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Modelling Industry 4.0 based Fog Computing environments for Application analysis and deployment

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Abstract

The extension of the Cloud to the Edge of the network through Fog Computing can have a significant impact on the reliability and latencies of deployed applications. Recent papers have suggested a shift from VM and Container based deployments to a shared environment among applications to better utilize resources. Unfortunately, the existing deployment and optimization methods pay little attention to developing and identifying complete models to such systems which may cause large inaccuracies between simulated and physical runtime parameters. Existing models do not account for application interdependence or the locality of application resources which causes extra communication and processing delays. This paper addresses these issues by carrying out experiments in both cloud and edge systems with various scales and applications. It analyses the outcomes to derive a new reference model with data driven parameter formulations and representations to help understand the effect of migration on these systems. As a result, we can have a more complete characterization of the fog environment. This, together with optimization methods can instruct application deployment and migration and improve the overall system reliability, delay and constraint violations. An Industry 4.0 based case study with different scenarios was used to analyze and validate the effectiveness of the proposed model. Tests were deployed on physical and virtual environments with different scales. The advantages of the model based optimization methods were validated in real physical environments. Based on these tests, we have found that our model is 90% accurate on load and delay predictions for application deployments in both cloud and edge.

Keywords: Cloud Computing, Fog Computing, Application Model, Migration

1. Introduction

The concept of Industry 4.0 provides new means of state of the art IT and manufacturing technologies integration through cybernetics, in order to advance automation of the

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