International Journal of Information Processing, 9(4), 1-14, 2015
ISSN : 0973-8215
IK International Publishing House Pvt. Ltd., New Delhi, India

Improving Resource Utilization in Datacenters by Accurately Triggering Live VM Migration

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Dynamic provisioning of physical resources to Virtual Machines (VMs) in virtualized environments can be achieved by (i) vertical scaling- adding/ removing attached resources from existing virtual machine and (ii) horizontal scaling- adding a new virtual machine with additional resources. The live migration of virtual machines across different Physical Machines (PMs) is a vertical scaling technique which facilitates resource hot-spot mitigation, server consolidation, load balancing and system level maintenance. It takes significant amount of resources to iteratively copy memory pages. Hence during the migration there may be too much overload which can affect the performance of applications running on the VMs on the physical server. It is better to predict the future workload of applications running on physical server for early detection of overloads and trigger the migration at an appropriate point where sufficient number of resources are available for all the applications so that there will not be performance degradation. This paper presents an intelligent decision maker to trigger the migration by predicting the future workload and combining it with predicted performance parameters of migration process. Experimental results shows that migration is triggered at an appropriate point such that there are sufficient amount of resources available (15-20 % more resources than high valued threshold method) and no application performance degradation exists as compared to properly chosen threshold method for triggering the migration. Prediction with support vector regression has got decent accuracy with MSE of 0.026. Also this system helps to improve resource utilization as compared to safer threshold value for triggering migration by removing unnecessary migrations.

Keywords : Live Virtual Machine Migration, Resource Provisioning, Support Vector Regression, Workload Prediction.

1. INTRODUCTION

Cloud computing is attracting the organizations to use virtualized resources in the cloud data centers as it enables multiple applications to collocate with total isolation on a single physical machine. It also enables dynamic resource provisioning through virtual machine resizing and live virtual machine migration to eliminate hotspot, consolidating servers on fewer virtual machines and load balancing. These provisioning techniques are of two types *i.e.*, vertical scaling and horizontal scaling [1].

Vertical scaling allocates or de-allocates resources to or from existing virtual machine and horizontal scaling adds or removes virtual machine instance. Virtual machine migration comes under vertical scaling as resources are de-allocated from one and added to the newly created virtual machine at another physical machine. Xen [2] uses pre-copy mechanism as virtual machine migration technique in which memory pages are transferred iteratively due to page dirtying process as shown in Figure 1. Pre-copy combines push and stop-and-copy phases. In push phase the source VM continues running while certain pages are transferred to the destination. To ensure consistency, pages modified during this process are resend. In stop-and-copy phase the source VM is stopped, remaining dirtied pages are copied to the destination VM and then new VM is started at destination.

HotSpot handling and Server Consolidation are the two general scenarios that appears in data

grations due to small spikes of workload is also resolved.

Figure 8 shows that there is an increase in network utilization from time 400 sec when the resource usage is above 50%. Our sytem predict that future usage usage is increasing, hence migration for VM on PM3 is triggered at t= 430 sec.

The overall time required to predict the hotspot and start migration is around 30 sec. In case of memory utilization, if the allocated memory is not sufficient then it is allocated in steps of 32MB as shown in Figure 9. If memory is not enough on that PM then the VM is migrated to other suitable PM. Here the migration is triggered when memory demand reaches to 382 MB.

8. CONCLUSIONS

This paper presented an intelligent system which predicts future workload for early detection of overloads so as to trigger migrations in such a way that possible system performance degradation is resolved. Also we have modeled actual migrating process of live virtual machine migration which determines the total network traffic generated and total time required for migration. The migration is triggered based on these predictions and determined values instead of triggering the migration based on predefined thresholds. This helps in resolving the degradation in the system due to overload on PM during migration and removes unnecessary migrations which exists because of small transient spikes in resource usage.

REFERENCES

1. Christopher Clark, Keir Fraser, Steven Hand, Jacob Gorm Hansen, Eric Jul, Christian Limpach, Ian Pratt, and Andrew Warfield. Live Migration of Virtual Machines, *In Proceedings of the 2Nd Conference on Symposium on Networked Systems Design and Implementation*,pages 273–286, Berkeley, CA, USA, 2005.
2. Paul Barham, Boris Dragovic, Keir Fraser, Steven Hand, Tim Harris, Alex Ho, Rolf Neugebauer, Ian Pratt, and Andrew Warfield. Xen and the Art of Virtualization. *SIGOPS Oper. Syst. Rev.*, 37(5):164–177, October 2003.
3. S. Nathan, P. Kulkarni, U. Bellur. Resource Availability based Performance Benchmarking of Virtual Machine Migration, *ICPE*, 2013.
4. S Akoush, R Sohan, A Rice, A W Moore and A Hopper. Predicting the Performance of Virtual Machine Migration. *In IEEE International Symposium on Modeling, Analysis Simulation of Computer and Telecommunication Systems (MASCOTS),* pages 37–46, Aug 2010.
5. William Voorsluys, James Broberg, Srikumar Venugopal, and Rajkumar Buyya. Cost of Virtual Machine Live Migration in Clouds: A Performance Evaluation. *In Proceedings of the 1st International Conference on Cloud Computing, Springer-Verlag*, pages 254–265, Berlin, Heidelberg, 2009.
6. Haikun Liu, Cheng Zhong Xu, Hai Jin, Jiayu Gong, and Xiaofei Liao. Performance and energy modeling for live migration of virtual machines. *In Proceedings of the 20th International Symposium on High Performance Distributed Computing, ACM.*, pages 171–182, New York, NY, USA, 2011.
7. John J, Prevost, KranthiManoj Nagothu, B Kelley and M Jamshidi. Prediction of Cloud Data Center Networks Loads using Stochastic and Neural Models. *In 6th International Conference on System of Systems Engineering (SoSE)*, pages 276–281, June 2011.
8. Timothy Wood, Prashant Shenoy, Arun Venkataramani, and Mazin Yousif. Sandpiper: Black-Box and Gray-Box Resource Management for Virtual Machines. *Computer Networks*, 53(17):2923 – 2938, 2009.
9. Timothy Wood, Prashant Shenoy, Arun Venkataramani, and Mazin Yousif. Black-Box and Gray-Box Strategies for Virtual Machine Migration. In *Proceedings of the 4th USENIX Conference on Networked Systems Design and Implementation*,pages 17–24, Berkeley, CA, USA, 2007.
10. Archana Ganapathi, Harumi Kuno, Umeshwar Dayal, Janet L, Wiener, Armando Fox, Michael Jordan, and David Patterson. Predicting Multiple Metrics for Queries: Better Decisions Enabled by Machine Learning. *In Proceedings of the IEEE International Conference on Data Engineering*, pages 592–603, Washington, DC, USA, 2009.
11. D Gmach, J Rolia, L Cherkasova and A Kemper. Capacity Management and Demand Pre-

diction for Next Generation Data centers. *In IEEE International Conference on Web Services*, pages 43–50, July 2007.
12. N.I. Sapankevych and Ravi Sankar. Time Series Prediction using Support Vector Machines: A Survey. *Computational Intelligence Magazine, IEEE*, 4(2):24–38, May 2009.
13. Yangyang W. Ming Zaho Performance Modeling of Virtual Machine Live Migration IMCP, 2014.
14. Paola Bermolen and Dario Rossi. Support Vector Regression for Link Load Prediction. *Computer Networks*, 53(2):191 – 201, 2009.
15. Dawei Huang, Deshi Ye, Qinming He, Jianhai Chen, and Kejiang Ye. Virt-lm: A Benchmark for Live Migration of Virtual Machine. *In Proceedings of the 2Nd ACM/SPEC International Conference on Performance Engineering*, pages 307–316, New York, NY, USA, 2011. ACM.
16. RUBiS: Rice University Bidding System. http://rubis.ow2.org.

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