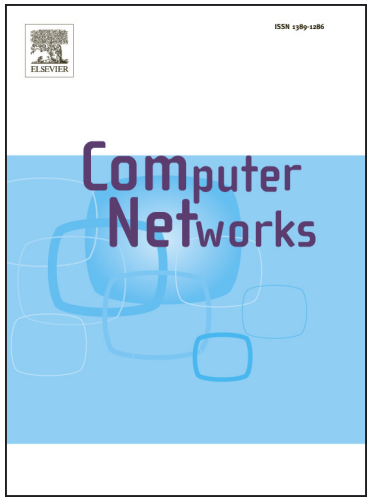

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The Effect of ISP Traffic Shaping on User-Perceived Performance in Broadband Shared Access Networks

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Abstract

Recent studies on the practice of shaping subscribers' traffic by Internet service providers (ISPs) give a new insight into the actual performance of broadband access networks at a packet level. Unlike metro and backbone networks, however, access networks directly interface with end-users, so it is important to base the study and design of access networks on the behaviors of and the actual performance perceived by end-users. In this paper we study the effect of ISP traffic shaping using traffic models based on user behaviors and application/session-layer metrics providing quantifiable measures of user-perceived performance for HTTP, FTP, and streaming video traffic. To compare the user-perceived performance of shaped traffic flows with those of unshaped ones in an integrated way, we use a multivariate non-inferiority testing procedure. We first investigate the effect of the token generation rate and the token bucket size of a token bucket filter (TBF) on user-perceived performance at a subscriber level with a single subscriber. Then we investigate their effect at an access level where shaped traffic flows from multiple subscribers interact with one another in a common shared access network. The simulation results show that for a given token generation rate, a larger token bucket — i.e., up to 100 MB and 1 GB for access line rates of 100 Mbit/s and 1 Gbit/s, respectively — provides better user-perceived performance at both subscriber and access levels. It is also shown that the loose burst control resulting from the large token bucket — again up to 100 MB for access line rate of 100 Mbit/s — does not negatively affect user-perceived performance with multiple subscribers even in the presence of non-conformant subscribers; with a much larger token bucket (e.g., size of 10 GB), however, the negative

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