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Comparison of Various Scheduling Techniques in OBS Networks

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Abstract

Optical burst switching (OBS) is a viable approach proposed with the objective of utilizing the huge transmission capacity available with WDM links both efficiently and cost effectively. In this paper simulation results for an OBS node with self-similar traffic comparing with drop history schemes, CTBR with the Horizon and the LAUC-VF scheduling algorithms clearly indicate their overall scheduling performance aligned with burst drop checks and their burst length. CTBR is the fastest scheduling algorithm that can produce an efficient burst schedule than other scheduling techniques. The CTBR scheduler is entirely able to schedule both bursts successfully on the multiplexing link.

Keywords: OBS, Min-SV, Horizon Scheduling, LAUC-VF, CTBR.

Introduction

In OBS, each burst is preceded by a header (or control packet) which includes all information necessary for the reservation of resources (available bandwidth) at all intermediate nodes. A burst header is sent on a separate control channel shortly before the transmission of the data burst [1]. At each node in the burst’s path, the control packet is converted into electronic form and an attempt is made to locate and reserve a wavelength that can accommodate the burst

Bursts do not wait for acknowledgements of successful bandwidth reservation but instead are transmitted shortly after their control packets. If the control packet fails to reserve the required resources the corresponding burst will be dropped. A significant issue in OBS networks is the scheduling of bursts at each node they reach, i.e. the assignment of bursts to wavelengths in the desired output fiber

The other important issues engage for assignment for bursts are how to design channel-scheduling algorithms that can utilize the available wavelengths efficiently and how to make the algorithm fast enough so that the scheduler can keep up with the burst incoming rate. In this paper various scheduling techniques, conventional and non-conventional, are compared to find the best scheduler in terms of burst drop ratio. The rest of the paper is organized as follows: In Section 2, we present and discussed different types of burst scheduling techniques. Result of the comparison made are discussed in Section 3. We conclude the paper in Section 4 by giving some future directions in Section 5.

Scheduling Algorithms

Horizon Scheduling

Horizon scheduling is a practical scheduling algorithm proposed for OBS networks [4,5]. The horizon for a channel is defined as the latest time at which the channel is currently scheduled to be in use. The horizon scheduler simply selects the channel with the latest horizon from a set of channels whose scheduling horizons are smaller than the burst's arrival time. Once a channel has been selected, the scheduler updates the scheduling horizon to be equal to the time when the burst is due to be completed (determined by the offset and length fields in the BHC). If no channels have horizons that are smaller than the arrival time of the burst, then the burst is discarded. Theoretically, horizon scheduling takes O(log *h*) time to schedule a burst, where *h* is the number of DWDM channels per link. Therefore, horizon scheduling can cause excessive burst discards when the variation of the offset between the BHCs and the bursts is large.

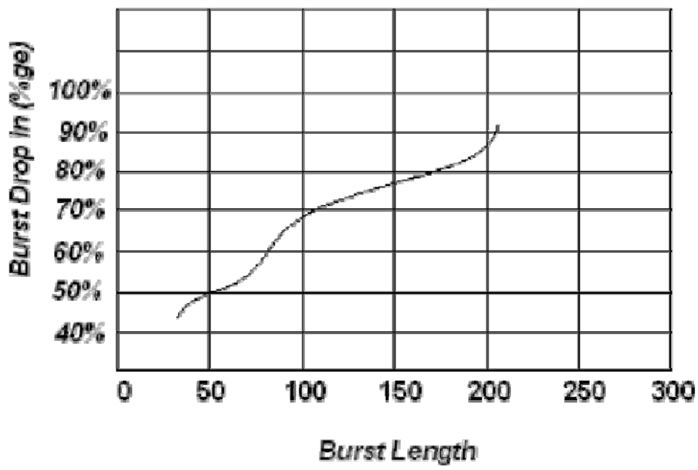

Figure 1: Performance Of Horizon Scheduling: Burst Length Vs Burst Drop

Latest Available Unused Channel with Void Filling (LAUC-VF)

LAUC-VF keeps track of all voids on the channels and tries to schedule a burst in one of the voids whenever possible [4,7]. If more than one void can fit a burst, the one with the latest beginning time is assigned to the burst. Since LAUC-VF can use the voids created by previously scheduled bursts, link utilization of LAUC-VF is higher than that of horizon scheduling. However, LAUC-VF takes much longer to schedule a burst compared to horizon scheduling. The complexity of LAUC-VF is O(*m*), where *m* is the number of voids. In general, LAUC-VF is too slow to be practical.

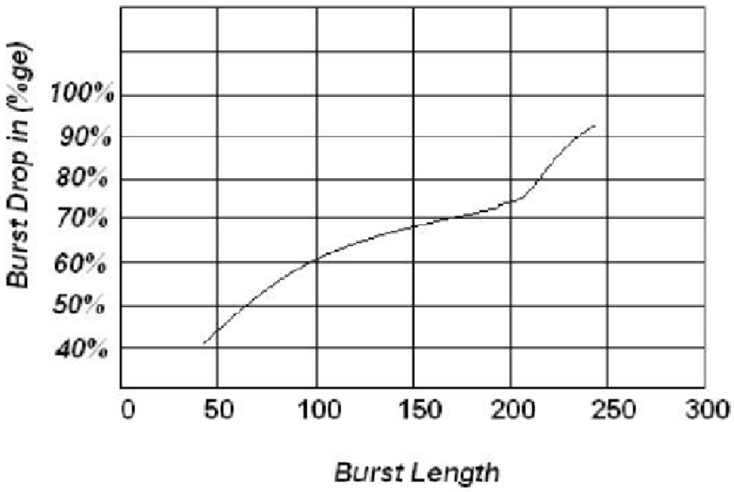

Figure 2: Performance of LAUC-VF: Burst Length Vs Burst Drop

Minimum Starting Void (Min-SV)

Min-SV uses a geometric approach and organizes the voids into a balanced binary search tree. Min-SV algorithm finds a void that minimizes the distance between the starting time of the void and the starting time of the burst [8]. The Min-SV algorithm takes O(log *m*) time to finish, which is a significant improvement over LAUC-VF. To date, it is the fastest scheduling algorithm that can produce an efficient burst schedule. However, in order to schedule a burst, Min-SV needs to performance 10 log *m* memory accesses for each burst-scheduling request, which means that it can take up to a few Microseconds to schedule a single burst. Therefore, Min-SV is still too slow to provide a practical solution to the problem.

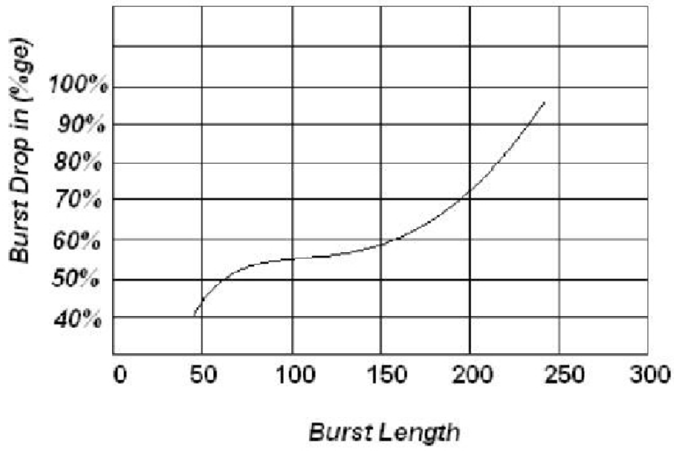

Figure 3: Performance of MIN-SV: Burst Length Vs Burst Drop

The Triangular Estimator Scheme

This scheme aims at reducing the scheduling complexity by avoiding unnecessary channel searches, i.e. searches that if performed will prove to be futile [9]. If the burst scheduler can identify and drop such bursts upon their arrival instead of attempting to schedule them, the total number of channel searches (checks) will be reduced and significant savings in both processing time and memory operations will be achieved The Triangular Estimator (TR-EST) scheduling algorithm works as upon the reception of a control packet the burst length and offset are extracted and examined and the burst's zone is determined. It must be noted that the TR-EST scheduling algorithm does not incur any additional processing overhead since the only extra operation is a logical test. Therefore the complexity of the scheduling algorithm is not affected.

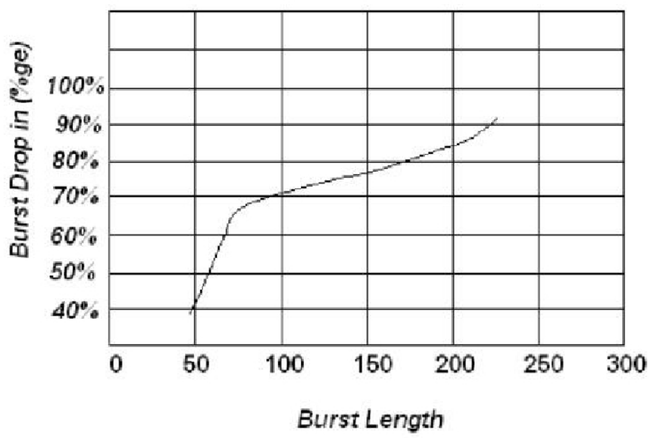

Figure 4: Performance of TR-EST: Burst Length Vs Burst Drop

The Drop History scheme

The Drop History (DH) approach works as follows: During a learning phase the algorithm schedules bursts exactly like LAUC-VF and records the number of bursts dropped and the total number of bursts for each class. After enough data has been gathered in the history table, the algorithm proceeds to its main phase of operation [9]. Before a burst is scheduled, the drop history table is checked.

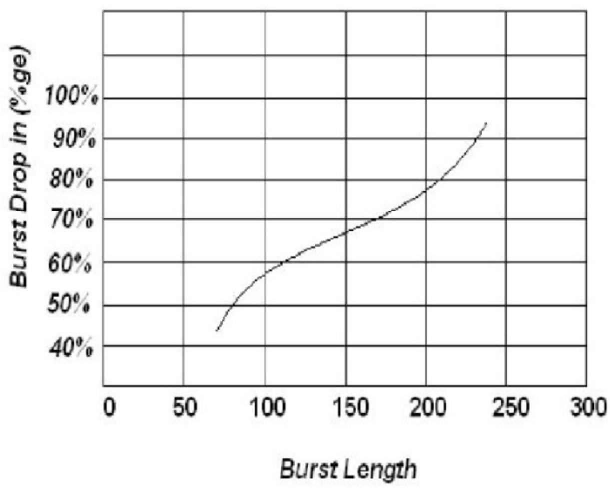

Figure 5: Performance of Drop History Scheme: Burst Length Vs Burst Drop

CTBR

Bursts are scheduled on channels at a time units before the burst arrival. It is an optimal wavelength scheduler using constant time burst resequencing (CTBR), which runs in O(1) time [10]. The proposed CTBR scheduler is able to produce optimal wavelength schedules while having the same processing speed as the horizon scheduler. The algorithm is well-suited to high performance hardware implementation. Compared to the results from a horizon scheduler in Fig. 1, the CTBR scheduler is able to schedule both bursts successfully on the link. The small gaps between successive bursts are not utilized because no bursts are present in the system.

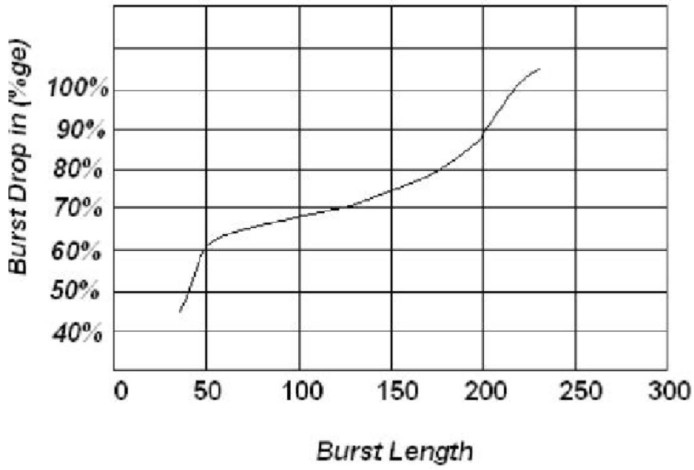

Figure 6: Performance of CTBR Scheme: Burst Length Vs Burst Drop

Results

In this section, we investigate & evaluate the burst drop ratio performance of the LAUC-VF, Horizon and CTBR scheduling schemes. The main objective is to analyze the no of bursts realized of each scheduling technique [9]. An OBS node with self-similar traffic comparing with drop history schemes, CTBR with the Horizon and the LAUC-VF scheduling algorithms clearly indicate that they have a parallel performance while they reduce the number of channel or void checks and thus the overall scheduling complexity. The performance and accuracy is directly dependent on the drop ratio for drop history schemes, CTBR with the Horizon and the LAUC-VF scheduling algorithms. The Triangular Estimator Scheme is concerned with also 1/network load.

Conclusion

The horizon scheduling can cause excessive burst discards when the variation of the offset is large. LAUC-VF takes much longer to schedule a burst compared to horizon scheduling. MIN-SV is the faster than LAUC-VF scheduling algorithm that can produce an efficient burst schedule. The CTBR scheduler is entirely able to schedule both bursts successfully on the multiplexing link. The triangular estimator scheme performance and accuracy degrade when the network load is low and the drop zone is fixed and is not adjusted dynamically according to traffic and/or network characteristics. The triangular estimator scheme successful identifies and discards voids that will not be able to find an available wavelength in scenarios where the network load is high, its performance and accuracy degrade when the network load is low. The drop zone is fixed and is not adjusted dynamically according to traffic and/or network characteristics. Horizon and the LAUC-VF scheduling algorithms clearly indicate that they have a similar performance while they reduce the number of channel or void checks and thus the overall scheduling complexity.

Future Scope

It also has the flexibility to measure up to with diverse parameters as burst offset and their precise time-slots with self-similar traffic comparing with drop history schemes, CTBR with the Horizon and the LAUC-VF scheduling algorithms and the Triangular Estimator Scheme.

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