VM Selection for Financial Exchanges in the Cloud

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1 Overview

Financial exchanges have shown interest in migrating their current infrastructure to the public cloud. The benefits are agreed upon by both the industry and academia, promising a more scalable, robust, and cost-efficient infrastructure. However, a vital concern is the lack of support for fair and performant multicast in the public cloud. Exchanges need to disseminate market data to market participants (MPs) both fast and fairly. Every MP has to receive market state updates almost simultaneously to not create an unfair advantage among MPs.

Different than the current exchange's on-premise data centers, the cloud does not offer native mechanisms for fair data delivery. Recent work, namely Jasper [1], has addressed this gap, offering a solution that creates an overlay multicast tree, leveraging up-to-date advancements in clock synchronization, kernel by-passing, and hedging, to present a scalable and fair multicast on the cloud. Jasper offers a commendable alternative, outperforming contemporary efforts, and Amazon's in-house multicast solution, as well as addressing known irregularities regarding network latency in the cloud.

However, there are possible avenues for improvement. LemonDrop [2], a component of a larger body of work, tackles the real issue of inconsistent VM performance within identical instance configurations in the cloud. Under-performing VMs within a given instance class are called *Lemons*. LemonDrop was developed to select and schedule a subset of VMs optimized for a given application's latency needs, by quickly detecting lemon VMs, repositioning them across the system, or dropping them completely. It does so by framing the selection and scheduling of VMs as a Quadratic Assignment Problem, where traffic flow between facilities, each assigned to a location, is to be minimized. LemonDrop treats services within an application as facilities and the VMs themselves as the locations.

Within the context of Jasper, lemons have the potential to drastically affect the overall system's performance. Inspired by LemonDrop's VM selection method, the proposed work here aims to develop a simpler heuristic that can achieve reasonably good results adapted to the smaller problem set of a multicast tree. Therefore, significant improvements could be brought to Jasper's deployment and performance as a cloud tenant solution for financial exchanges in the cloud.

2 Objectives

1. Develop a VM selection heuristic for the Cloud.
2. Adapt heuristic to Jasper's tree-like network structure.

3 Experimental Setup

Creation of a cloud stack and data analysis are be done locally. The cloud stack deployment, node benchmarking and heuristic development would be done via Google Cloud credits provided by Dr.Sivaraman's and his team at Systems@NYU.

References

[1] M. Haseeb, J. Geng, U. Butler, X. Hao, D. Duclos-Cavalcanti, and A. Sivaraman, "Jasper: Scalable and fair multicast for financial exchanges in the cloud," 2024.

[2] V. Sachidananda, *Scheduling and Autoscaling Methods for Low Latency Applications*. Stanford University, 2022.