenarios. R09801 (General

Ledger Processing) processed approximately 14,000 F0911 rows per minute. Both UBE throughput numbers are useful in understanding the impact of running both types of UBEs concurrently with 4000 users.

Conclusion

In reviewing the results for the eight concurrent short-running and eight concurrent long-running UBE tests, we note that:

- Both types of UBEs have a similar impact on the CPU utilization
- The long-running UBEs in this scenario have a higher percent of CPU in logic calculations than in database requests
- Short-running UBEs appear to have more impact on end user response time than long-running UBEs. The characteristics of the short-running UBEs which may contribute to this include:
  - Higher job throughput and therefore more initialization and termination cost on the IBM i
  - Higher use of the Metadata Kernel during JD Edwards EnterpriseOne job startup. Both the interactive and batch processes use the Metadata kernel
  - Increased contention on IPC resources. During JD Edwards EnterpriseOne process startup and shutdown, locks are used to create and remove the IPC resources that are required by each UBE. Interactive processes also require the use of IPC, so there can be more contention with short-running UBEs due to the high number of jobs starting

Impact of mixed UBE workload on interactive users

The final series of tests increases the number of concurrent batch jobs active in the system. The tests execute a mixed UBE workload with 4000 users as follows:

- two short-running and two long-running (four total) batch job streams
- four short-running and four long-running (eight total) batch job streams
- eight short-running and eight long-running (16 total) batch job streams

NOTE: In the tests for this scenario, the short-running UBEs ran with a job run priority of 40, and the long-running UBEs ran with a job run priority equal to 50. This gives the short-running jobs priority access to the available CPU resources on the system and will favor short-running throughput over long-running throughput.

Test results

Figure 11 shows the interactive user response times for the three tests: four, eight and 16 batch job streams. The response time ranges between 0.186 and 0.197 seconds. The baseline for interactive users with no UBEs was 0.127 seconds. Therefore, there is some impact to the interactive response in this scenario, but average response time is still below 0.2 seconds.

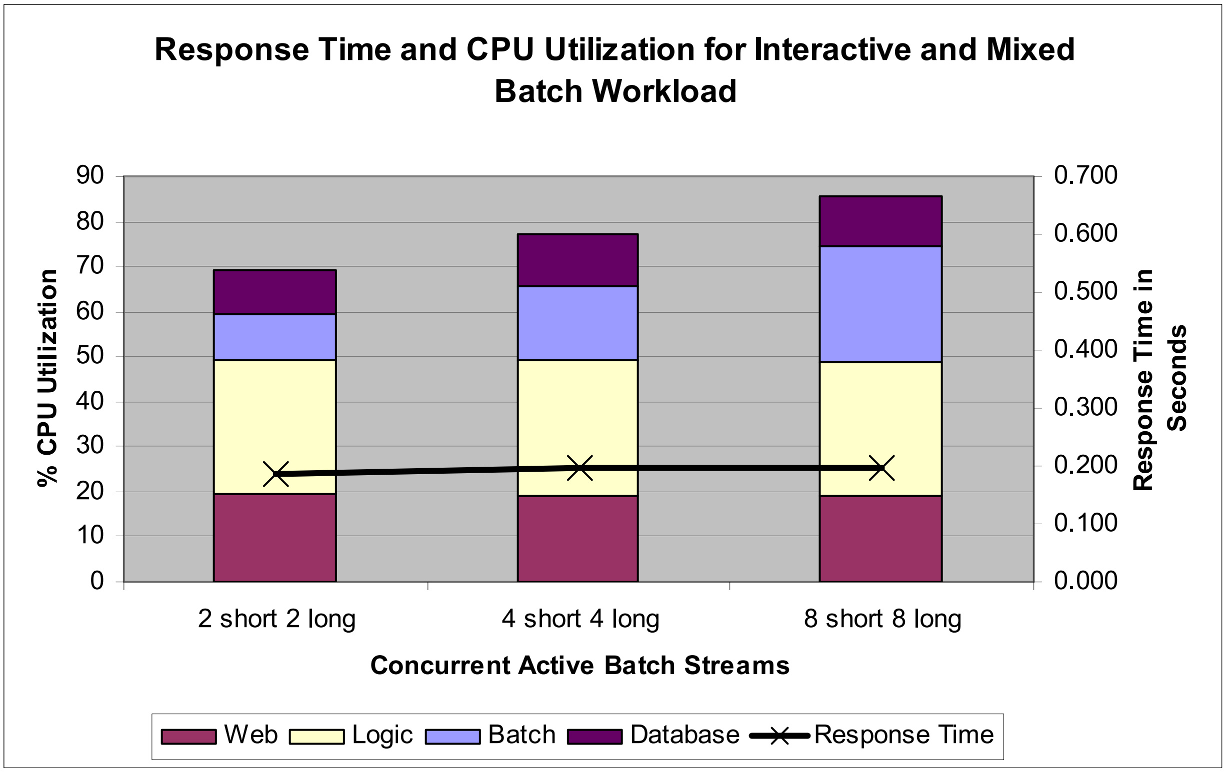

Figure 11: Response time and CPU utilization with four, eight and 16 concurrent batch jobs streams

Figure 11 also show the CPU utilization for the scenarios. Total CPU utilization increased from seventy percent to almost ninety percent. This graph also breaks down the CPU utilization into the web, logic, batch and database components. The web and logic CPU utilization remain constant. This is expected given the number of users remained constant in all tests.

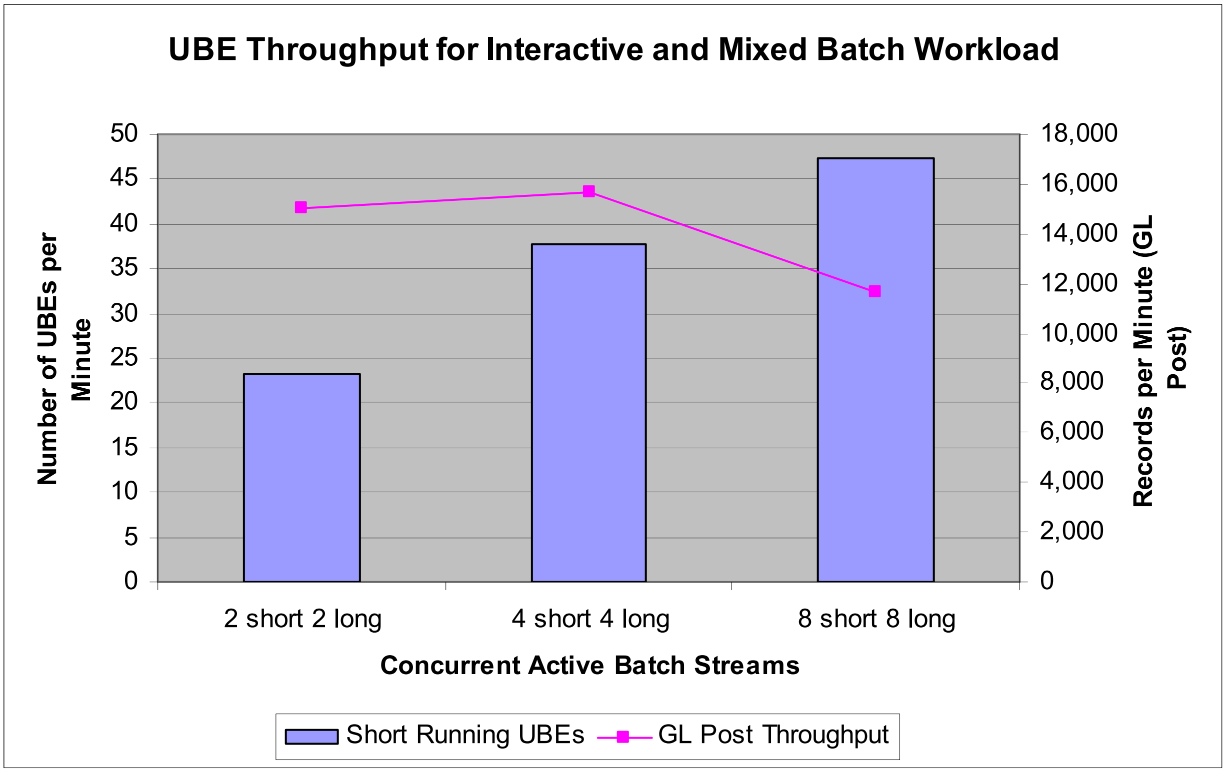

Figure 12: Batch throughput with four, eight and 16 concurrent batch jobs streams

Figure 12 shows the UBE throughput for each test scenario. The number of short running UBEs run per minute increased between the three runs. Simultaneously, the throughput for the GL Post started declining when run in the 16 concurrent UBE test. This shows that at higher CPU utilizations the contention for the resources started impacting the throughput of the priority 50 UBEs; however the response time for interactive users was not impacted. This demonstrates one of the strengths of Power Systems™ with IBM i – the ability to manage a mixed priority workload in a single partition, giving more priority to interactive and short running UBEs while still processing the long running UBEs, albeit at a slower rate.

Conclusion

In these the mixed UBE scenario, we see that:

- The batch workloads had minimal impact on the interactive response time
- As CPU utilizations increase, UBE throughput is impacted
- In this scenario, short-running UBE throughput continued to increase even though long-running UBE throughput decreased. This shows that it can be important to use multiple priorities for batch jobs to help ensure throughput for critical jobs

Summary

The results from this performance characterization reflect the following about JD Edwards EnterpriseOne when run on IBM Power Systems POWER7 processor-based servers with IBM i:

- They validate the linear scalability of JD Edwards EnterpriseOne on POWER7 with IBM i with 1000, 2000, 3000 and 4000 interactive users
- They show that an average response time less than 0.2 seconds can be maintained with a mixed batch and interactive workload
- They demonstrate the integration and work management capabilities of IBM i which allow the entire workload to be run in a single partition

Appendix A - resources

General system documentation

- IBM Power Systems and IBM i Information Center
  http://publib.boulder.ibm.com/infocenter/iseries/v7r1m0/index.jsp
- IBM / Oracle Informational APARs http://www-03.ibm.com/systems/i/advantages/oracle/
- IBM Power Systems Performance Capabilities Reference IBM i operating system 7.1
  http://www-03.ibm.com/systems/resources/systems_power_software_i_perfmgmt_pcrm_oct2011.pdf
- Performance Management for IBM System i Home Page http://www-03.ibm.com/systems/i/advantages/perfmgmt/

General JD Edwards EnterpriseOne tuning

- IBM Power Systems with IBM i performance and tuning tips for Oracle's JD Edwards EnterpriseOne WebSphere-based HTML servers
  http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101777
- IBM Power Systems with IBM i Performance and Tuning Tips for Oracle's JD Edwards EnterpriseOne 9.0
  http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101504

Oracle Minimum Technical Requirements

- Oracle Minimum Technical Requirements (MTRs) (userid and password required):
  https://support.oracle.com/CSP/ui/flash.html#tab=KBHome(page=KBHome&id=()),(page=KBNavigator&id=(bmDocType=REFERENCE&bmDocTitle=JD%20Edwards%20EnterpriseOne%20Current%20MTR%20Index&viewingMode=1143&from=BOOKMARK&bmDocDsrc=KB&bmDocID=747323.1))

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Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

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