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Performance Analysis of BetaRED-AQM algorithms with multiple TCP and UDP flows

Ángel Giménez, José M. Amigó, Óscar Martínez-Bonastre, José Valero
Centro de Investigación Operativa, Universidad Miguel Hernández de Elche
Avda. de la Universidad s/n, 03202 Elche, Spain
a.gimenez@umh.es; jm.amigo@umh.es; oscar.martinez@umh.es; jvalero@umh.es;

Extended Abstract

Internet congestion control is achieved through two mechanisms. The first, called Active Queue Management (AQM), tries to manage impending congestion by acting on router queues before they overflow. The second, located in the TCP end-to-end transport layer, has the task of regulating the sending rate of the sources based on the congestion signals it receives from the AQM.

Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) are two data transmission protocols at the transport layer that are essential for communications over the Internet. The TCP protocol is characterized by reliable transmission and a congestion control mechanism. However, today there is a proliferation of streaming applications (multimedia applications, interactive applications, etc.) where speed is more important than reliability. For such time-sensitive applications, the use of the UDP protocol is much more appropriate, but this protocol does not provide any congestion control. When there is congestion on the network, packets may be lost, but the UDP protocol does not take care of forwarding them as TCP does. On the other hand, when the two types of TCP and UDP flows meet at a bottleneck, the TCP-AQM congestion control mechanism usually favors UDP flows. This is because TCP flows respond to congestion by decreasing the sending rate, but UDP flows are unresponsive, i.e., they do not retreat in response to congestion, on the contrary they tend to capture the available bandwidth.

The Random Early Detection (RED) algorithm [1] is considered the pioneer in queue-based AQM and is one of the most widely investigated congestion avoidance algorithms. Based on [2] the authors designed in [3] a new set of AQM algorithms based on packet dropping beta functions. In the basic version, the BetaRED algorithm was introduced, where there is more freedom to adjust the tunable parameters according to the network traffic characteristics. BetaRED was used as a framework to design two dynamic algorithms, Adaptive Beta RED (ABetaRED) and Dynamic Beta RED (DBetaRED). In these new algorithms, some of the BetaRED parameters are automatically adjusted so that the queue length remains stable around a predetermined reference value.

In this work we analyze the performance of dynamic variants of BetaRED algorithm acting on the router when multiple TCP and UDP data streams meet at the bottleneck link of a dumbbell network topology. Through simulations in ns-3 software [4], we compare the performance of ABetaRED and DBetaRED with other representative algorithms that pursue a similar objective. The performance metrics used are fairness, goodput, delay and queue length. The obtained results show performance improvements of the BetaRED algorithm variants over the others in some simulation scenarios.

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