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HIGH INTEGRITY IT INFRASTRUCTURE

WHY USE OVM FOR ORACLE DATABASES

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The Author

Francisco's has over 23 years of experience in consulting, analysis, support, implementation, and migration of Oracle products; he is also an expert in most phases of a database life cycle as per example: Development, Stabilization, Security, Backup and Recovery, Tuning, Installations, and Data warehouse ("ETL"). Furthermore Francisco is well known for his excellent implementation and support methodologies leading him to be a popular speaker on Oracle conferences around the world. Since 2009 Francisco has been focusing on developing best practices of virtualization solutions and helping many IT organizations architect virtual infrastructure and virtualize their applications.

Francisco for his well-known performance within Oracle community became President of CLOUG (Chilean Oracle Users Group), LAOUC (Latin American Oracle Users Groups Community (Umbrella organization for all Latin America), and NZOUG (New Zealand Oracle Users Group).

So far he has worked as associate technologist at Oracle Brazil and Chile, as Oracle instructor for New Horizons Centre, Chile and for Oracle education (Brazil and Chile). Also was part of the first team to introduce Oracle to South American market (Oracle 6 and Beta version of Oracle 7). Francisco was the first Master Oracle 7 Database Administrator in South America, as well the first South American Oracle professional to being awarded twice as ACE (ACE at 2008 and ACE Director at 2009) by Oracle HQ.

In 2010 he had the privilege to receive the prestigious Oracle Magazine Editor's Choice Awards as the Oracle evangelist of the year – a huge recognition of his outstanding achievements in the Oracle world that includes the creation and organization of the already famous OTN Tours that has become the biggest Oracle evangelist's events in the world.

Currently Francisco works for Revera Limited which is a leader provider of utility computing infrastructure and enterprise data management in New Zealand with 5 strategically located Data Centres around the country as Oracle Professional Services Manager since June, 2011. Revera is a partner of Oracle and manages the largest OVM farm in New Zealand.

The Benchmark

The main goal of this exercise was to test how an Oracle Database (single instance) performs in a virtualized environment and then compare the results to a database running on an exclusive bare metal server. We are looking with this benchmark to find answers to the following questions:

- Does an Oracle Database perform well on a virtualized environment?
- What virtualization technology is more stable and allows an Oracle database to perform faster?
- What is the performance difference between using a bare metal and a virtualized guest?
- Is it safe to run a production database in a virtualized environment?

The Environment

The environment used for this benchmark was composing of:

- Hardware
  - 3 Dell M610 with:
    - 96 GB of RAM each
    - 2 hexa-core processors each (12 cores in total)
  - Hitachi Storage (Fiber Channel Storage Array)
- Software/Database
  - OEL (Oracle Enterprise Linux) 5.7 64 bit
  - OEE (Oracle DB Enterprise Edition) 11.2.0.3 with:
    - SGA: 4864 MB
    - 7 Redo Log Groups with files of 150 MB each

The three servers used on this benchmark have exact same specifications and configurations and shares the same storage and network, and all servers are also located on the same blade chassis.

The network and storage was exclusive for this benchmark without anyone else running on the same environment.

The Servers and VMs

Each physical server was built as follows:

- **Server A**: Built using OVM 3.2.1.516 and hosts a unique guest VM that uses 4 vCPUS, 6 GB of RAM and 100 GB of storage.
- **Server B**: Built using **the best non Oracle virtualization product available in the market (**called non-OVM on this document) to hosts a unique guest VM that uses 4 vCPUS, 6 GB of RAM and 100 GB of storage.
- **Server C**: Bare metal server using OEL 5.7 with 12 CPUs, 96 GB of RAM, and 100 GB of storage.

As you can see on figure 1, Percentage of Physical server used/available for the benchmark.

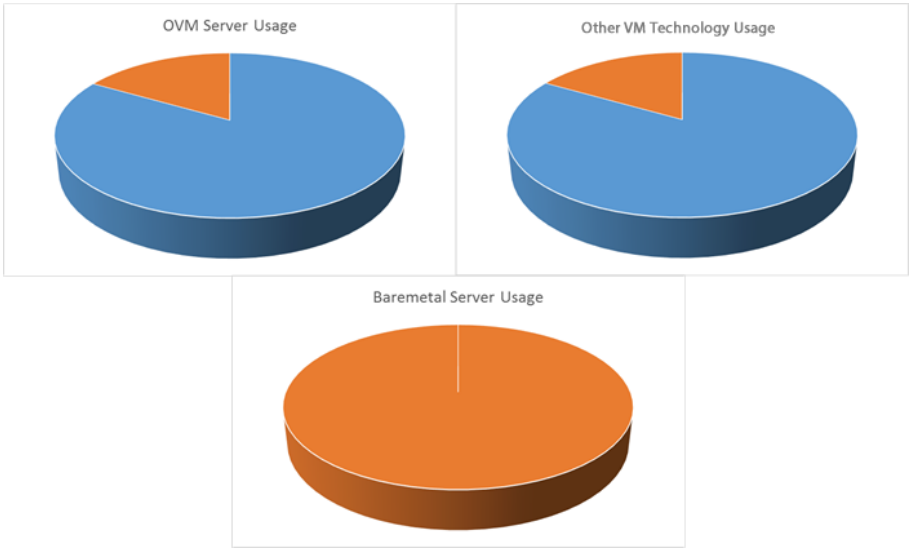


Figure 1- Percentage of Physical server used/available

This shows clearly that the Virtualization physical servers are using only a fraction of their capacity and have capability to grow if requested or even host more virtual machines (using a better use of the resources available). In contrast the bare metal server has all resources available to the Oracle Database being used on this benchmark exercise.

Products Used for the Benchmark

The products used to execute and measure the benchmark results are:

- CPUmonitor 2.91
- Swingbench 2.4

Figure 2 – Benchmark tools used

The Setup Process

The process used to create the benchmark environment was the following (as per figure 3):

1. Create a virtual Machine using the non-OVM virtualization product and installed Oracle Enterprise Linux 5.7 64 bit as the OS and proceeded to install, create and configure the Oracle Database 11.2.0.3.
2. Create the Swingbench environment in the just created database.
3. After the first VM was completed, it was cloned and migrated using the V2V process to a physical server running OVM 3.2.
4. After the migration was completed, the new OVM guest was power up and tested to ensure that everything is running as on the non-OVM source environment.
5. Next in the bare metal server, installed Oracle Enterprise Linux 5.7 64 bit as the OS and proceeded to install the Oracle Database 11.2.0.3 RDBMS.
6. Finally we proceed to duplicate the Oracle Database running on the OVM guest created on the step 3 using the Active Duplication process available within 11gR2 to ensure that the bare metal database will be an exact copy of the database available on the virtual environments.

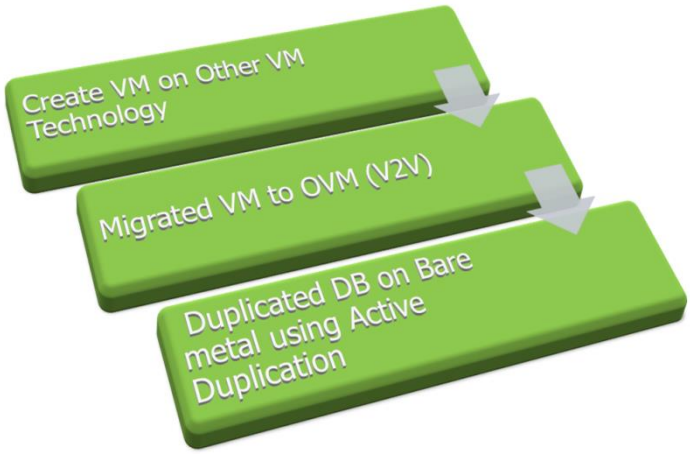


Figure 3 – The setup/creation process

After the creation and setup of all machines was completed, the final step was to install Swingbench and CPUmonitor on a laptop and setup it to be able to connect to all 3 servers (2 virtual and one bare metal).

Results

The following results were collected when running the exact same stress test for a time-frame of 15 minutes of load to each machine.

Response Times

The following results regarding Response Time (at milliseconds) were achieved when running 15, 50, 100 and 200 concurrent users (Now we will show the results obtained at a graphic way).

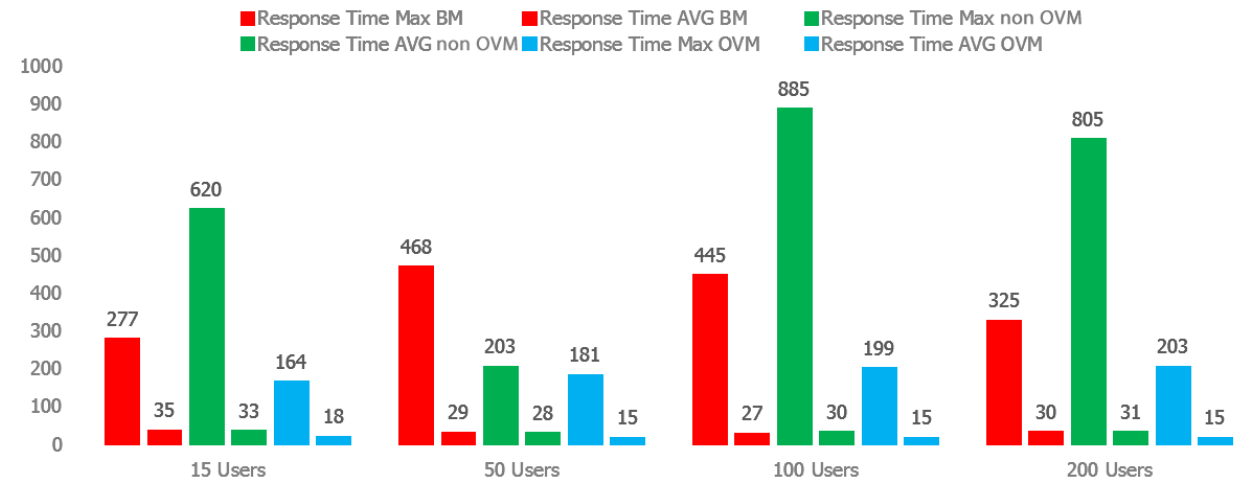


Figure 4 – Response Time AVG and Max up to 200 Users

As you can see in figure 4 when running 15 to 200 concurrent users, OVM had the best result regarding AVG and Max response times. Additionally the times were stable during the whole process with minimal variations on the Max response time when compared with non-OVM and with the bare metal server.

Now let's take a closer look on what will happen if we stress even more the environments when using 400 and 800 concurrent users.

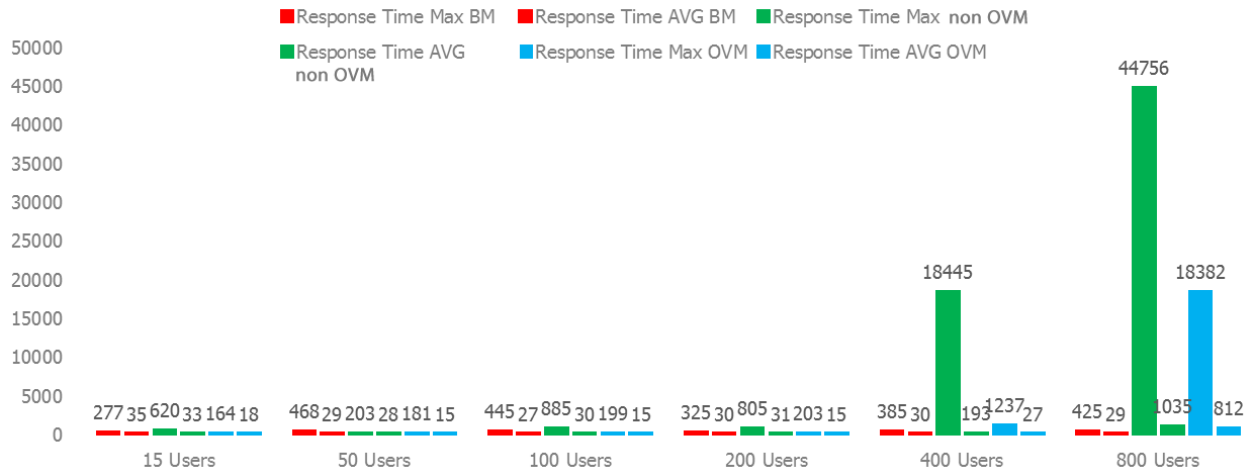


Figure 5 – Response Time AVG and Max up to 800 Users

As I expected with this huge load of concurrent users (figure 5), the resources available to the virtual guests started to become depleted and consequently the performance of the virtual machines was affected; of course the only stable environment on this new scenario was the bare metal server that have more resources available for the Oracle database (CPU and memory). As a result the non-OVM virtual machine (non-OVM) started to have serious performance issues earlier than the OVM machine.

With this in mind let's take a closer look to the results again, but just taking in consideration the response time AVG results.

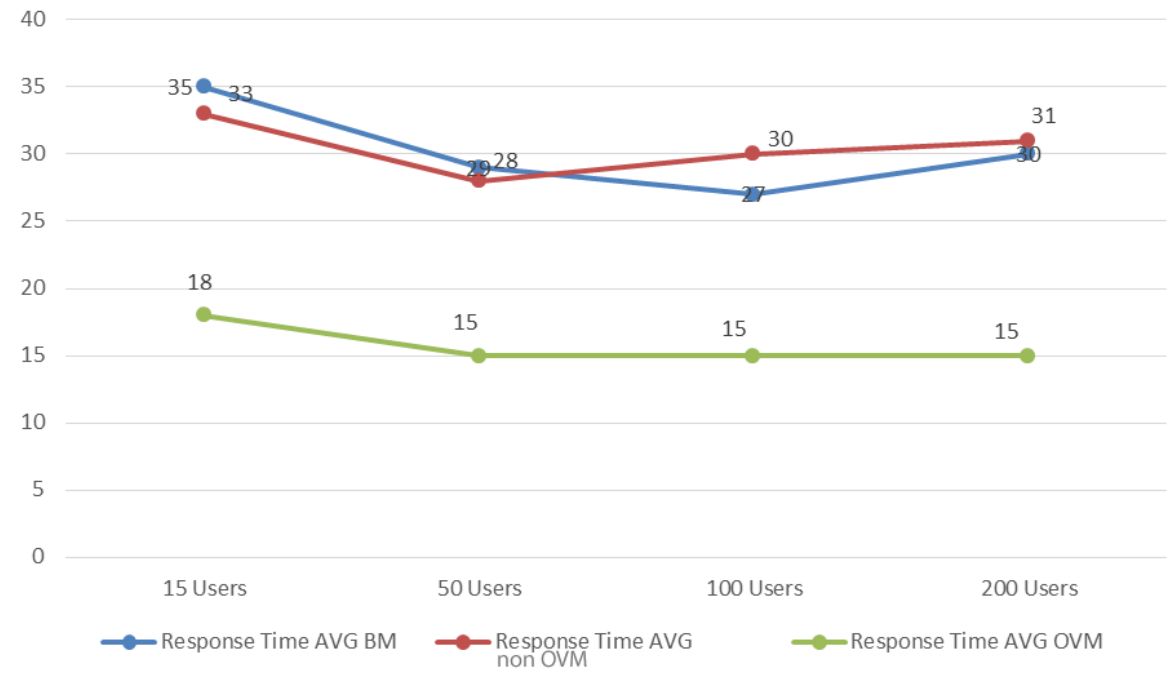


Figure 6 – Response Time AVG up to 200 Users

In the graphic above (figure 6) it can easily be identify the OVM environment as the one with the best response time, followed by the bare metal environment as the load increases. Now let's take a closer look in the changes this graphic will suffer when increasing the load to 400 and 800 concurrent users.

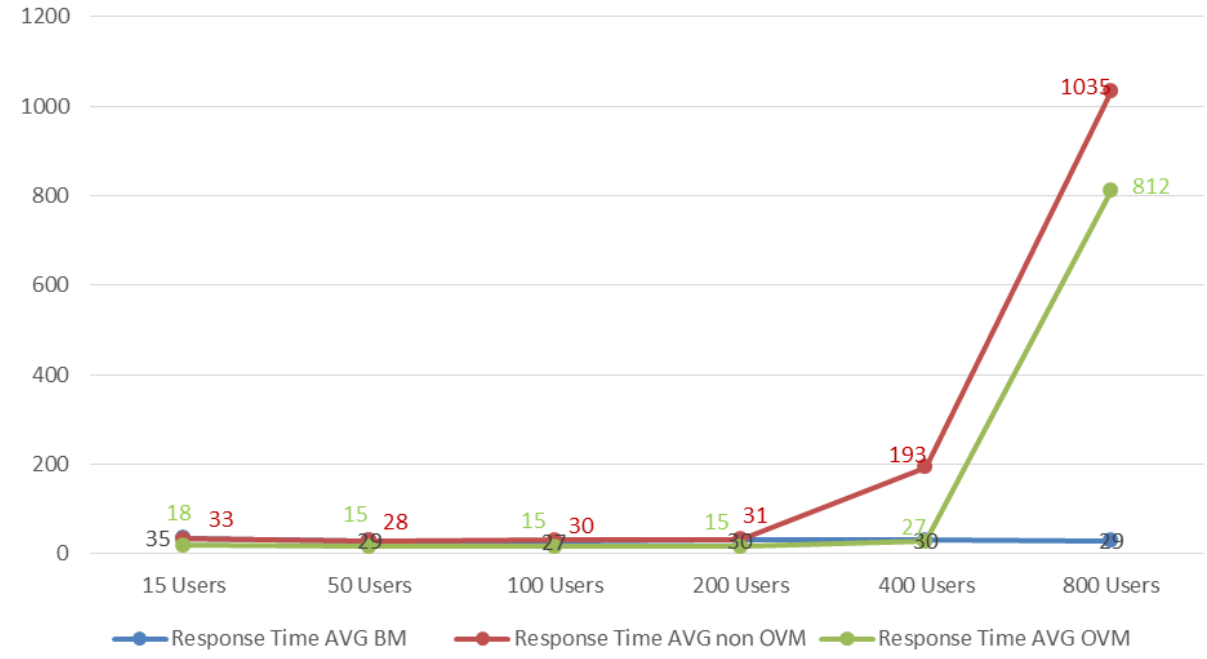


Figure 7 – Response Time AVG up to 800 Users

In figure 7 the bare metal response time had no change and was still stable when the load of 400 and 800 users was executed, this happened due to this environment had more resources available to the load. Although the non-OVM could not cope with the load of 400 users and started to show several decrease in response time when with OVM this only happened when 800 concurrent users load was executed.

Transactions per Minute

In the meantime let's see the results at transaction level. We will test how many transactions per minute can each environment process.

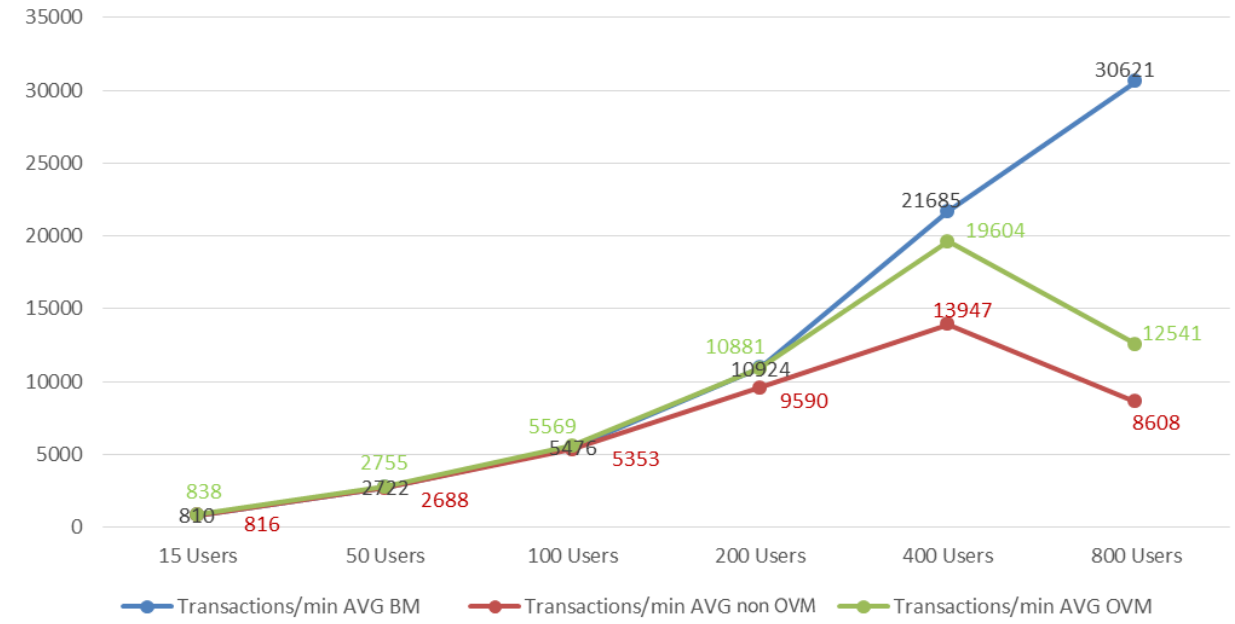
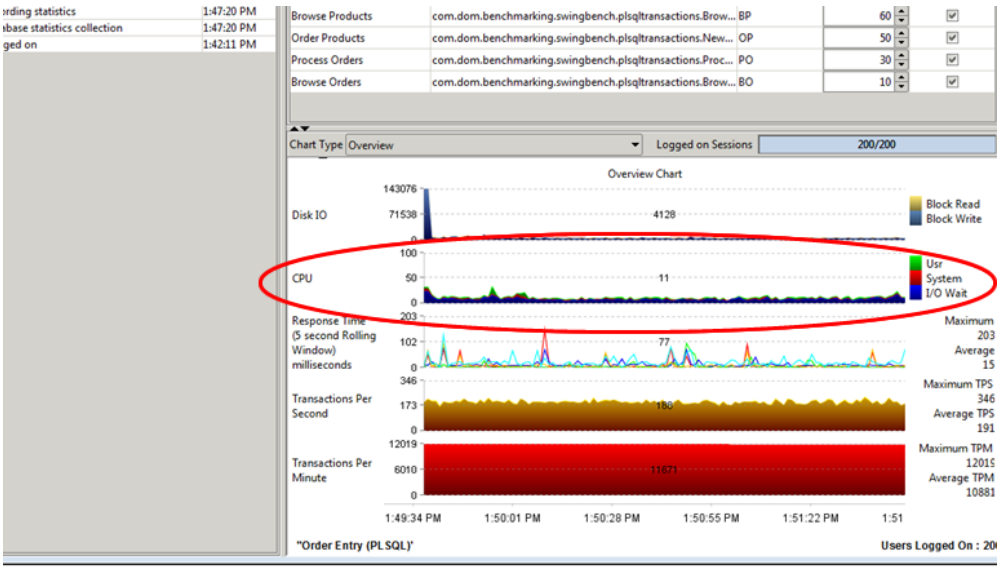


Figure 8 – Transactions per minute

We can easily identify now that at transaction level the behaviour of the environments were very similar at response time level. OVM was able to process more transactions per minute than any other environment up to a load of 200 concurrent users, starting to lose performance as the VM resource becomes depleted.

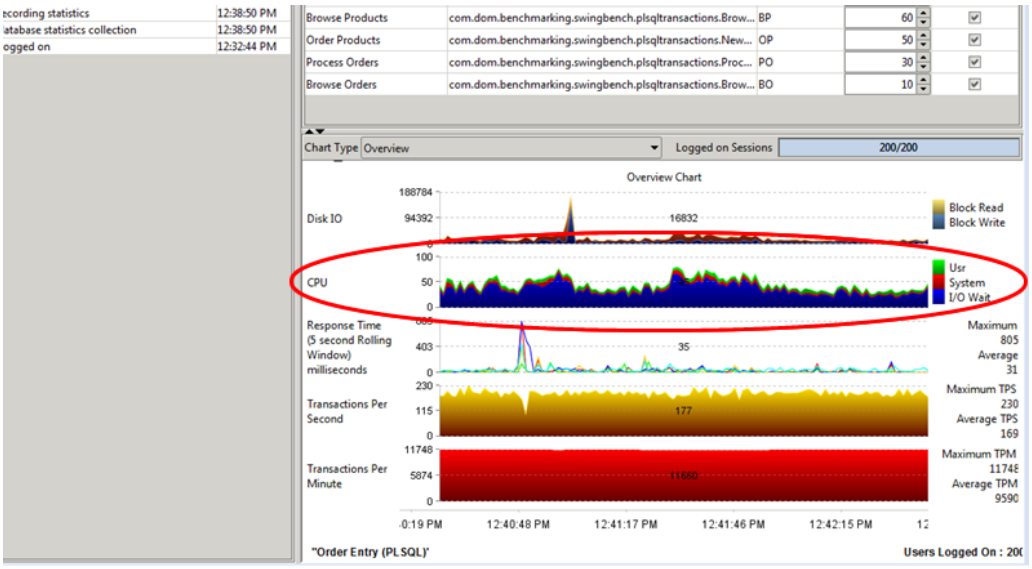
At CPU level

For this reason let's take a closer look on what is happening at CPU level in the VMs with a load of 200, 400 and 800 concurrent users.



Oracle VM

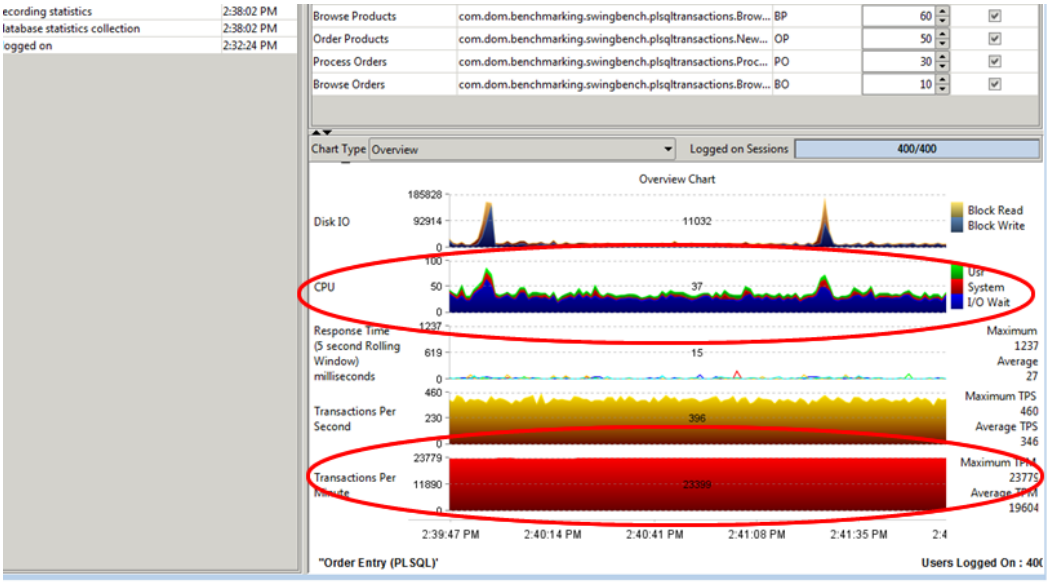
Figure 9 – OVM CPU Usage with 200 concurrent users



Non -Oracle VM

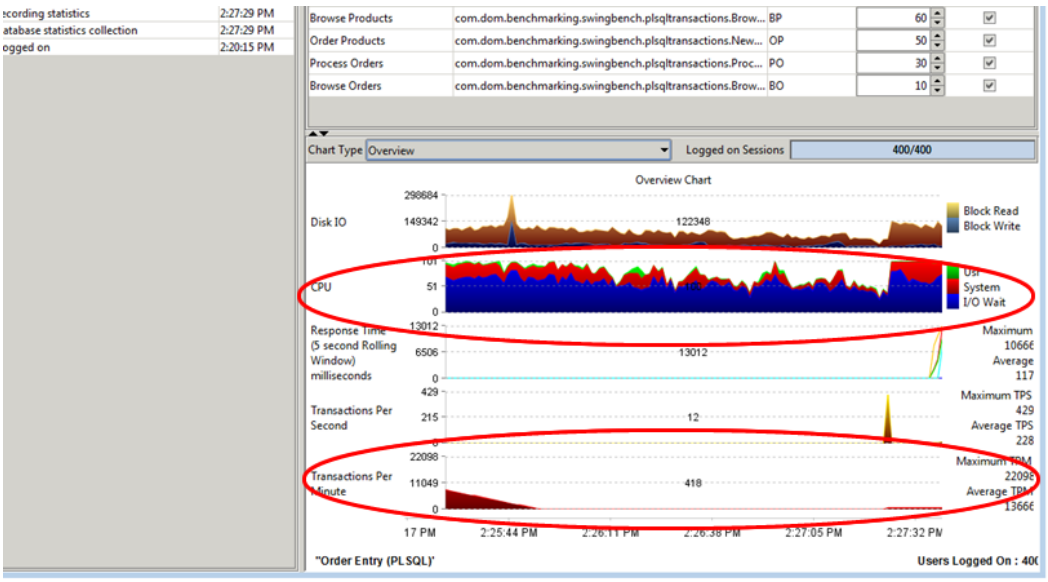
Figure 10 – non-OVM CPU Usage with 200 concurrent users

When comparing how much CPU was used between the OVM machine (figure 9) and the non-OVM machine (figure 10) , it becomes clear that the OVM environment makes a better use of CPU and consequently have better results at response time and transactions per minute level. Now let's see what's happening within 400 concurrent users.



Oracle VM

Figure 11 – OVM CPU Usage with 400 concurrent users

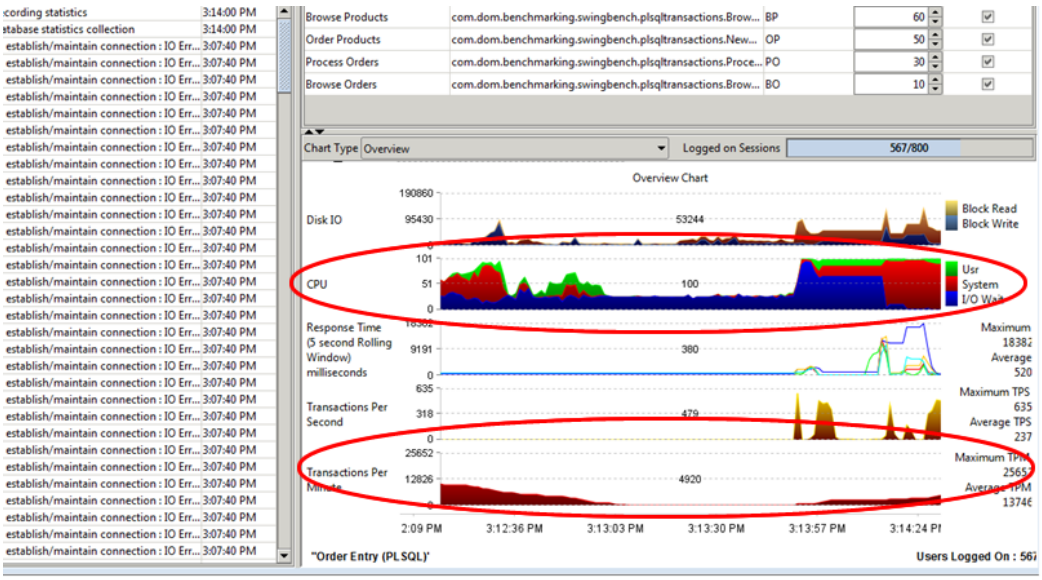


Non -Oracle VM

Figure 12 – non-OVM CPU Usage with 400 concurrent users

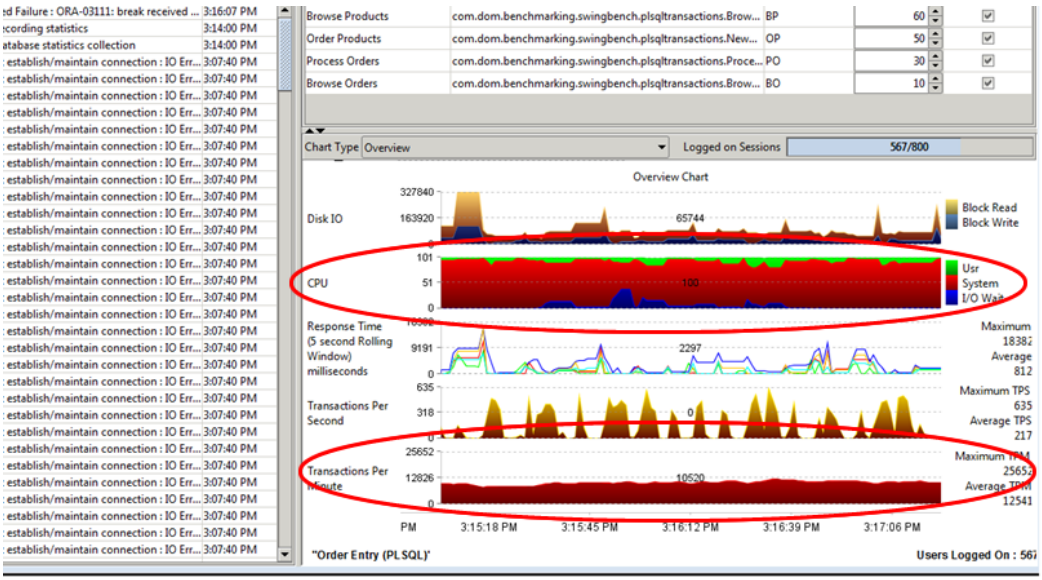
Comparing the behaviour of both virtualization technologies when having a load of 400 concurrent users, clearly it shows that the non-OVM guest machine is once again using more CPU to try to cope with the load, similarly but if you take a closer look on the Figure 12 (non-OVM) in the highlighted oval in the bottom of the figure can be easily seen that the VM could not cope with the load and as a result not being able to process any transaction for the last 2 minutes of the stress test (from 2:25:44 to 2:27:32), it basically gives up.

The figure 13 shows the behaviour of OVM machine at the middle of the load of 800 concurrent users. It denotes that in the middle of the process the VM was not able to process anything else more for a short period of time (from 3:13:03 to 3:13:57) consequently recovering from this situation slowly (figure 14).



Oracle VM

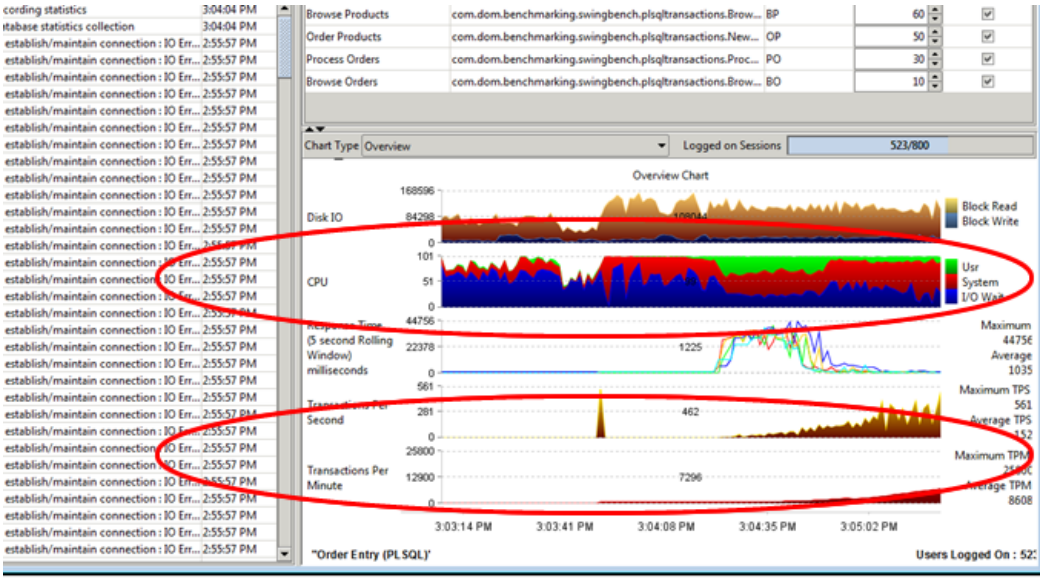
Figure 13 – OVM CPU Usage with 800 concurrent users at the middle of the load



Oracle VM

Figure 14 – OVM CPU Usage with 800 concurrent users at the end of the load

This basically shows that OVM had no more resources available to cope with the load (CPU) and after a short period of time 54 seconds it was able to overcome this issue and start once again to process data. If this happened with OVM, let's see what happened to the non-OVM machine in the same exercise.



Non-Oracle VM

Figure 15 – Non-OVM CPU Usage with 800 concurrent users at the middle of the load

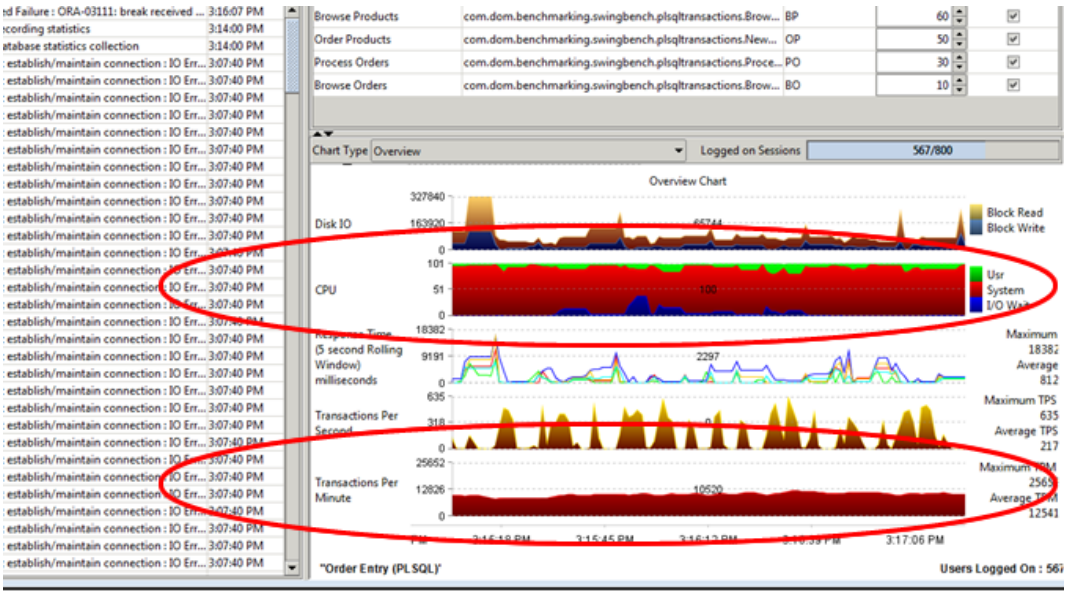


Figure 16 – Non-OVM CPU Usage with 800 concurrent users at the end of the

The non-OVM machine had similar behaviour compared to the OVM machine, but it was unable to process any transaction for a longer period of time, 3 minutes and 17 seconds (from 3:01:45 to 3:05:02) versus 54 seconds with OVM. Even worse, this happened twice during the 15 minutes test.

Equally important to mention that due to the size of memory (4864 MB), assigned to the Oracle databases instance was not enough to allow 800 users to connect simultaneously to the database, each environment only allowed the following maximum number of users to connect:

- **Bare Metal**: Able to open 563 connections
- **Non-OVM**: Able to open 523 connections
- **OVM**: Able to open 567 connections

Scaling

The benchmark up to this point has clearly pointed that OVM is the best virtualization product to run an Oracle database and that a bare metal server is more stable due that it has more resources available for the database. But what happens if we give more resources to our OVM guest? Should it cope with a load of 400 or 800 concurrent users?

To answer these questions we will increase the VM RAM from 6 GB to 12GB and the number of vCPUs from 4 to 8 and execute the benchmark again.

Response Time

After the modifications to the VM were done, we found the following results as per response time.

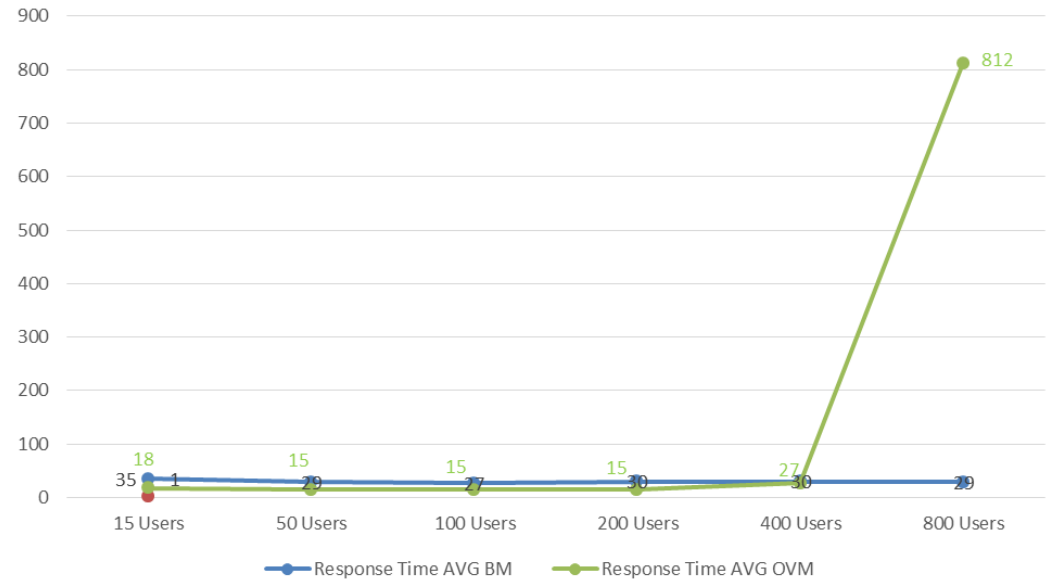


Figure 17 – OVM and Bare Metal AVG Response times before changes

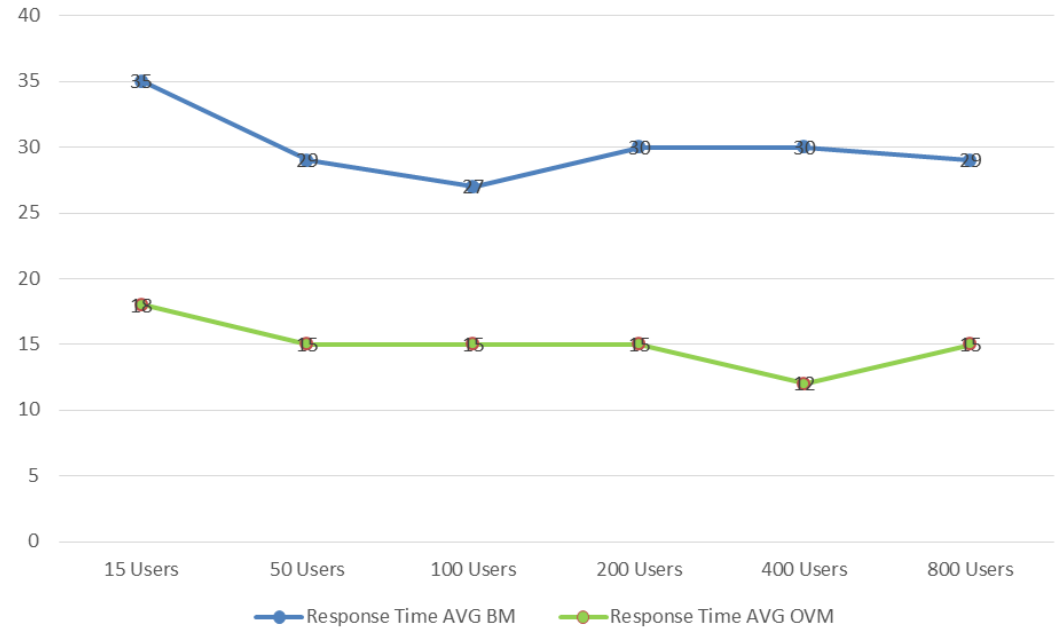


Figure 18 – OVM and Bare Metal AVG Response times after changes

We can easily see when comparing before (figure 17) and after results (figure 18) that when giving more resources to the VM the performance improves and it becomes once again, faster than the bare metal server.

Transactions per Minute

Now let's take a look in what happened regarding transactions per minute.

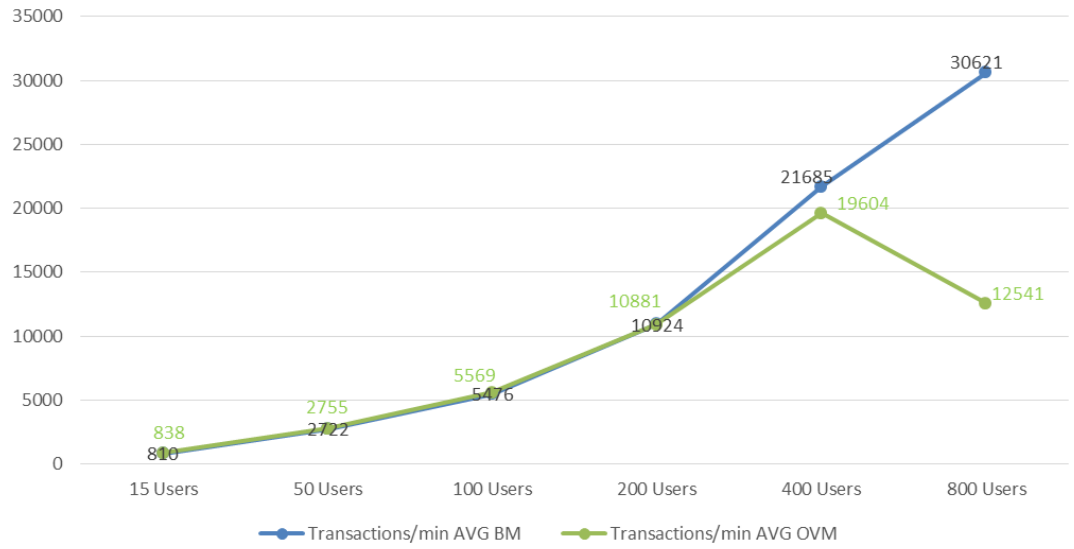


Figure 19 – OVM and Bare Metal AVG Transactions per minute before changes

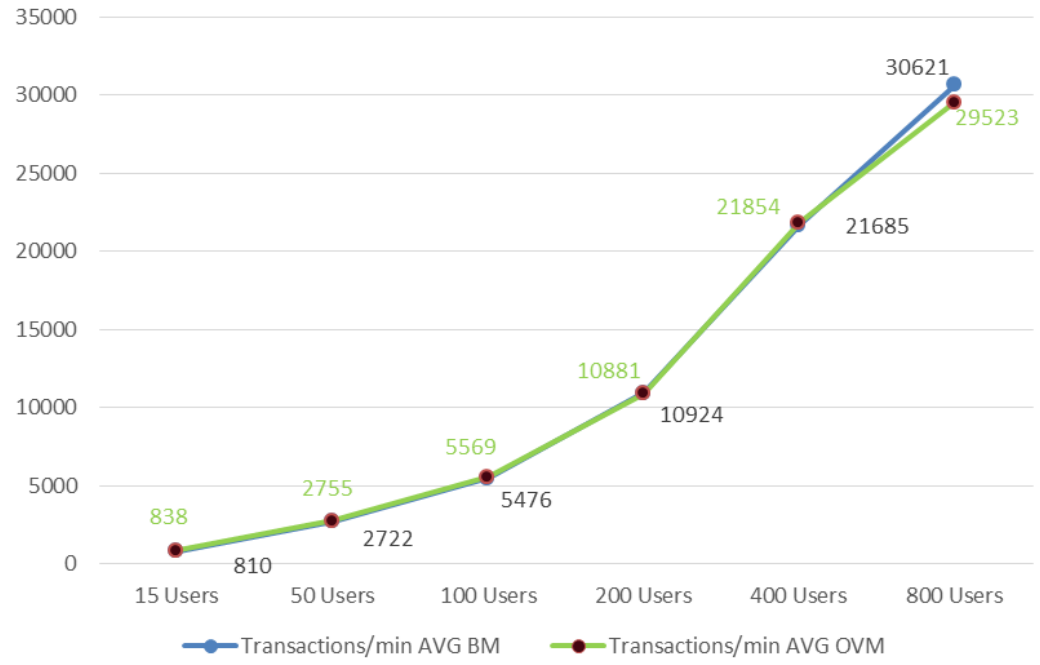


Figure 20 – OVM and Bare Metal AVG Transactions per minute after changes

When comparing before and after the changes, it clearly shows us that the performance improved and the VM becomes more stable for huge loads.

This exercise proved how scalable OVM is, and how easy is to increase resources on-demand when required.

Conclusion

The main conclusions retrieved from this benchmark are:

- OVM is the better virtualization technology to run Oracle Databases
- OVM makes a better use of all available resources
- OVM is more scalable and stable for Oracle Databases
- OVM allows better consolidation of loads in a virtual environment
- OVM uses less CPU than non-Oracle virtualization technologies

Without OVM you will have a full physical server (bare metal) with underutilized resources, but if using OVM you will be able to virtualize it to host many Oracle Databases without loss of performance and make a better use of all available database licenses. Plus as a bonus: Allows extra HA and is fully certified and supported by Oracle.

Many companies around the world are afraid to use virtualization for production databases, as per our experience we can say that it is only a myth. Revera have many production databases running on OVM without any unsatisfied client.