A Price-Aware Congestion Control Protocol for Cloud Services

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Abstract

In current infrastructure-as-a service (IaaS) cloud services, customers are charged for the usage of computing/storage resources only, but not the network resource. The difficulty lies in the fact that it is nontrivial to allocate network resource to individual customers effectively, especially for short-lived flows, in terms of both performance and cost, due to highly dynamic environments by flows generated by all customers. To tackle this challenge, in this paper, we propose an end-to-end Price-Aware Congestion Control Protocol (PACCP) for cloud services. PACCP is a network utility maximization (NUM) based optimal congestion control protocol. It supports three different classes of services (CoSes), i.e., best effort service (BE), differentiated service (DS), and minimum rate guaranteed (MRG) service. In PACCP, the desired CoS or rate allocation for a given flow is enabled by properly setting a pair of control parameters, i.e., a minimum guaranteed rate and a utility weight, which in turn, determines the price paid by the user of the flow. Two pricing models, i.e., a coarse-grained VM-Based Pricing model (VBP) and a fine-grained Flow-Based Pricing model (FBP), are proposed. The optimality of PACCP is verified by both large scale simulation and small testbed implementation. The price-performance consistency of PACCP are evaluated using real datacenter workloads. The results demonstrate that PACCP provides minimum rate guarantee, high bandwidth utilization and fair rate allocation, commensurate with the pricing models.

Full-text

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Figures

Figure 1

An example network.

Figure 2

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Figure 3

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Figure 4

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Figure 5

A 3x1 spine-leaf testbed.

Figure 6

Rate allocation in the testbed.

Figure 7

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Figure 8

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Figure 9

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Figure 10

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