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Zero-queue Ethernet Congestion Control Protocol based on available bandwidth estimation

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Abstract

Router's switch fabric has strict characteristics in terms of packet loss, latency, fairness and head-of-line (HOL) blocking. Network manufacturers address these requirements using specialized, proprietary and highly expensive switches. Simultaneously, IEEE introduces Data Center Bridging (DCB) as an enhancement to existing Ethernet bridge specifications which include technological enhancements addressing packet loss, HOL blocking and latency issues. Motivated by DCB enhancements, we investigate the possibility of using Ethernet commodity switches as a switch fabric for routers. Thereby, we present Ethernet Congestion Control Protocol (ECCP) that uses Ethernet commodity switches to achieves flexible and cost-efficient switch fabric, and fulfills the strict router characteristics. Furthermore, we present a mathematical model of ECCP using Delay Differential Equations (DDEs), and analyze its stability using the phase plane method. We deduced the sufficient conditions of the stability of ECCP that could be used for parameter setting properly. We also discovered that the stability of ECCP is mainly ensured by the sliding mode motion, causing ECCP to keep cross traffic close to the maximum link capacity and queue length close to zero. Extensive simulation scenarios are driven to validate the analytical results of ECCP behavior. Our analysis shows that ECCP is practical in avoiding

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