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The OrionX Constellation: Data Center
Application Performance

Case Study: The World Bank Performance Analysis

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Executive Summary

We examine a major server refresh at the World Bank. We were fortunate enough to receive data directly from the bank concerning their needs, the server alternatives they evaluated, their evaluation criteria, the results of their analysis, and, of course, their final decision. In this case, the Fujitsu M10 was selected over the Oracle T5 on the bank's applications, mainly due to the Fujitsu M10's integer-floating point design.

This is a fascinating glimpse into how real world customers evaluate, test, and make decisions between different server technologies.

The World Bank

It's not often that you get a look inside the real decision process for a major server purchase. So we jumped at the chance to review and write about the decision process for the World Bank when they purchased a new set of servers to host their various financial applications.

The World Bank was founded shortly after World War II with the goal of funding the rebuilding of a devastated Europe. The bank has evolved over the years to become the world's largest source of development finance and expertise for underdeveloped countries.

The bank manages an active portfolio of over $207 billion worth of net commitments to developing countries and regions. The World Bank funds its loans and grants through issuing bonds in the capital markets. Much like any large bank, the World Bank has to manage their lending and borrowing portfolios with a set of sophisticated technical applications and tools.

Like many organizations, World Bank needed both strong integer and floating point performance. More organizations will be seeing a need for floating point as they journey deeper into big data, AI, etc.

Herschell Andrews is a Senior IT Officer with the bank and is responsible for supporting a number of World Bank applications used to support its fixed-income, treasury, and capital markets lines of business. He shared with us details about their current infrastructure, pre-upgrade, how they evaluated potential new systems, and their ultimate decision.

Evaluation

The World Bank Server Upgrade Process

It's World Bank policy to upgrade their server hardware systems every four to five years. They want to reduce their overall risk by running on modern hardware, plus receive the benefits of faster, more versatile, and scalable systems.

The bank was looking to replace an aging population (15 individual systems) of Fujitsu M4000 (up to 4 sockets) and M5000 (up to 8 sockets) servers. The goals of the replacement were to allow them to consolidate application instances onto a common set of hardware, while also reducing the number of systems from 15 down to 6.

In addition, they were looking to increase both their intraday and batch processing performance by taking advantage of greater performance levels provided by new systems. Another benefit would be to have greater capacity to host more development and test environments.

The Contenders

Since the World Bank was already using SPARC/Solaris-based systems, they didn't include x86 systems in the evaluation because that would require a port of all of their applications, plus their workloads are mission critical for the bank. They have also seen good performance from the SPARC/Solaris combination and saw little need to change.

The primary application the bank runs is Summit, a COTS financial application that provides front, middle, and back office functionality to the World Bank's three lines of business in Treasury & Capital Markets.

This narrowed their search down to two platforms: the Oracle T5-2 and the Fujitsu M10-4.

- The Oracle T5 is a two socket, 32-core system that can run up to 128 threads per processor. The server has 16 memory sockets and can support up to 1TB of memory in a single chassis plus up to six SATA drives. It's designed to run mission critical enterprise workloads and includes the Oracle virtualization and lights out system management tool suite.
- The Fujitsu M10 is a two or four socket system, with 16-core SPARC processors that can run up to 32 threads per processor. The system supports up to 1TB memory per node and up to eight SATA drives. Like the Oracle T5, the M10 also includes Oracle virtualization tools (same as above) plus Fujitsu's XSCF monitoring, management, and server configuration utilities.

Server	CPU	Clock	Total Threads	Memory
Oracle T5-2 Small	SPARC T5	3.6 GHz	1 x 8 x 16 = 128	128 GB
Fujitsu M10-4 Small	SPARC64 X+	3.4 GHz	4 x 2 x 16 = 128	128 GB

The two platforms were connected to an Oracle Exadata database server via 10 gigabit Ethernet.

The bank availed itself of the Fujitsu loaner program that allowed the bank to use an M10-4 system over the 8-9 week testing period at no charge. Coincidentally, this is the second time the bank has taken advantage of Fujitsu's loaner program, with the first being when they purchased their original Fujitsu systems. Oracle also loaned the bank an Oracle T5-2 system.

Evaluation Criteria and Test Results

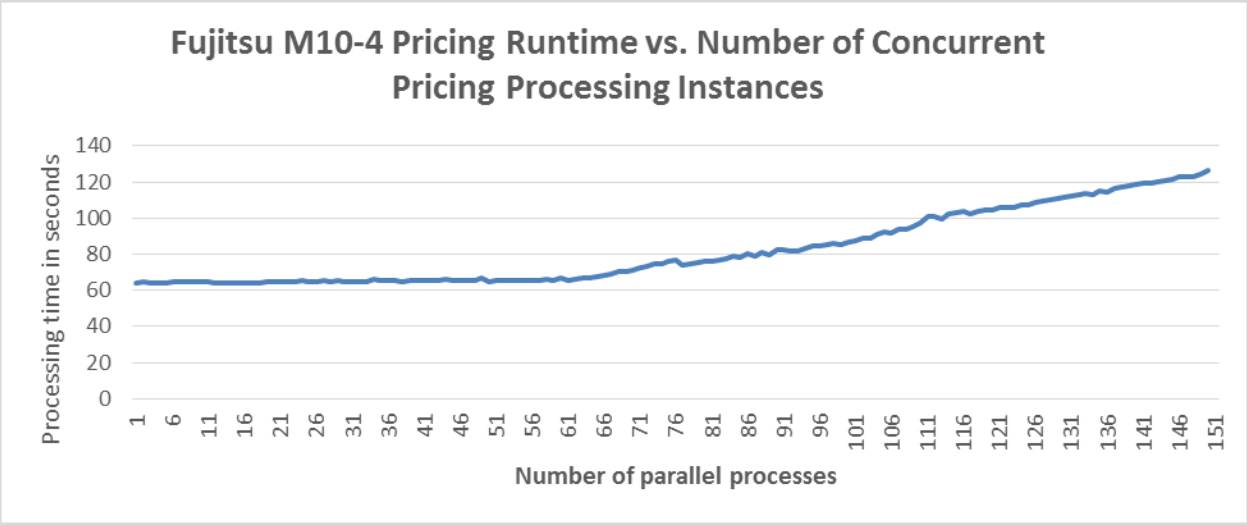
The head-to-head testing was conducted with real World Bank applications running real-world data. The bank put together a representative set of system tests that would fully evaluate the performance characteristics of each system.

The three tests below were run on the legacy Fujitsu M4000, the candidate Oracle T5-2 system, and the candidate Fujitsu M10-4 system. Let's see what happened.

Pricing Runtime vs. Number of Concurrent Pricing Processing Instances

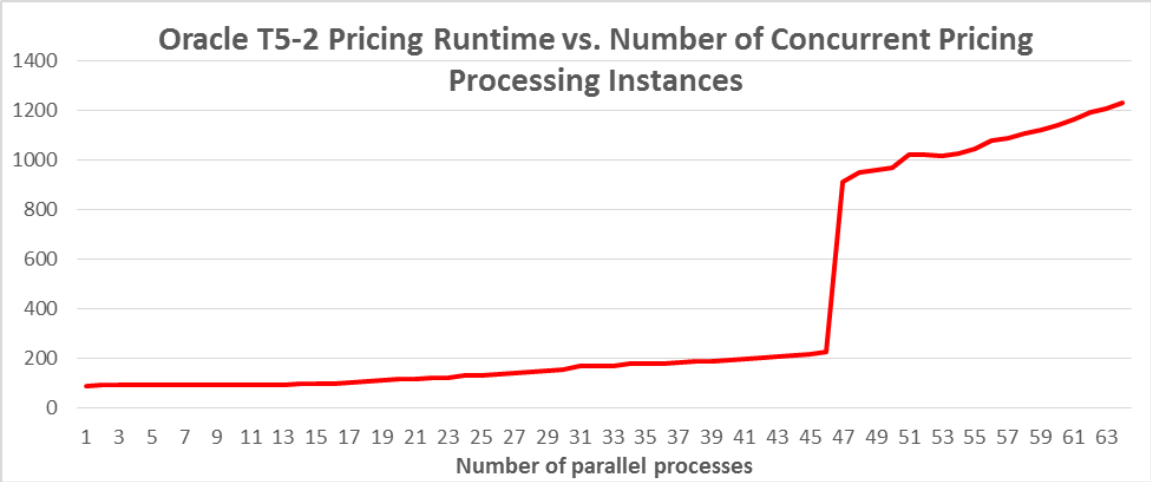
In this test, a single trade is priced out by each system, starting with one trade at a time. As the benchmark progresses, the number of trades handled simultaneously increases until 64 trades are being processed at a time. The average runtime for each grouping is averaged and used for evaluation purposes.

The comparative performance between the Fujitsu M10-4 and the Oracle T5-2 is stark. First, let's look at the Fujitsu M10-4.



As can be seen in the chart above, the processing performance of the Fujitsu M10 remains very constant from 1 to around 66 simultaneous process instances – barely varying at all. When loaded with higher numbers of processes, the system does slow down, but it's a very gradual and predictable process, which is what you want from a system. Predictability is the key here, so that the admins know when the processes will complete.

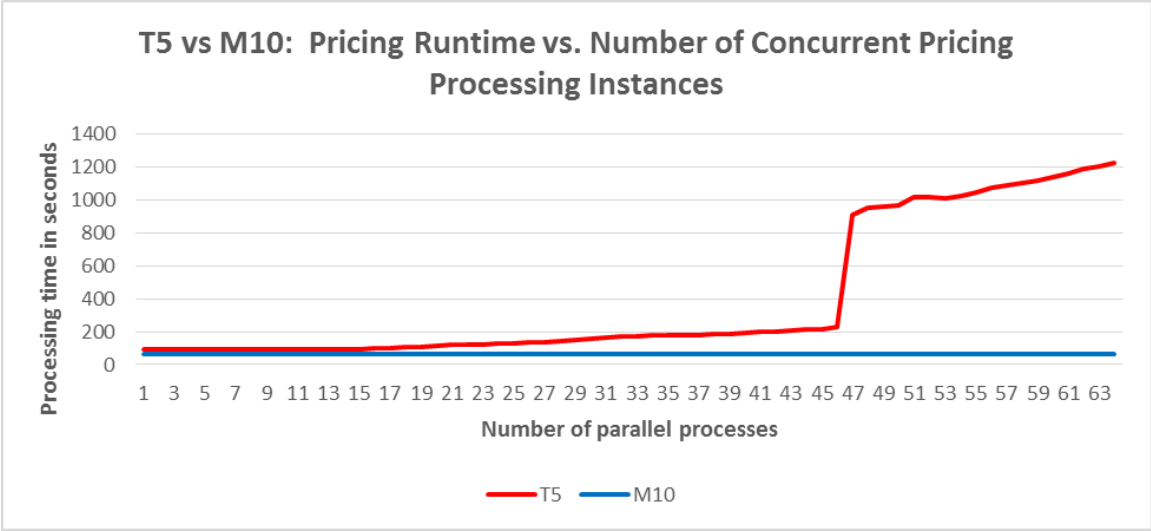
The chart below for the T5-2 tells a completely different story.



First, note the start point of the line compared to the right axis. While the Fujitsu system started with an average processing time of 65 seconds or so, the Oracle server starts at around 90 seconds – almost 50% slower right off the bat.

Oracle T5 performance gradually declines up until the system is confronted with about 46 pricing processing instances. At this point, performance goes out the window, degrading by an astounding margin until 49 processes, and then rising significantly until it reaches the 64 process test maximum.

While the Fujitsu system maxes out at around 125 seconds total processing time for 64 instances, the Oracle server is an order of magnitude slower at 1,229 seconds total processing time. That's an extraordinary difference between the two systems. Here's a graph that tells the story even more clearly:



Runtime Comparison of Pricing Batches, Executed with and Without Concurrency

This exercise prices a full batch of 688 individual trades. The first test processes the trades one at a time, with the second test measuring how well the system copes with a constant load of 64 trades at a time. This is a Monte Carlo like simulation that tests multiple options for each trade. The first table below summarizes how each of the three systems (legacy, plus Oracle T5 and Fujitsu M10) performed on the serial run of the test.

	M4000 Serial Run	T5-2 Serial Run	M10-4 Serial Run
Total seconds	90,413	65,540	47,343
Total hours	25.11	18.21	13.15

The table shows that both the Oracle T5 and the Fujitsu M10 performed significantly faster than the legacy M4000, which was expected.

What wasn't expected was the performance margin between the T5 and the M10. The Fujitsu M10 was nearly 28% faster than the T5 on the serial run, and almost 48% faster than the M4000. This translated to a 12 hour advantage for the Fujitsu M10 vs. the M4000, and a five hour advantage vs. the Oracle T5.

	T5-2 Parallel Run	M10-4 Parallel Run
Total seconds	138,348	47,506
Total hours	38.43	13.20

On the parallel side of the test, we see yet another huge performance delta between the two systems.

The Fujitsu M10 is almost 3x faster than the T5 on the parallel workload, saving a massive 25 hours in processing time.

It's also important to note the difference between the serial and parallel tests for each system. On the Oracle side, the parallel run is more than double the time needed for the serial. But with the Fujitsu M10, the results between serial and parallel runs barely vary at all – this shows excellent system scalability.

Runtime Comparison of Key Batch Jobs of Both Instances of Summit

The Summit application is a primarily single-threaded app that consists of many large, monolithic executables. This is in contrast to a web application whose middle tier might consist of lightweight, highly threaded services supporting many user sessions. Multiple process instances are created as required to support interactive use during the day. In the evening, Summit's batch jobs execute in typical batch mode. When a particular batch job can be parallelized, it is done by spawning many multiple UNIX processes, each of which could grow to several gigabytes in size.

M10 IMD Summit Completion Times - Minutes

	M4000 (prod)	M10	Change
Accounting driver	37	14	**62.16%**
Cashflow	40	20	**50.00%**
Staging Area	78	50	**35.90%**
BVS	95	40	**57.89%**

There are two different production applications that are run in batch mode, IMD Summit and CMD Summit. The results of the testing on both the two loaner systems vs. the legacy M4000 is shown in the tables below.

As can be seen from the table, the Fujitsu M10 is clearly significantly faster than the legacy M4000 server. The average speed up for the M10 is almost 52% across all of the tasks – a very good result.

T5 IMD Summit Completion Times - Minutes

	M4000 (prod)	T5	Change
Accounting driver	32	42	**-31.25%**
Cashflow	24	63	**-162.50%**
Staging Area	81	145	**-79.01%**
BVS	96	49	**48.96%**
			-55.95%

It's quite a different picture when comparing legacy M4000 performance to the T5 loaner. In fact, it's almost a mirror image, but in a negative way.

The T5 is slower than the legacy system in three out of four categories, and by an average of almost 56%. This is both surprising and disappointing.

The bank also tested their other batch application, CMD Summit, on all three systems. The results are summarized in the tables below.

M10 CMD Summit Completion Times - Minutes

	M4000 (prod)	M10	Change
Accounting driver	69	30	**56.52%**
Cashflow	47	21	**55.32%**
Staging Area	49	25	**48.98%**
BVS	20	11	**45.00%**

The Fujitsu server outperforms the older M4000 server on each of the tasks in the CMD Summit application.

The average performance margin is almost 51%, very similar to what the bank saw with the IMD Summit suite of tests.

T5 CMD Summit Completion Times - Minutes			
	M4000 (prod)	T5	Change
Accounting driver	56	43	23.21%
Cashflow	39	124	-217.95%
Staging Area	50	74	-48.00%
BVS	20	31	-55.00%

Unfortunately, the Oracle T5 system couldn't keep up. It was better than the M4000 on only one section of the test – and then was only 23% better – which is surprising for hardware that is five years newer.

Overall, the T5 was more than 70% slower than the legacy M4000 on average.

After these exhaustive tests, it was clear to the bank that the Fujitsu M10 was the choice.

This isn't to say that the Fujitsu M10 would outperform the Oracle T5 on all business applications. The World Bank's applications have a significant need for floating point performance. The Fujitsu version of the SPARC processor has considerably more floating point performance; in fact, it's very balanced between integer and floating point capabilities. The Oracle version of the SPARC chip is weighted more towards integer performance,

meaning it might do a better job on light weight web workloads and other, non-floating point, operations.

Conclusion and closing thoughts

A number of key findings have emerged as a result of the bank's comprehensive evaluation process to upgrade its legacy SPARC servers.

According to the bank and their tests, the Fujitsu delivered more than twice the performance (on average) vs. their existing M4000 systems. There were 'no surprises' in the system, it loaded up predictably and performed linearly during stress tests.

The Oracle T5 did not complete some of the tests, and performed poorly on others – turning in scores even lower than the legacy system. The bank believes this is probably because of the weak floating point processing inherent in their version of the SPARC processor making this system less ideal for the bank's numerically-intensive workloads.

Balanced performance between floating point and integer operations is where the Fujitsu M10 shines. It also doesn't hurt that the system is highly expandable, scaling up to 64 processors and 64TB of memory in a single O/S image – so plenty of head room. Through Fujitsu's core activation program, the bank can add more capacity a processing core at a time, so it will be inexpensive and easy to grow.

The speed of the system allowed the bank to reduce the number of physical systems in their data center by more than 50% (from 15 to 6). This will pay off in lower power/cooling costs, while also freeing up floor space for other uses.

The higher performance of the Fujitsu M10 system also allows the World Bank to host more virtual systems, along with more test and development workloads.

The bank did a thorough job in putting the servers through their paces. They benchmarked each system on the actual workloads they'd be running in the real world, which is always a best practice. They were methodical and relied on the data to guide their decision. We're grateful that they shared their thought process, data, and results with us and believe this evaluation can serve as one example for other organizations running similar workloads.