PERFORMANCE COMPARISON BETWEEN CONTAINER-BASED AND VM-BASED SERVICES

CSCI 5410 – Serverless Data Processing
Assignment 1 – Part A

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Performance Comparison between Container-based and VM-based Services [1]

This paper presents a performance comparison of services' deployment using AWS (Amazon Web Services), namely deployment on Amazon ECS (Elastic Container Service) - a container-based service and Amazon EC2 (Elastic Cloud Compute) - a VM-based service, based on metrics like throughput(requests/sec), the response time(millisecond), and CPU utilization(percentage) in various scenarios. The main reason behind this research by authors is the deployment of Docker containers on AWS. The containers are deployed on top of EC2 VMs and not directly on the hardware, which contradicts the common practice of containers deployment. Thus, it introduces overhead because of this setup which further affects the overall performance of the deployed services. The reasons for such an architecture setup by Amazon are threefold. First is the use of existing infrastructure EC2 VMs to reduce the cost. The second is to leverage the capabilities and functionalities of ECS and EC2 VMs. Last is to improve management and increase the deployment speed. To quantify the performance difference, the authors of this paper conducted a practical experiment using ECS and EC2 VMs with three evaluation scenarios. In the first scenario, the authors considered one web service running on one ECS container instance of size t2.small and a similar setup on EC2 with the same instance size. In the second scenario, the authors selected two containers with two web services running on two different ports (i.e., port 80 and 8080) with a similar setup on EC2. In the last scenario, three web services run on three different ports (i.e., port 80, 8080 and 81) but on the same container instance simultaneously. It measured the performance more accurately. To automate the performance measurement, they used JMeter which, simulates multiple users sending requests to the target server with results displayed on a graphical dashboard. The deployment of JMeter was on t2.large EC2 instance. The whole experimental setup was in the Tokyo region and the same availability zones, and to prevent any network fluctuations, the experiment was conducted at midnight Tokyo time.

The findings for each scenario were presented using three graphs (i.e., average throughput, average CPU utilization and, average response time against several threads). Astonishingly, it was observed that VM-based services performed extraordinarily well as compared to container-based services under all the deployment scenarios. For scenario 1, the throughput saturation was at 10000 requests/sec for EC2 while only 8000 requests/sec for ECS and, the response time of EC2 was 26.3% less than ECS. For scenario 2, throughput saturation was reached at 9000 requests/sec and 6000 requests/sec for EC2 and ECS respectively. Further, ECS has a significant overhead of about 125% in response time compared to EC2. Similarly, scenario 3 performed significantly well for EC2 compared to ECS for all three performance metrics. The major cause for the unexpected performance decrease of container-based applications when deployed on the Amazon cloud is that it executes containers on top of EC2 VMs rather than directly on bare-metal physical hosts.

References

[1] T. Salah, M. J. Zemerly, . C. Y. Yeun, M. Al-Qutayri and Y. Al-Hammadi, "Performance Comparison between Container-based," 17 April 2017. [Online]. Available: https://ieeexplore-ieee-org.ezproxy.library.dal.ca/document/7899408. [Accessed 18 September 2021].