FAIRNESS PROVISIONING IN OPTICAL BURST SWITCHING NETWORKS

Tananun Orawiwattanakul

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Department of Informatics,

School of Multidisciplinary Sciences,

The Graduate University for Advanced Studies

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Abstract

Optical burst switching (OBS) is a promising switching technology for next-generation Internet backbone networks. The main objectives of the dissertation was to provide fairness from various aspects, including rate and distance fairness, to OBS networks without degrading the loss probability or throughput.

This dissertation proposes a rate fairness preemption (RFP) scheme to achieve max-min fair bandwidth allocation (FBA) or rate fairness in OBS networks. Core switches in RFP do not need to have a function for monitoring both the arrival and loss rates of flows. Methods of adaptive and fixed max-min rate allocation are introduced. RFP based on fixed max-min rate allocation is the simplest way of achieving max-min FBA in OBS networks because it does not require any additional control message to update the arrival or fairly allocated rates as required by existing FBA schemes. A discrete-time Markov chain-based model for analysis of the burst loss probability for flows in RFP-based OBS networks is proposed. The performance of RFP was demonstrated through both analyses and simulations.

In addition, this dissertation proposes a technique of deflection routing (DR), called max-min DR (MMDR), to reduce losses when max-min FBA is achieved in OBS networks. The proposed DR strategy can be adapted to preemption-based and rate-control-based FBA schemes. In this research, we integrated MMDR with RFP and derived a new scheme called rate fairness preemption with deflection routing (RFP-DR). The simulation results indicate that RFP-DR can isolate and protect services as RFP does, but RFP-DR yields the lower total burst loss probability.

Although FBA can be achieved in OBS networks, the actual transmission rate of flows not only depends on the fairly allocated rate but also its burst loss probability due to the high-loss characteristic of OBS. The burst loss probability of flows in OBS networks tends to increase with larger hop counts. Therefore, rate fairness or FBA should be provided with distance fairness (fairness among flows with different hop

counts) so that we can achieve real fairness in the sense of fair transmission rates. Consequently, this dissertation introduces a rate and distance fairness preemption (RDFP) scheme to achieve max-min FBA while ensuring distance fairness for traffic transmitted under the max-min rate.

The analytical and simulation results indicate that the proposed schemes effectively solve fairness problems in OBS networks without degrading the total burst loss probability. In addition, the proposed schemes are simple enough to implement in practical networks because of their low computational complexity.