Thesis title: Title: Provider-centric data replication in cloud systems

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Absract:

Advances in cloud computing enabled hosting a wide range of tenants' applications. Running these applications on geographically distributed provider's resources faces a massive amount of data transfer, which affects the Quality of Service (QoS) delivery. A key challenge faced by cloud providers is to efficiently manage their resources in order to satisfy a set of Service Level Objectives (SLOs), specified in the Service Level Agreement (SLA) for their tenants while minimizing their management costs.

In this context, data replication is a well-known technique to cope with these issues. It aims to increase data availability, reduce bandwidth consumption, and achieve fault-tolerance. A data replication strategy notably addresses replica identification, replica placement, and replica number adjustment. Dealing with these issues is challenging due to the dynamic nature of cloud environment, the fluctuations in network and resources' load and the increased amount of data and tenants' tasks to manage. Most of the existing strategies in the literature focus on improving availability and performance when only some of them also aim to reduce the operational cost of replication. The economic profit of the provider is almost neglected. Moreover, only some strategies rely on extracting and exploiting correlations that exist between data during the replication process. Taking advantage of those correlations enables improved system performance and cost savings.

In this thesis, we address data replication issues in cloud systems, including single cloud and interconnected cloud environments. Our objective is to maintain the economic profit of the cloud provider while minimizing SLA violations in terms of response time and minimum data availability. In this context, we propose provider-centric and dynamic data replication strategies for On-line Analytical Processing (OLAP) applications, i.e., read-only data, which take advantage of data correlations. These correlations are extracted using Triadic Concept Analysis (TCA) and clustering techniques. Furthermore, economic models are presented to assess the profit of the cloud provider. First, we propose CEMR (Correlation and Economic Model-based Replication) strategy for single cloud systems. This strategy is combined with a new task scheduling algorithm called BCVS (Bottleneck and Cost Value Scheduling) to avoid future SLA violations. Second, for federated cloud systems, we propose DCRF (Data Correlation and

fuzzy inference system-based data Replication in Federated cloud systems) strategy. DCRF relies on a Fuzzy Inference System (FIS) that enables the aggregation of four important parameters to decide the placement of replica groups.

In order to evaluate and validate the proposed strategies, we conducted extensive simulations, through the CloudSim simulator, while using real-world cloud parameters. The experimental results show the effectiveness of our proposals.

Keywords: Cloud systems; Data replication; Data correlation; Economic model; Service Level Agreement; Performance; Profit.