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# Use of Early Burst Drop Prediction Technique to Improve Scheduling in OBS Network

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***Abstract— In WDM networks, the huge bandwidth offered by fiber is managed by splitting it into a number of wavelengths, Each acting as an independent communication channel. There are three popular switching techniques, optical circuit switching (OCS), optical packet switching (OPS) and optical burst switching (OBS). Optical burst switching combines the features of both the OCS and OPS. The key issue in OBS networks is efficient scheduling. Basically there are two types of scheduling algorithms, horizon and void filling scheduling algorithm used for scheduling in OBS network. Horizon scheduling algorithm is simple to implement but high bust drop ratio where as void filling scheduling algorithm is complex to implement but low burst drop ratio as compared to horizon scheduling algorithm. But, both are having considerable burst drop ratio which is very important factor for burst scheduling algorithm's efficiency. If the calculation of burst drop probability before scheduling then it will help to decrease burst drop ratio (BDR). In this paper propose early burst drop prediction technique (EBPT) at core node also that processes control packets of bursts which will allow control packets for scheduling. Simulation results show that the burst drop ratio is improved by proposed technique.***

***Keywords— WDM, OCS, OPS, OBS, EBPT, BDR***

## I. INTRODUCTION

Today the internet services is increasing tremendously which resulted in demand of data transfer speed. The various fields which required high data transfer speed are remote information access, video-on-demand, video conferencing, on-line banking, and other multimedia applications. Wavelength Division Multiplexing (WDM) is one such technology developed to handle the future bandwidth demands. In WDM networks, the huge bandwidth offered by fiber is managed by splitting it into a number of wavelengths. The optical burst switching (OBS) is the combination of circuit switching and packet switching which gives the advantages of both. Burst is a variable length data packet, assembled at an ingress router by aggregating a number of IP packets, which may be received from a single host or from multiple hosts belonging to the same or different access networks[6]. Optical burst switching is a technique for transmitting bursts of traffic through an optical transport network by setting up a connection and reserving resources end-to-end only for the duration of a burst[3,1]. A burst has two components: control and payload. The control packet carries the header information. Thus, the control component incurs an overhead, referred to as control overhead. Payload is the actual data transmitted. The ingress node is responsible for burst assembly, routing, wavelength assignment, scheduling of burst at edge node. The core node is responsible for signalling, scheduling, resolving contention. The egress edge node is responsible for disassembling network layer and Comparison of three switching technology is given in Table 1[3].

TABLE 1
COMPARISON OF OPTICAL SWITCHING TECHNOLOGIES [3]

| Optical Switching Technology | Bandwidth Utilization | Setup | Optical Buffer Latency | Adaptively (Traffic and Fault) |
|---|---|---|---|---|
| OCS | Low | High | Not Required | Low |
| OPS | High | Low | Required | High |
| OBS | Low | High | Not Required | High |

## II. OBS NETWORK ARCHITECTURE

An optical burst-switched network consists of optical burst switching nodes that are interconnected via fiber links. In each fiber link capable of supporting multiple wave-length channels using wavelength division multiplexing (WDM) as shown in Figure 1. This architecture consists of Edge node and core node[8].

 

OBS Edge Node consists of an electronic router and an OBS interface. It collects upper layer traffic based on destination addresses and aggregates it into variable sized bursts. Also, it is responsible for setting up connections for a burst. This procedure contains signalling, routing and wavelength allocation. A signalling is procedure by which services are provisioned by using signalling protocols. The control packet can be reserved for resources of the corresponding data burst which are guiding it through a routing path. Routing takes fixed path where physical route is predefined for each pair of OBS edge nodes. Wavelength allocation is done for the bursts as per availability and scheduling. When an edge node intends to transmit a data burst, first it sends control burst on the control wavelength to the nearest core node. Core node classifies traffic and sends it to burst assembler. Then offset management schedule burst moves towards to output line. In this way core node architecture work.

Core node has two layers. The upper layer is responsible for processing control packets and configuring the switching fabric[1]. It requires optical switching matrix control unit, port forwarding table (look up table) and link scheduling module which known as electronic control path layer. The control path contains O/E/O processing, cell switch and BHP processors (BPs). The cell switch maps input link to output according to destination of data burst[7]. The lower layer consists of optical ports, wavelengths, optical to optical connections, FDLs and optical cross connects. This layer is known as optical data path layer. The optical cross connects are having capability of wavelength conversion. Function of OBS core nodes are extraction and processing of header, burst scheduling, resource reservation, burst transmission and

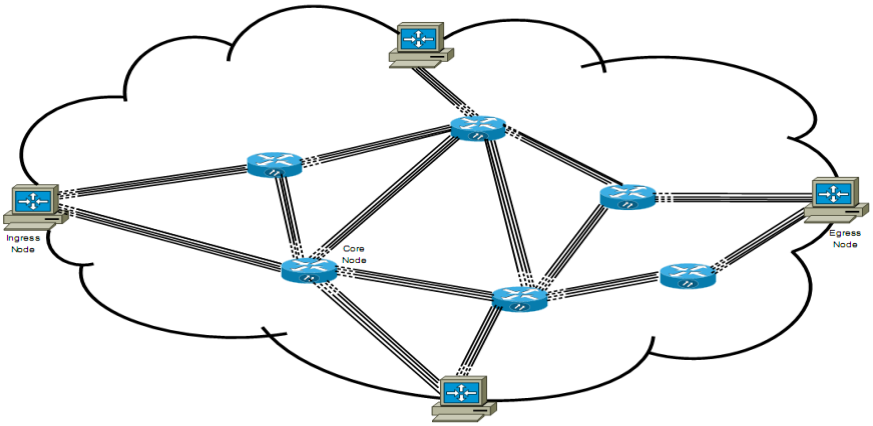


Fig 1: OBS Architecture

release resources.OBS Architecture shows in Fig. 1.[18]

## III. PROCESSES IN OBS

**Burst assembly scheme**

It is process of assembling data from higher layer into burst at ingress edge node of the OBS network. Burst assembly and disassembly process shows in figure 3. In this to egress node IP packets and sonnet voice are assembled in ingress node and control packets and data burst will generated, through (E/O) conversion. In other hand particular control and data packets are disassembled into previous packets through (O/E) conversion[5,7]. Most common burst assembly techniques are time based and threshold base. The timer-based scheme is used to gives uniform gap between successive burst. In threshold base assembly limit is placed on the maximum number of packet contain each burst. Also it will be generated at the network edge and non-periodic time interval. Main problem in burst assembly is how to choose the appropriate time and threshold value for certain burst in order to minimize packet loss probability in OBS network[3].

**Wavelength reservation scheme**

Wavelength reservation is a technique in which when and how wavelength is reserved is define. In this two types

TABLE 2
COMPARISON OF DIFFERENT WAVELENGTH RESERVATION SCHEMES

| Schemes | Direction | Reservation | Delay | Loss |
|---|---|---|---|---|
| TAG | One-Way | Implicit | Least | High |
| JET | One-Way | Implicit | Low | High |
| JIT | One- Way | Explicit | Low | High |

are there immediate reservation or Just in Time (JIT) and delay reservation. Delay reservation also contains void filling or Just Enough Time (JET) and no void filling or Horizon. In immediate reservation output wavelength reserved immediately after arrival of a BHC. If any case wavelength cannot reserved at that time BHC and respected burst are dropped. In delay reservation output wavelength is reserved for a burst just before arrival of first bit of burst. BHP arrived and if it determined that no wavelength can be reserved at the appropriate time then the BHC is discarded and burst is dropped.

 

## IV. SCHEDULING ALGORITHMS IN OBS

Optical Burst Switching is a brighter technology in Optical Network. The key problem is to scheduled data burst in data channels by an optimal way. The main aim is to reduce the burst loss in data channel so that more burst can be scheduled. When a control packet arrives at a core node channel scheduling algorithm determine a wavelength of channel for outgoing link for the corresponding data burst. The information required for the scheduler is the expected arrival time of the data burst. The scheduler keeps track of the availability of time slots on every wavelength channel and selects idle channels. The selection of wavelength channel is such a way that burst loss is less. At the same time, the scheduler must be simple and should not use complex algorithm because the routing nodes operate on very high speed burst traffic. A complex scheduling algorithm work on the early data burst arrival situation if the data burst arrives before its control packet is processed then the data burst is dropped. Scheduling algorithms can be classified as Horizon or without void filing and with void filling.

Horizon algorithms are: First Fit Unscheduled Channel (FFUC), Latest Available Unused Channel (LAUC) and that of void filling algorithms are: First Fit Unscheduled Channel with Void Filling (FFUC-VF)], Latest Available Unused Channel with Void Filling (LAUCVF) and Minimum End Void (Min-EV)

TABLE 3: COMPARISON OF SCHEDULING ALGORITHMS

| Algorithms | Time Complexity | State Information | Bandwidth Utilization |
|---|---|---|---|
| FAUC | O(log W) | Horizon | Low |
| FFUC-VF | O(Log(WNb)) | Sij,Eij | High |
| LAUC | O(log W) | Horizon | Low |
| LAUC-VF | O(Wlog M) | Sij,Eij | High |

## V. EARLY BURST DROP PREDICTION IN OBS NETWORK

The scheme burst drop rates marginally lower or identical to the existing scheduling algorithm while reducing the number of channel or void checks and thus the algorithm complexity and execution time. But this scheme is applied only at edge node to check the drop probability of the scheduling burst. This is existing approach towards burst drop prediction technique at edge node.

This scheme can be extended and applied to each core node. For that this paper propose burst drop prediction technique. This technique is applied at both edge and core node. In this technique we check burst size and offset time on which the burst drop probability is depending. To minimize the burst drop it have to take optimal values of burst size and offset time called as threshold values discussed in the next section.

**Threshold Burst Size and Offset Time**

According to the scheme explained in the previous part that has to check the properties of the burst before scheduling them and identified burst size and offset time as the critical properties of bursts on which the burst drop probability is depending. The burst assembled at edge nodes should have appropriate values of burst size and offset time so that it can successfully reach its destination through underlying OBS network whereas these values are called as `Threshold Burst Size' and `Threshold Offset Time'. As at each edge node as well as at core node the burst size and offset time is checked against their threshold values, the probability of dropping out the burst is decreased significantly. With this threshold values, it will define the Burst Drop Prediction (BDP) technique.

**Burst Drop Prediction Technique**

Burst Drop Prediction technique is used to verify that whether the current burst which is to be schedule is having threshold burst size and offset time or not. If their values are below the threshold values then that burst is allowed for scheduling otherwise rejected. This technique is applied at edge node as well as at core node. At edge node this technique is applied after control packet generator creates a control packet for newly created burst and after offset manager sets the proper offset time for this burst, unit where the control packet is processed. While processing the control packet the burst length and the offset time information is extracted and by using this information the resources are reserved for incoming burst before that these values are tested for Burst Drop Prediction technique. If control packet passes the technique it is allowed for reserving the resources at each intermediated node. Whereas, at core node this technique is applied at switch control.

## VI. SIMULATION AND RESULT

As extensive simulations carried out to study the performance of the Burst Drop Prediction technique and to see how it fares in comparison with LAUC scheduling Algorithm. In this chapter, we describe the method used for conducting simulations, the performance parameter used to analyse the Burst Drop Prediction technique and present the results obtained from the simulations.

**Burst Drop Ratio**

It is defined as number of bursts dropped over number bursts sent. The efficiency of scheduling algorithm depends on burst drop ratio and it should be as less as possible. Because, burst drop ratio is very important factor as it leads to very huge amount of data loss in optical network.

The BDP technique that extends the techniques to improve scheduling is applied to the standard network topology to get the result. As explained earlier the simulations ware using standard NSF Network topology for implementing the BDP technique. The burst drop rate is checked against the 14 node NSF topology.

 

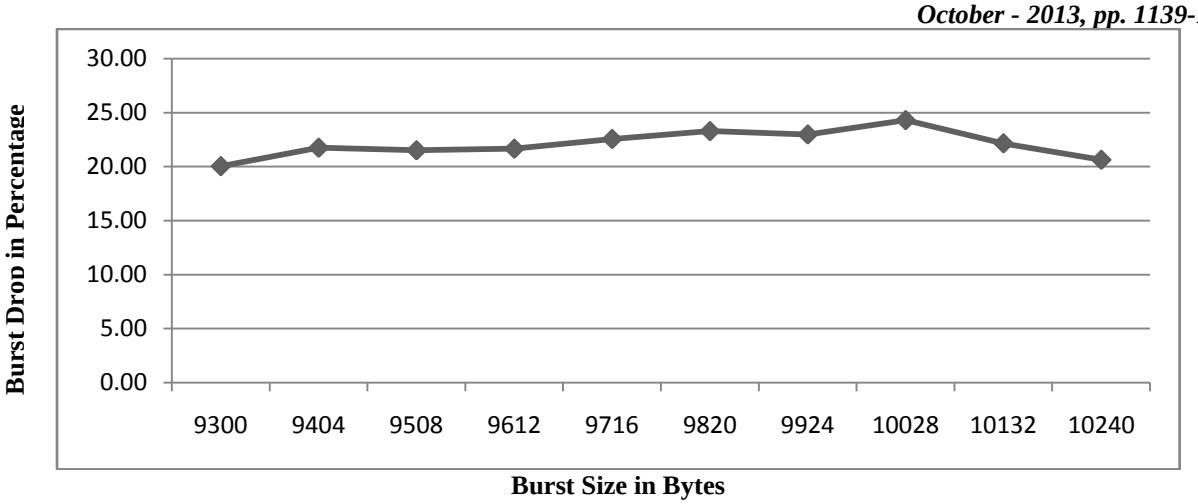


Fig 2. Burst Drop ratio for maximum burst length 10KB

Fig.2 shows the number of burst send, number of burst received and total number of burst dropped in the network when maximum burst size is 10KB. Percentage burst dropped against sent bursts is also calculated which shows the difference between the burst sent with and without BDP technique. Without applying algorithm 32.72% bursts were dropped where as 22.07% bursts were dropped by applying the algorithm. There is significant improvement in the number burst received with respect to number of bursts sent.

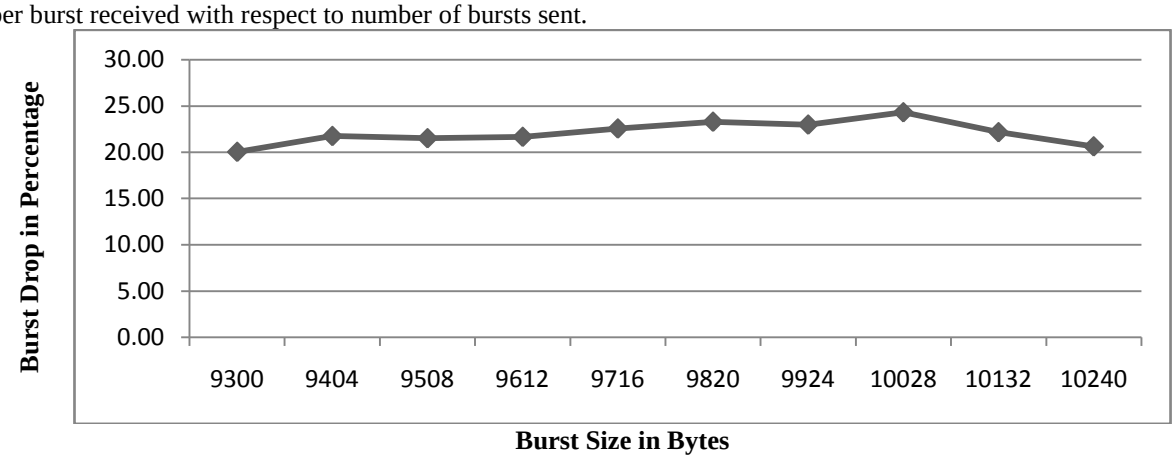


Fig 3: Burst Drop ratio for maximum burst length 20KB

Fig. 3 shows values for the maximum burst length 20KB for NSF 14 node topology. Its shows that burst size in bytes increase percentage burst drop decreases. As the size of burst is increased the number of burst sent through network is decreased. It is also observed from Table 4 that percentage drop rate for each threshold value of burst also decreased.

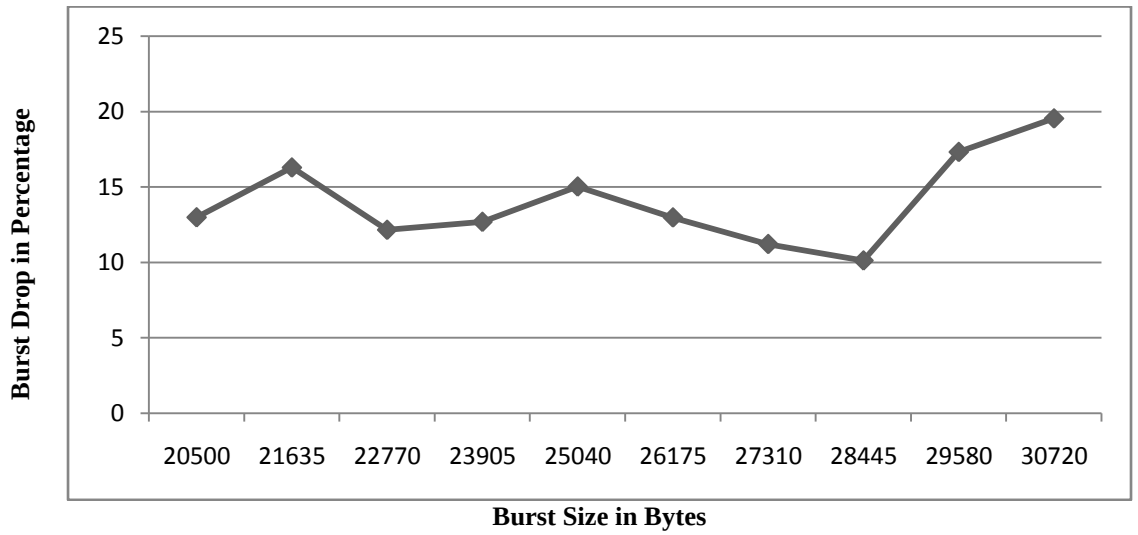


Fig. 4: Burst Drop ratio for maximum burst length 30KB

 

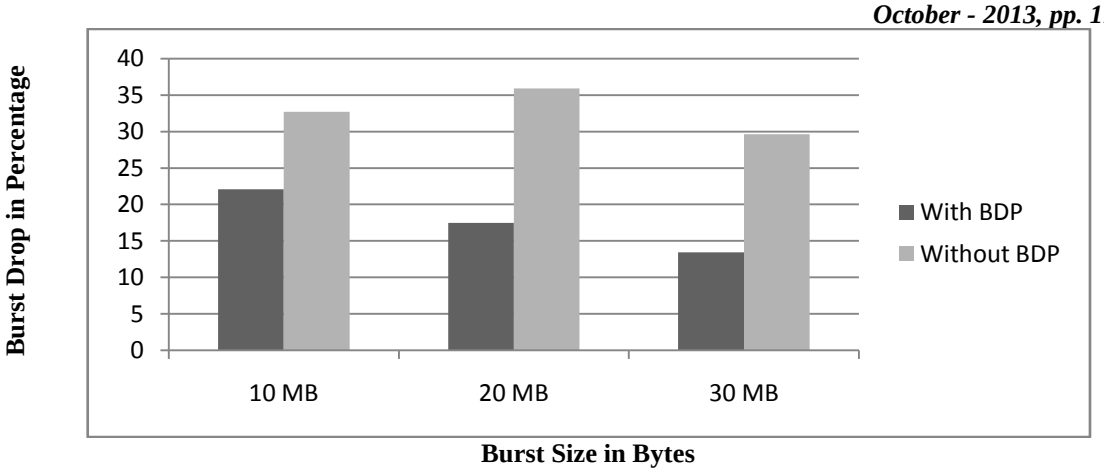


Fig. 5: Comparison of Burst Drop ratios with and without BDP Technique

But, without applying algorithm 35.91% bursts were dropped where as 17.49% bursts were dropped by applying the algorithm.

Fig.4 shows values for the maximum burst length 30KB for NSF 14 node topology. It's shows that burst size in bytes increase percentage burst drop will remain nearly same up to 28445 bytes for further burst size percentage burst drop is increases

Fig. 5 shows comparison of burst drop ratios with and without using BDP technique. It is observed that it can reduce burst drop ratio by using BDP technique. The number of bursts dropped by with and without applying BDP technique are 13.42% and 29.62% respectively. From the statistics of applying BDP technique before scheduling it is being observed that the burst drop rate is minimized considerably.

## VII. CONCLUSION

1. It has been observed that the threshold based schemes is not a good scheme for burst generation. As threshold based scheme generate the same size of burst, all void filling algorithm have the same burst dropping probability under self-similar and poisson trac. It is also noticed that as the threshold value increases the burst dropping probability decreases.
2. This paper studied existing Modified TR-EST and DH Scheme which reduces the scheduling complexity and improves the performance of the scheduling algorithms. In this report we have extended the functionality of these schemes to each core node by using BDP technique so as to get the better result. The simulation results show that it is improving the performance significantly. The drop probability can be reduced to 10 to 15 %.
3. The number of bursts dropped by with and without applying BDP technique are 13.42% and 29.62% respectively.

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