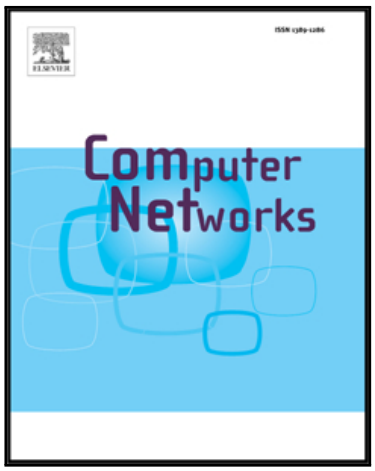

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Load-Balancing Routing in Software Defined Networks with Multiple Controllers

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Abstract

Software defined networking is a new paradigm that separates the control plane from the data plane. To provide high scalability and reduce the controller load in a large-scale software defined network (SDN), a natural way is to deploy a cluster of distributed controllers so as to cooperatively manage the network. However, since each controller just manages a set of the connected (or associated) switches and usually holds the information of these switches (and connected links), it may result in controller load imbalance and link load imbalance. Thus, both controller load and link load should be optimized to achieve better QoS in SDNs. To this end, this paper tries to answer the following question: *how to perform both controller load balancing and link load balancing in an SDN?* We formulate the load-balancing routing for both links and controllers (LBR-LC) problem in an SDN, and prove its NP-hardness. A rounding-based algorithm is proposed to solve this problem, and the approximation performance is also analyzed. Moreover, we discuss the efficient mechanism for network status maintenance among distributed controllers. The extensive simulation results show that our proposed algorithm can reduce the maximum controller response time by 70% compared with the previous solution, while only increasing the maximum link load by 3%.

Keywords: *Software Defined Networks, Controller Load, Link Load, Rounding.*

1. Introduction

Software defined networking (SDN) separates the control plane and data plane on independent devices [1]. The controllers can provide centralized and flexible control by installing forwarding rules in the data plane, and the switches perform different operations on packets according to these

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