The Cost of Cloud Computing to Small Businesses
(STS Topic)

Survey of Game-Theoretic Approaches to Cloud Computing
(Technical Topic)

A Thesis Prospectus In STS 4500

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By
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On my honor as a University student, I have neither given nor received unauthorized aid on this
assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Overall Introduction:

Cloud Computing has brought on demand computing resources to the masses bringing a a fundamental change to the daily lives of billions of people. As such, businesses have taken full advantage, bringing the connection between customer and shop ever so close. Cloud providers have tried for many years to create a steady state relationship between provider and the businesses, balancing the price and benefit ratio of the new market. However, larger businesses with a vast amount of financial resources have been able to take even more advantage of the market. This situation has brought upon much academic research looking at the best way to fairly incentivize both the largest corporations in the world along with local businesses wanting to make a bigger name for themselves. One clever way researchers have thought about this problem is with game theory. Game theory is the study of mathematical models of strategic interaction among rational decision-makers (Ross, 2019). Essentially, game theory allows for predictions on what could happen to existing systems if change is introduced. Therefore, this has been a solid way to experiment how possible changes to cloud computing impact the existing market. The technical topic of this paper is surveying different game theoretic approaches to cloud computing. This includes approaches such as changing traffic congestion control and resource efficiency improvement to best understand how to minimize the negative impacts of smaller tenants for being small. This leads into the question from the STS viewpoint: Has Cloud Computing brought upon more harm than benefits since its inception, and was this intended? Cloud Computing has had an obvious benefit to many customers, but it hasn't necessarily been good for all societal factors.

Technical Topic:

Since the formation of Amazon Web Services in 2006, cloud computing has greatly expanded the access to a vast amount of resources to both companies and individuals. (Shulak, 2020). As it has grown, so has the demand for resources and reliability of said resources. For example, a tenant may "purposely change its actual bandwidth demand to receive more bandwidth allocation, which reduces network utilization" (Shen, 2014). As such, cloud providers have had to optimize their allocation of their resources in many different ways to prevent tenants taking advantage of the current system. These "strategies" have been utilized in order to offer as many resources as needed while keeping the reliability of the service intact for other users. For example, a possible problem may be handling a sudden surge of requests. While a cloud provider can dynamically allocate more resources to alleviate the surge, this may come at a cost to other resources. Therefore, many studies have been done to model possible improvements to current systems. The technical project for this prospectus is surveying game theoretic approaches to Cloud Computing. Game Theory has been used to model how different "tenants" react to specific changes in policy. Formerly, integer programming for solving the payoff matrix for optimization was used as a way to help find the "win-win" for both tenants and provider, but it was very complex and did not react well to decision making (Pillai, 2014).This project will look at different changes, such as pricing, affects cloud computing performance. Different metrics include traffic congestion control, resource efficiency improvement, and resource competition avoidance(Mitchell, 2010). For example, in a linear based pricing model, larger tenants may purchase more bandwidth than needed, which can put an unnecessary strain on smaller tenants fighting for a smaller amount of bandwidth (Kash, 2015). This technical project will survey the

most recent and relevant peer reviewed articles to see the current state of different strategies and give suggestions on future improvements and studies.

STS Topic:

As seen in the technical topic, Cloud Computing has had a major change in many people's lives. Companies, such as Capital One, have abandoned their data centers, opting for a complete cloud presence (Sverdlik, 2019). This can often mean lower costs than a traditional data center since maintenance and upgrades can be very costly. However, the playing field is not entirely equal. Large companies may have a large advantage over small businesses when it comes to accessing these cloud networks. While accessing the cloud can actually lower costs for large corporations, small businesses may not be able to invest as much. Having a cloud network can be very costly for a small business, so it is not always practical for up and coming businesses Ward, 2020). This means that small businesses will miss out on some of the most coveted features that customers have come to expect such as dynamic load management (Boston, 2020). This is a major disadvantage that small businesses face because this can hinder growth. This paper will explore the benefits and consequences that cloud computing has had on small businesses. As Cloud Computing technology has progressed, have the advantages that Small Businesses could have dwindled? Since there are only three major Cloud providers who can be considered "leaders", many small businesses are at their mercy in terms of pricing and availability (Dignan, 2020). Therefore, flexibility is very small and may let providers charge more than usual. This is undesirable because the gap may continue to grow between large and small businesses as the technology continues to advance. While the technical project looks at technical solutions for these issues; it does not mean companies are actually changing their

policies to help their tenants. This paper will look at possible regulatory changes that may be needed to drive the change in the economy, if needed.

Conclusion:

This technical work will bring a fresh perspective to the work currently being done on game-theoretic approaches to cloud computing. Furthermore, this STS work will analyze the impacts that the current schemes that cloud computing have brought upon small business while looking how the improvements found in the technical work can be used to minimize these impacts. With the technical work, I will experience how to perform a detailed analysis of peer-reviewed articles and to categorize large amounts of articles. With the STS work, I will connect the technical work with the real-world impacts of the technology on people and businesses. Overall, this work is significant as it helps understand a major problem and the vast amount of solutions that tackles said problem.

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