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Data transmission strategies for resource monitoring in cloud computing platforms

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ABSTRACT

This paper proposes three data transmission strategies for resource monitoring in cloud computing platforms, which are dynamic periodic push strategy, window-based event-driven push strategy, and window-based hybrid push strategy, respectively. The dynamic periodic push strategy periodically pushes resource status information at a dynamic time interval that is dynamically updated by considering the change degree of resource status information. The window-based event-driven push strategy pushes resource status information if the change degree of resource status information is larger than a threshold that is dynamically updated by using the exponentially weighted moving average. The window-based hybrid push strategy combines the dynamic periodic push strategy and the window-based event-driven push strategy and then further reduces the communication overhead and improves the data coherence. Experimental results show that the window-based hybrid push strategy performs better than previous data transmission strategies in terms of the number of data transmissions and the data coherence.

1. Introduction

Cloud computing is a new computing model that is based on the Internet network [1]. Compared with traditional IT infrastructure, cloud computing platforms introduce the virtualization technology to build resource pools and can deal with the problem that the traditional IT infrastructure shows low hardware resource utilization and long application deployment time [2]. Therefore, more and more enterprises choose to move their applications to cloud computing platforms [3]. As applications deployed in cloud computing platforms increase in type and number, scales of cloud computing platforms are increasingly expanding and cloud computing platforms become more and more complex [4], [5], [6]. Moreover, virtual machines in cloud computing platforms share hardware resources [7]. These make cloud computing platforms be prone to error [8]. Resource monitoring can help system administrators understand running status of cloud computing platforms and system administrators can take precautions before cloud computing platforms fail to run [9,10].

The data transmission strategy is an important part of resource monitoring and has a significant influence on the performance of resource monitoring in terms of the communication overhead and the data coherence [11]. Existing data transmission strategies cannot achieve a better trade-off between the low communication overhead and high data coherence. In this case, three mechanisms were proposed, which are the offset-sensitive mechanism (OSM), the time-sensitive

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mechanism (TSM), and the announcing with change and time consideration (ACTC), respectively [12]. In these three mechanisms, the time interval is dynamically updated as the average of time intervals between resource status information changes and the threshold is dynamically updated as the average amount of changes for resource status information. However, the time interval does not consider the change degree of resource status information and the threshold does not consider the change trend of resource status information. Therefore, the time interval and the threshold in these three mechanisms may be too small or too large and then performances of these three mechanisms will be affected.

In this paper, three data transmission strategies are proposed, which are the dynamic periodic push strategy, window-based event-driven push strategy, window-based hybrid push strategy, respectively. The dynamic periodic push strategy periodically pushes resource status information at a time interval that is dynamically updated by considering the change degree of resource status information. The window-based event-driven push strategy pushes resource status information if the change degree of resource status information is larger than a threshold that is dynamically updated by using the exponentially weighted moving average. The window-based hybrid push strategy combines the advantages of the dynamic periodic push strategy and the window-based event-driven push strategy and then further reduces the communication overhead and improves the data coherence. Experimental results show that the window-based hybrid push strategy performs better than previous data transmission strategies in terms of the number of data transmissions and the data coherence.

The remainder of this paper is organized as follows. Section 2 briefly reviews existing works on data transmission strategy. Section 3 shows our proposed data transmission strategies. Section 4 presents experimental results. Finally, conclusions are drawn in Section 5.

2. Existing works on data transmission strategy

In large-scale distributed networks, there are two basic data transmission strategies, which are the push strategy and the pull strategy [13] [14]. According to different trigger conditions, the push strategy can be divided into the periodic push strategy and the event-driven push strategy, respectively. For the periodic push strategy, monitored nodes periodically send their resource status information to the monitoring node at a time interval. For the event-driven push strategy, monitored nodes send their resource status information to the monitoring node if the change degree of resource status information is larger than a threshold. The pull strategy can also be divided into the periodic pull strategy and the event-driven pull strategy, respectively. For the periodic pull strategy, the monitoring node periodically sends requests for obtaining resource status information to monitored nodes at a time interval and monitored nodes send their resource status information to the monitoring node after receiving requests. For the event-driven pull strategy, the monitoring node sends requests for obtaining resource status information to monitored nodes if the change degree of the resource status information is larger than a threshold and then monitored nodes send their resource status information to the monitoring node after receiving requests. The time interval and the threshold have a significant influence on performances of the push strategy and the pull strategy. If the time interval or the threshold is too small, useless resource status information will be collected and then the communication overhead will be increased. If the time interval or the threshold is too large, important resource status information will be lost and then the data coherence will be lowered. In order to reduce the communication overhead and improve the data coherence, a number of data transmission strategies have been proposed.

R. Sundaresan et al. proposed three modified pull strategies, which are the regular polling strategy, the adaptive polling strategy, and the slacker polling strategy [15,16]. In the regular polling strategy, the time interval is a constant and cannot change with the change of resource status information. In the adaptive polling strategy, the time interval can be dynamically adjusted by using a damping factor. However, the damping factor is a constant and then the time interval cannot change with the change degree of resource status information. In the slacker polling strategy, the moving average estimator is introduced to estimate the next time interval. All these three data transmission strategies cannot pull resource status information during the time interval.

F. F. Han et al. proposed a periodically and event-driven push (PEP) algorithm, which is based on the push strategy [17]. In the PEP algorithm, monitored nodes periodically send their resource status information to the monitoring node at a time interval of 1 s. If the change degree of resource status information is larger than a predefined threshold, monitored nodes also send their resource status information to the monitoring node. The PEP algorithm could reduce the communication overhead and improve the data coherence. However, the time interval and the threshold in the PEP algorithm are constants and cannot change with the change degree resource status information. Therefore, the time interval and the threshold in the PEP algorithm may be too small or too large.

W. C. Chung and R. S. Chang proposed three data transmission mechanisms for grid computing, which are the offset-sensitive mechanism (OSM), the time-sensitive mechanism (TSM), and the announcing with change and time consideration mechanism (ACTC) [12]. All these three mechanisms are based on the push strategy. The OSM is an event-driven push strategy. In the OSM, monitored nodes send their resource status information to the monitoring when the change degree of resource status information is larger than a threshold. The threshold is initialized to 0 and then the threshold is dynamically updated as the average amount of changes for resource status information. In the TSM, monitored nodes periodically send their resource status information to the monitoring node at a time interval. The time interval is calculated as the average of time intervals between resource status information changes. The ACTC combines the advantages of the OSM and TSM strategies and effectively improves the performance of data transmission. However, the time interval does not consider