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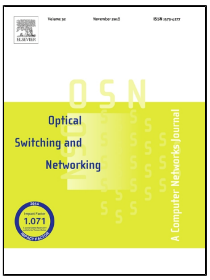

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A New DBA Algorithm for Reducing Delay and Solving the Over-Granting Problem of Long Reach PON

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Abstract: The main problem of the deployment of long reach passive optical network (LR-PON) is that it suffers from larger propagation delay. Multi-thread polling (MTP) based dynamic bandwidth allocation (DBA) algorithm is one of the solutions to mitigate the larger propagation delay in the LR-PON system. However, in the conventional online MTP based DBA scheme, over-granting problem is severe. In this paper, we propose a new online MTP based DBA algorithm namely slotted MTP (S-MTP) scheme, where each time cycle is divided into multiple grant scheduling slots and, in each slot, multiple request and grant messages are processed simultaneously including the use of frame by frame information in both the request and grant messages. The proposed S-MTP scheme effectively reduces the end-to-end packet delay and over-granting problem in the LR-PON system with lower computational complexity. We have evaluated the performances of the proposed scheme by numerical simulations. The simulation results show that the proposed scheme provides 45% and 20% lower end-to-end packet delay with 38% and 10% lower over-granting rate than the conventional online MTP and enhanced interleaved polling with adaptive cycle time schemes, respectively. The S-MTP scheme also provides higher throughput and bandwidth utilization than those of the existing schemes.

Keywords: LR-PON; DBA algorithm; Multi-thread polling (MTP); E-IPACT; Over-granting problem.

1. Introduction

The main aim of long-reach passive optical network (LR-PON) is the reduction of network deployment complexity and cost by combining multiple optical access networks [1]. The LR-PON system ensures the expansion of the fiber to the home (FTTH) infrastructure with sufficient bandwidth supports. An optical line terminal (OLT) in the central office of the LR-PON system distributes the upstream bandwidth among the N optical network units (ONUs) through a passive 1: N splitter/combiner. The multi-point control protocol (MPCP) is used for overlapping free data transmissions in the upstream channel. The MPCP uses two control messages, i.e., Report and Gate messages, to perform its operation. The MPCP calculates the round trip time (RTT) of every ONU from the OLT to schedule these control messages. The LR-PON system covers larger area that requires wider variations in the fiber length. That is why, longer propagation delay and wider variations of the RTTs are inherent in the LR-PON systems. As a result, in the LR-PON systems, the MPCP suffers from the huge amount of pre-transmission delays, i.e., polling delay, granting delay, and queuing delay [2, 3]. Usually, the end-to-end packet delay of the LR-PON system is the summation of these three pre-transmission delays, congestion delay, and propagation delay. Different dynamic bandwidth allocation (DBA) algorithms have been proposed by several researchers for reducing the end-to-end packet delay and improving the quality of services (QoSs) of the LR-PON systems. However, only the multi-thread polling (MTP) based DBA schemes play a vital role to reduce this longer propagation delay as well as end-to-end packet delay in the LR-PON systems [4].