A Data Burst Assembly Algorithm in Optical Burst Switching Networks

Se-yoon Oh, Hyun Ha Hong, and Minho Kang

Presently, optical burst switching (OBS) technology is under study as a promising solution for the backbone of the optical Internet in the near future because OBS eliminates the optical buffer problem at the switching node with the help of no optical/electro/optical conversion and guarantees class of service without any buffering.

To implement the OBS network, there are a lot of challenging issues to be solved. The edge router, burst offset time management, and burst assembly mechanism are critical issues. In addition, the core router needs data burst and control header packet scheduling, a protection and restoration mechanism, and a contention resolution scheme. In this paper, we focus on the burst assembly mechanism.

We present a novel data burst generation algorithm that uses hysteresis characteristics in the queueing model for the ingress edge node in optical burst switching networks. Simulation with Poisson and self-similar traffic models shows that this algorithm adaptively changes the data burst size according to the offered load and offers high average data burst utilization with a lower timer operation. It also reduces the possibility of a continuous blocking problem in the bandwidth reservation request, limits the maximum queueing delay, and minimizes the required burst size by lifting up data burst utilization for bursty input IP traffic.

I. INTRODUCTION

Internet traffic is growing exponentially and is expected to be more than 10 times that of voice traffic by the year 2005 [1]. This situation has triggered much research activity on wavelength division multiplexing (WDM) transmission and optical switching technologies. Considering the trend in IP networks and the advance in optical technology, the next generation Internet will apparently depend on WDM networks to transport the expected huge amounts of Internet traffic.

Optical networks based on WDM are evolving from today's point-to-point transport links over add/drop multiplexers (ADM) and cross-connects for ring and mesh networks, to networks with higher reconfiguration speed [2]. In the long term, optical packet switching seems to be a promising technology, but due to its complexity it is expected to remain a research topic for some more years.

The current use of a circuit switching mechanism is relatively simple to realize but requires a certain amount of time for channel establishment and release independent of the connection holding time. This overhead, mainly determined by the end-to-end signaling time, leads to poor channel utilization if connection holding times are very short. The pressure to optimize network resources and protocols for IP traffic has focused attention on network architectures that can rapidly adapt to changes in traffic patterns as well as traffic loads.

Optical packet switching allows good bandwidth utilization, latency, and adaptability in the optical domain. However presently, optical packet switching is difficult to implement due to the lack of optical random access memory (RAM) and other necessary signal processing capability.

Optical burst switching is attracting the spotlight because it comprises IP over WDM circuit switching and pure optical

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packet switching with limited use of optical buffers. In optical burst switching (OBS) technology, burst data can be transported without optical RAMs at intermediate nodes [3]. In OBS, a data burst cuts through intermediate nodes without being buffered, whereas in packet switching, a packet is stored and forwarded at each intermediate node. Compared to optical circuit switching, OBS can achieve better bandwidth utilization because it allows statistical sharing of each wavelength among the flow of bursts that may otherwise consume several wavelengths. In addition, a burst will have a shorter end-to-end delay since the offset time used in OBS is often much shorter than the time needed to set up a wavelength path in wavelength routed networks. However, optical burst switching requires fast optical switching, which is still being researched.

In order to implement the OBS network, there are a lot of challenging issues to be solved. The edge router, burst offset time management, and burst assembly mechanism are critical issues. In addition, the core router needs data burst and control header packet scheduling, a protection and restoration mechanism, and a contention resolution scheme [4]. The configuration and functions of the control plane in OBS, including the control packet, are not yet standardized. In this paper, we focus on the burst assembly mechanism.

We first address the basic concept of OBS and present the ingress/core/egress functional model for optical burst switching networks and propose a multiprotocol label switching (MPLS)-based OBS control packet structure and a new burst assembly algorithm that uses hysteresis characteristics in the queueing model for the ingress edge node in optical burst switching networks.

II. OPTICAL BURST SWITCHING NETWORK ARCHITECTURE

1. Just-Enough-Time Protocol

Since 1980, various electrical burst switching techniques have been proposed: Tell-and-go (TAG), in-band-terminator (IBT) and reserve-a-fixed-duration (RFD), and so on. The TAG technique is similar to fast circuit switching. It transmits data bursts without an acknowledgement that bandwidth has been successfully reserved for the entire circuit. The IBT scheme reserves the bandwidth from the time the control packet is processed to the time the IBT is detected. In burst switching based on RFD, bandwidth is reserved for a duration specified by each control packet; this eliminates signaling overhead and offers efficient bandwidth reservation [5].

Just-Enough-Time (JET) is the RFD-based burst switching protocol in the optical domain. It adopts two unique characteristics, namely, the use of *offset time* and *delayed reservation*. These features make JET and its variations more suitable for OBS than OBS protocols based on TAG or other one way reservation schemes that do not adopt either or both of these features [6]. JET allows switching of data channels entirely in the optical domain by processing control packets in the electronic domain. A control packet precedes every data burst. Both the control packet and the corresponding data burst are separated by an offset time and are launched at the source node. The separate transmission and switching of data bursts and their headers help facilitate the processing of headers and lower the optoelectronic processing capacity required at the core node. Moreover, by assigning *extra-offset time*, JET can be extended to support prioritized services in the optical domain.

The control packet contains information necessary for routing the data burst through the optical channel, as well as information on the length of the burst and the offset value. Another important characteristic of JET is the *delayed reservation*. It reserves the bandwidth on each link just for the data burst duration. For example, let t_1' be the time when the first control packet arrives at a node after the control packet is processed and the bandwidth is reserved for the period from t_1 (the time the data burst arrives at a node) to $t_1+ L_1$ (the data burst duration). This increases the bandwidth utilization and reduces the probability that a burst will be dropped. For example, in both cases shown in Fig. 1., namely $t_2 > t_1+L_1$ (case 1) and $t_2 < t_1$ (case 2), the second burst will not be dropped, provided that its length is shorter than $t_1–t_2$. However, when the second burst using TAG arrives at t_2', it will be dropped because there is no buffer for it.

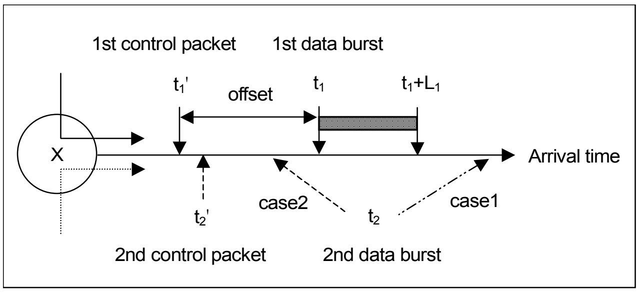


Fig. 1. OBS using the JET protocol [6].

2. OBS Network Architecture

The functional model of an IP over WDM network with OBS is shown in Fig 2. At the ingress node, edge routers determine the data burst-size and the offset time after considering the input IP traffic. Control packets, which contain information including the egress address, offset time, data burst size, and quality of service (QoS), go ahead on separate control wavelengths, and the main data burst follows the control packet after a given offset time. These control packets are converted to

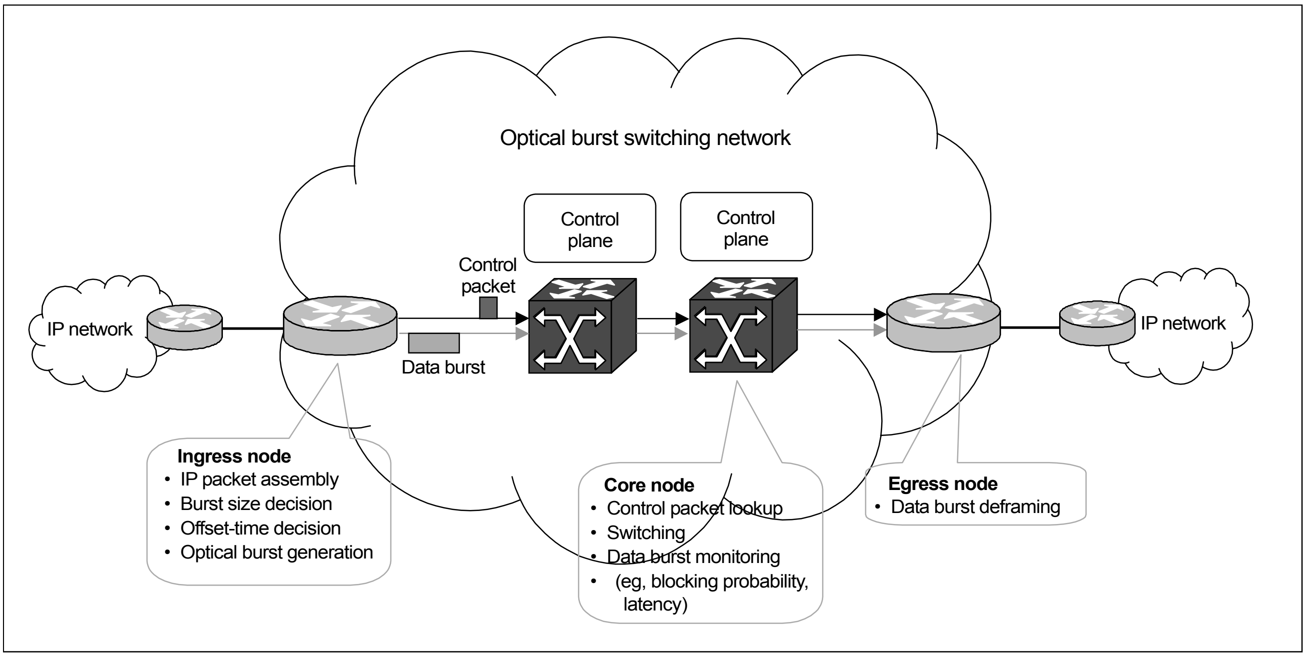


Fig. 2. Node functional model of OBS networks.

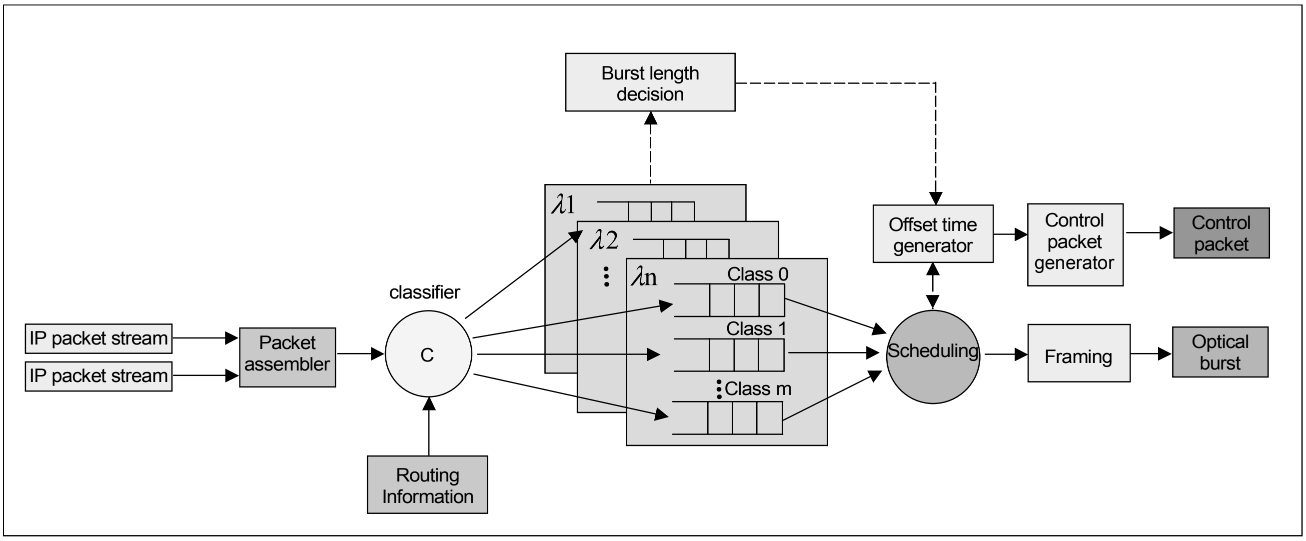


Fig. 3. Functional model of the ingress node in OBS networks.

electrical signals for processing at every intermediate node [7].

At the core node, bandwidth is reserved for the transmission time of the data burst. The elements that need to be monitored in traffic engineering are blocking probabilities, latency, and processing time. This information determines the optical path at the ingress node. At the egress node, a data burst is deframed and disassembled into multiple IP packets in a rather simple manner. Burst reordering and retransmission is handled in the egress node if required.

Parameters, such as offset time, burst size, and QoS values, are essential in achieving an OBS network. These are assigned in the ingress node of the OBS networks. In the following, we describe in more detail the functions of the ingress node.

The first step to aggregate incoming bursty IP traffic streams into a data burst is to assemble the bursty data at the packet assembler. The assembled data is then classified according to the priority of the IP traffic. Traffic can be further classified into congestion-controlled traffic and non-congestion-controlled traffic in IPv6. In the case of non-congestion-controlled traffic, the traffic is divided into eight classes based on the blocking rate [8]. In IPv4, the *Type-of-Service* (TOS) field in IP headers allows one to choose from none to all of the following service types: low delay, high throughput, and high reliability. It also allows a priority selection from 0 to 7. Thus, considering both service types, eight or more classes are possible in this classification. Another consideration for classification is routing information. Routing information contains a specific combination on fiber (or port number) and wavelength (Fig. 3). Assembling packets in separate queues provides more differences in grades than using a unified class queue.

We can consider two ways to assemble multiple IP packets into an optical data burst. The first segmented method separates IP packets whenever necessary as shown in Fig. 4(a), while the non-segmented method constructs earlier data bursts with idle data and puts IP packets in later data bursts as shown in Fig. 4(b). The segmented method offers high bandwidth utilization but requires complex hardware and a protocol system. The non-segmented method can be achieved more easily than the segmented method and reduces complexity but suffers from lower bandwidth utilization. In OBS, the processing burden is heavy in the ingress and egress nodes and the non-segmented method is better suited for assembling data bursts in OBS.

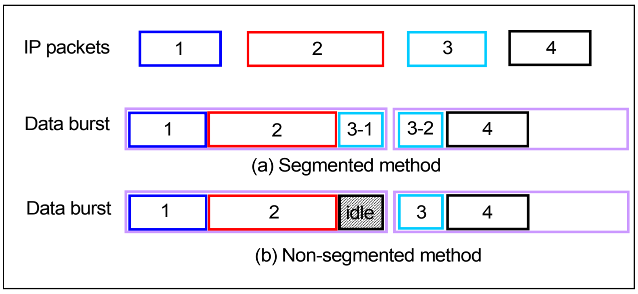


Fig. 4. Data burst assembly method.

In the burst-length decision step, the burst size is determined by the burstiness of input IP data (queueing length), QoS, and so on. In an OBS network, offset time is generated on the basis of the burst length decision, and a lower class (or higher blocking rate) data burst affects a higher class (or lower blocking rate) data burst because higher class traffic is protected by adding extra offset time to the base offset time [6]. The control packet generator generates the control packet, which contains information such as offset time, burst size, and class number. The data in the buffer is scheduled and framed for transmission through the designated fiber.

3. Proposed OBS Control Packet Structure

A burst consists of a burst header and a data burst. In OBS, a data burst and its header are transmitted separately on different wavelengths with the burst header first. Each control packet includes information for switching, burst size, offset time, etc. Yijun Xiong gave an example of the data burst format [9], but there has been no study on control packet structures yet. In this section, we propose an OBS control packet structure based on MPLS (Fig. 5).

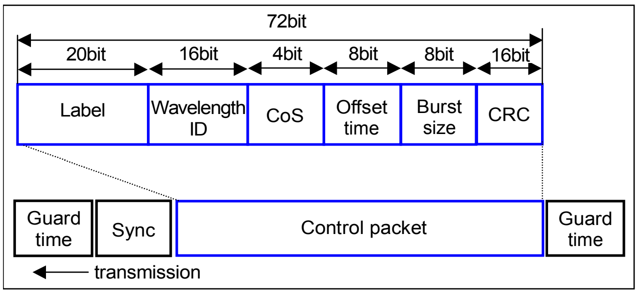


Fig. 5. Control packet structure.

Multiprotocol Label Switching (MPLS) provides simple forwarding and supports explicit routing without requiring each packet to carry an explicit route by using a fixed length label and a forwarding equivalence class mechanism [11]. In addition, MPLS offers a mechanism for traffic engineering using explicit routing and high speed switching. There are several reasons to adopt an MPLS-like control plane in OBS. Supervision of the whole process in the edge and core nodes can be carried out using the MPLS control plane. A concrete format and functions of the control packet in OBS are not yet defined and these can be constructed by modifying MPLS for the OBS control plane. By establishing a label switched path we can make an explicitly routed path and relieve the burden of control packet processing and also provide the traffic engineering functions of MPLS [10]. A new paradigm for the design of control planes for optical cross-connectors (OXCs) intended for data-centric automatically switched optical transport networks was proposed [11]. This new paradigm is termed multiprotocol lambda switching (MPΛS) and exploits recent advances in MPLS traffic engineering control plane technology to foster the expedited development and deployment of a new class of versatile OXCs that specifically address the optical transport needs of the Internet. In MPΛS, the label information table at each node is configured using an optical label based on wavelength in order to make a labeled switched path (LSP). The control plane using MPΛS reduces the burden of maintaining OBS networks, such as for interface definitions, label assignment, traffic management, and so on. In applying MPΛS to the OBS control plane, the control packet structure for label, wavelength identification, class of service (CoS), offset time, burst size and CRC of Fig. 5 are specified as follows:

A. Label (*20 bits*)

When burst data is sent to a core node, the control packet processor takes a control packet, gets information about the burst size, offset time, and CoS and looks up the label information table in order to obtain output information, such as output port, wavelength, and label (Fig. 6) [12].

B. Wavelength ID (*16 bits*)

The control packet contains wavelength identification information for distinction of channel and switching, including wavelength conversion in the optical burst switch. Since more than several hundreds of individual wavelengths should be available in a single fiber, we assign 16 bits to the wavelength ID for future enhancements.

C. CoS (*4 bits*)

MPLS offers 8 different types of CoS (3bits) [12]. Since the overall size of the control packet should be expressed in multiples of 8 bits, for example, 72 bits, we assign 4 bits as the CoS field.

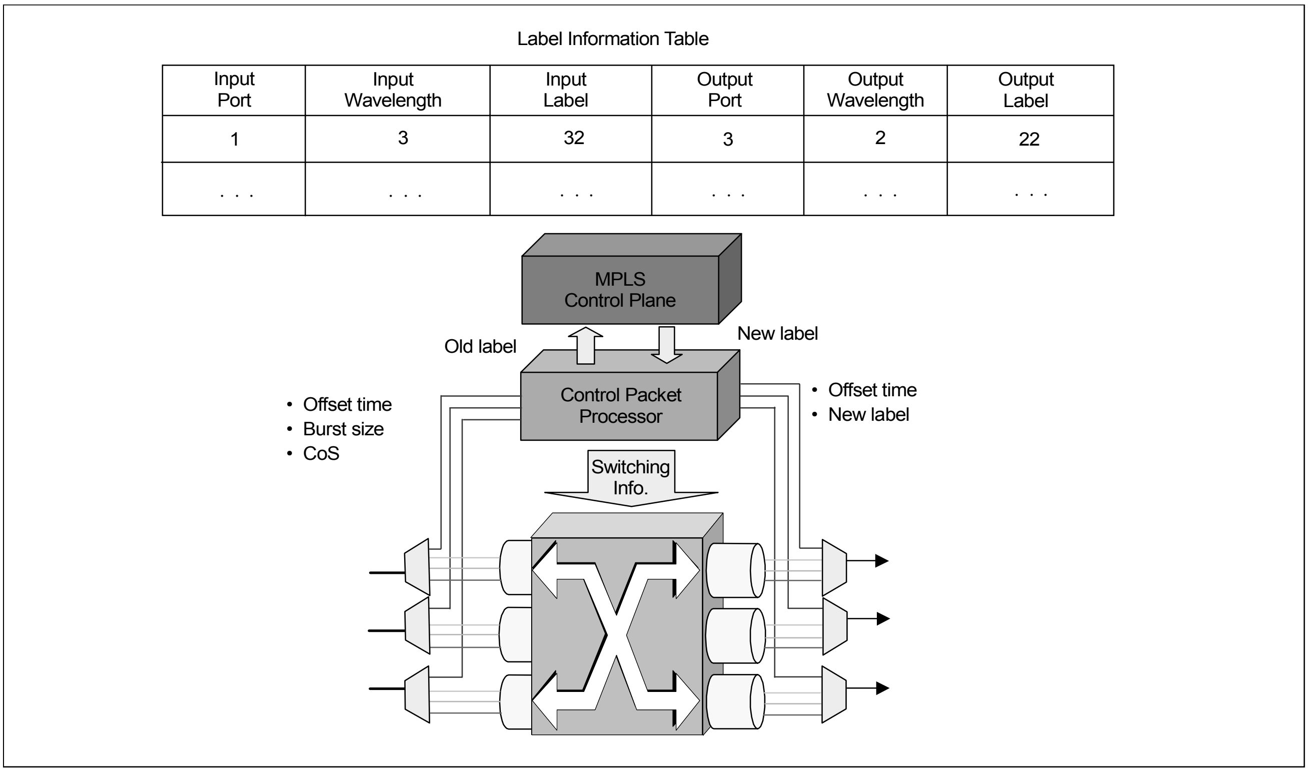
D. Offset time (*8 bits*)

Offset time indicates the difference between the arrival time of the control packet and the arrival time of the data burst. To reduce the control burden, the control packet contention problem, and the complexity of scheduling, the offset time should be quantized to a discrete set of values and assigned by the multiples as 256 steps. The offset time is decreased at each intermediate node along the path as much as the control packet processing time in the control plane. The offset time can be used as time to live (TTL) in OBS networks by measuring its value.

E. Burst Size (*8 bits*)

The minimum size of a data burst is determined by the electronic processing speed, switching speed, and maximum size of a single IP packet. The electronic processing speed of the control channel limits the number of control packets and the data burst transported per unit of time across the optical channel. Switching speed affects the data burst size. To achieve a high bandwidth utilization, the data burst transmission time (burst size/optical channel speed) should be much larger than the switching time. As the switching speed becomes faster, the restriction due to switching speed soon becomes minimal. Finally, to avoid a reassembly procedure for IP packets at the egress node, the data burst size should be larger than the maximum size of a single IP packet (65,535 B). Considering these restrictions, the reasonable minimum data burst size is 64 kB.

Figure 7 shows the interrelation between burst size and offset



Label Information Table

Input Port	Input Wavelength	Input Label	Output Port	Output Wavelength	Output Label
1	3	32	3	2	22
. . .	. . .	. . .	. . .	. . .	. . .

Fig. 6. Core node architecture using MPLS control plane for OBS.

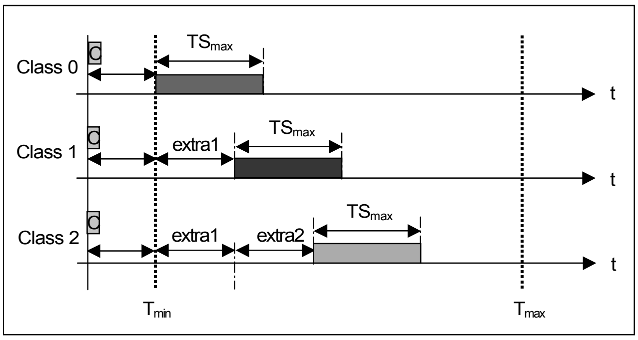


Fig. 7. Interrelation between offset time and burst size. extra1(2): extra offset time of class 1(2) traffic, T_{min}: base offset time, T_{max}: tolerable delay of IP packet, TS_{max}: transmission time of maximum size of the data burst, c: control packet.

time. To provide a lower blocking probability for a higher class data burst (class 2), more offset time should be assigned than the extra offset time of the lower class data burst (class 1). Because the extra offset time of the higher class (class 1) is determined by the lower class (class 0) data burst size distribution, the maximum size of a data burst is limited by the tolerable maximum delay of IP packets in the optical burst switching network.

Let the transmission time of the maximum size of the data burst be "TS_{max}" and let OBS networks offer n different classes with a 100% isolation degree (i.e., TS_{max} = extra1(2)). Then the maximum delay of the highest class traffic in OBS networks is "base offset time + $TS_{max} \cdot n$ + propagation delay." The tolerable end-to-end delay of delay sensitive Voice over Internet Protocol (VoIP) traffic is 150 ms [13]. We assume that the tolerable delay of an IP packet, T_{max} in an OBS network is 10 ms, the maximum number of hops is 5, and the control packet processing time is 1 ms. These assumptions yield a base offset time of 5 ms (maximum number of hops · control packet processing time). For example, taking a propagation delay of 3 ms into account by assuming an OBS network diameter of 600 km, TS_{max} becomes 0.25 ms or the maximum data burst size at 10 Gbps becomes 313 kB. As with offset time, 8 bits (256 steps) are assigned.

F. Guard Time

A guard time is placed between control packets. The guard time helps to overcome the uncertainty of the packet arrival time [14].

III. DATA BURST GENERATION ALGORITHM IN OBS NETWORKS

At the edge node of an OBS network, edge routers assemble bursts by merging multiple IP packets. The data burst should vary as little as possible, because a variation in large data burst size requires more extra-offset time for QoS which results in more delay. Thus, a data burst generation algorithm is necessary to generate high utilization data bursts and less variation in burst size.

An Ge and Franco Callegati proposed a burst assembly algorithm using a timer-counter [15]. However, this scheme resulted in low data burst utilization in the low offered load and huge variation in burst size because the data burst size was not optimized according to the input traffic. Moreover, a burst assembly algorithm based on a timer-counter may cause continuous blocking of data bursts in the core router as illustrated in Fig. 8. Suppose ingress routers A and B use the same timer period, i.e., $T_{period\text{-}A} = T_{period\text{-}B}$; those control packets request the bandwidth reservation in node X, and node X does not have FDL buffers. If a fixed offset is deployed, an intermediate node X can only honor the bandwidth request of nodes A and B. Because of periodic burst assembly time, a timer-counter-based scheme causes a high rate continuous blocking rate in a low offered load in reserving the bandwidth. We propose a new burst generation algorithm that uses hysteresis characteristics to solve this continuous blocking problem, minimize the timer operation frequency by maximizing burst utilization, and offer the optimized variable data burst size.

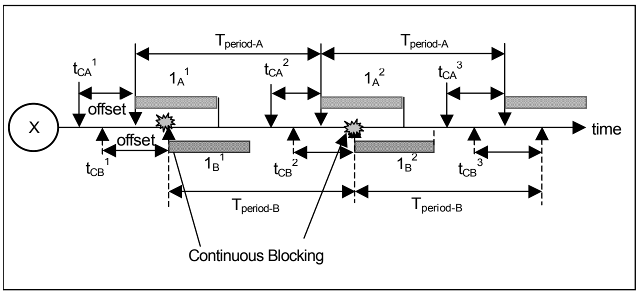


Fig. 8. Continuous blocking problem of data burst in bandwidth reservation request at core router with burst algorithm using timer-counter based scheme.

Figure 9(a) shows a class m FIFO queue model for the ingress node in OBS networks and Fig. 9(b) shows the hysteresis characteristics of the cross-over count number transition in this FIFO queue model. Q_{high} (Q_{low}) is the transition conditions for increasing (decreasing) the cross-over count number and BS is the burst size. To alleviate an excessive variation in burst size transition when using a single threshold, we propose a hysteresis characteristic for the transition condition by assigning a redundancy from Q_{low} to Q_{high} in changing the cross-over count number (Fig. 9(a)). In this way, the cross-over count number changes according to the threshold values of Q_{low} and Q_{high}.

To keep track of the arrival input traffic, the data burst-size

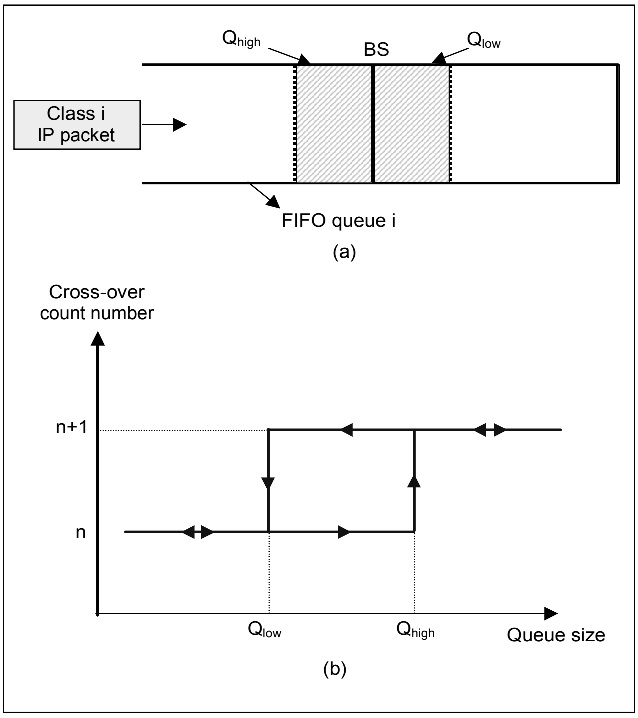


Fig. 9. (a) Class m FIFO queue model, (b) Hysteresis characteristics of cross-over count number transition.

(BS) should be adjusted accordingly. The burst size is determined either discretely or continuously. Because the control burden is critical in optical burst switching, we propose a discrete type burst-size decision algorithm that uses a hysteresis transition to relax the data burst size optimization process for arrival input traffic.

Figure 10 shows the discrete type burst size decision scheme. There are several stable states in a burst size in terms of the cross-over count number. If the cross-over count exceeds the upper bound, the burst size is increased by one step. If the cross-over count drops below the lower bound, the burst size is reduced by one step. This scheme offers less variation in data burst size and a smaller control packet processing burden.

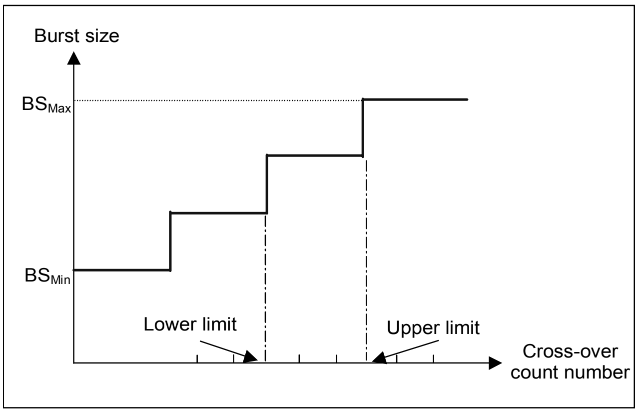


Fig. 10. Discrete type burst size decision scheme.

Since it may require a long time to generate a data burst when there is a low offered load, we used a timer to limit the waiting time of the packets in the burst assembly.

Figure 11 shows the overall flow diagram for the dynamic burst size decision algorithm.

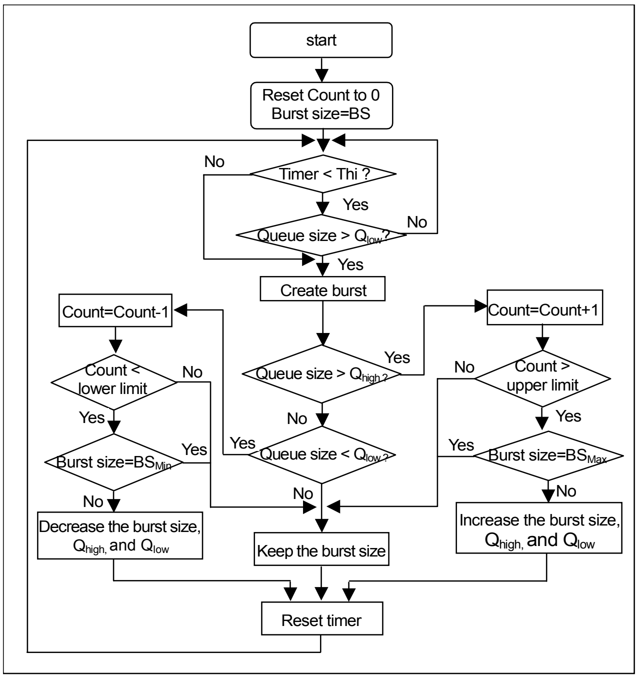


Fig. 11. Flow diagram for the dynamic burst size decision algorithm.

1) A timer starts as soon as the first packet arrives at the queue. If the timer value reaches the threshold value (Thi) or if the timer value is smaller than Thi and the queue size is greater than Q_{low} a new burst is created.

2) If the queue size is greater than Q_{high}, the counter number is increased by 1. If the queue size is smaller than Q_{low}, the count number is decreased by 1 (Fig. 9(b)).

3) The cross-over count number is compared with the upper and lower limits. If it crosses over the upper (lower) limit, the burst size is increased (decreased) by one stage (Fig. 10), otherwise, it is not changed. By repeating steps 1), and 2), the burst size is adaptively changed according to the input traffic.

4) Reset the timer to 0 and the operation goes back to step 1).

This algorithm adaptively generates stage-wise data burst size and minimizes the required burst size for bursty IP traffic. The optimized data burst size enhances data burst utilization and finally reduces the variation in burst size. Moreover, it diminishes timer operation frequency and also guarantees the maximum queuing delay by limiting waiting time using the threshold value (Thi) in the low offered load.

IV. TRAFFIC MODEL

Simulating the behavior of the global Internet data network is a challenging undertaking because the IP network is greatly heterogeneous and changes rapidly. The heterogeneity ranges from the individual links that carry the network traffic to the protocols that interoperate over the links to the "mix" of different applications used at a site and the levels of load seen on different links. Murad Taqqu, Walter Willinger, and Robert Sherman mathematically explained the observed self-similarity in wide-area Ethernet traffic by aggregating simple renewal (ON-OFF) processes with self-similar behavior [16], [17].

In this particular case, the traffic source is either transmitting packets at a constant rate during the ON period or is idle during the OFF period (Fig. 12). The time spent during the ON state (T_{on}) or OFF state (T_{off}) is independent identically distributed (i.i.d) and possesses a heavy tail distribution [18]. A large number of aggregated sources result in traffic having self-similar characteristics [17], [18].

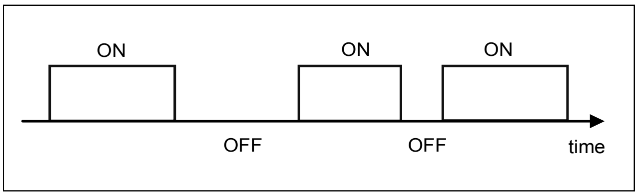


Fig. 12. ON/OFF distribution self-similar traffic model.

The *Hurst parameter* (H) indicates the degree of self-similarity, i.e., the degree of persistence of the statistical phenomenon. H takes a value from 0.5 to 1.0. A value of H=0.5 indicates a lack of self-similarity, whereas a large value for H (close to 1.0) indicates a large degree of self-similarity in the process.

We generate five different traffic models (Table 1). "Traffic 1" is a Poisson traffic model and "Traffics 2-5" are self-similar traffic models. In each traffic model, we generated 1,000,000 packets with the ON/OFF traffic source model.

Figure 13 depicts a sequence of simple plots of the packet counts (i.e., the number of packets per time unit) for five different traffic models. The scale-invariant or self-similar feature of the traffic patterns is drastically different from the conventional Poisson traffic pattern (Traffic 1).

Table 1. ON/OFF period distribution of traffic model. H is the burstiness parameter and larger H means higher burstiness [20], [21].

Traffic model \ Period		ON period	OFF period
Poisson traffic model	Traffic 1	Exponential	Exponential
Self-similar traffic model	Traffic 2	Pareto (H=0.6)	Pareto (H=0.6)
	Traffic 3	Pareto (H=0.7)	Pareto (H=0.7)
	Traffic 4	Pareto (H=0.8)	Pareto (H=0.8)
	Traffic 5	Pareto (H=0.9)	Pareto (H=0.9)

V. SIMULATION AND RESULTS

To evaluate the effect of a varying load and other parameters, we generated traffic with an average value of 1 kB packet length and burstiness varying from H=0.6 to H=0.9 and simulated the performance of the proposed burst generation algorithm in the ingress router. We assumed a data burst variation of 2% and set the default values of BS_{Min}, and BS_{Max} to 64 kB and 180 kB, respectively. The default values performed well for the burst generation in the simulated traffic.

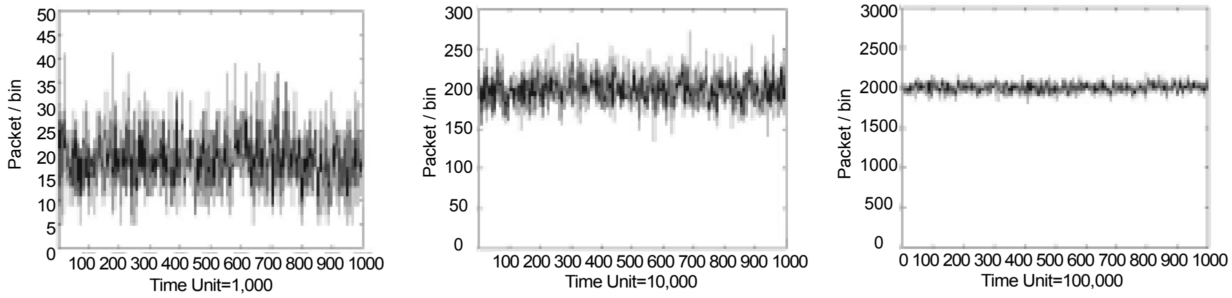
Figure 14 compares the variations of the average data burst size according to the offered load. The data burst size changed adaptively to the offered load (Traffic model 1) with a variable burst size.

Figure 15 shows the transition of the data burst size in Traffic model 3 with an offered load of 0.5. With the passage of time, the data burst size changed adaptively in a 2% step of the data burst size.

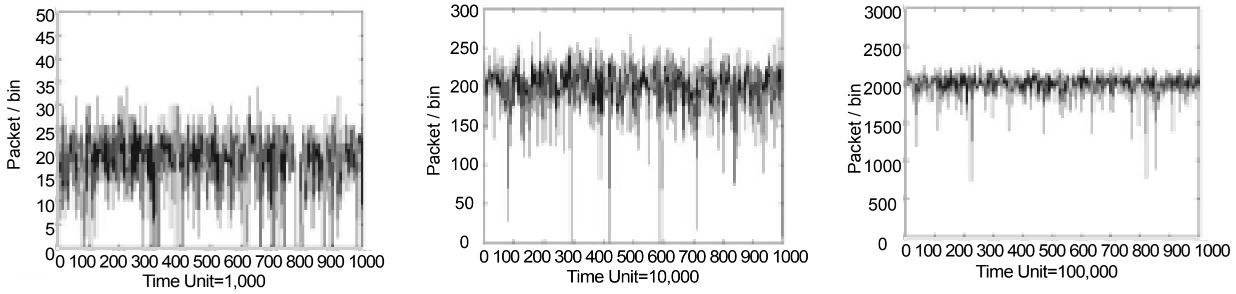
Figure 16 compares the average data burst utilization for fixed and variable data burst sizes in exponentially distributed traffic (Traffic model 1). The data burst utilization is defined as the sum of the total IP packet size in the data burst over the data burst size. Using the proposed algorithm, when the offered load was below 0.5, the variable burst offered higher data burst utilization. The timer operation frequency is compared in Fig. 17. The proposed algorithm offers a lower timer operation when the offered load is below 0.5, so it reduces the probability of continuous blocking in the bandwidth reservation request.

Figure 18 shows the average data burst utilization for Traffics 2 to 5. (H=0.6 to H=0.9). The proposed algorithm offers a higher average data burst utilization as the burstiness increases and offers over 50% of the average data burst utilization even in the worst case of high burstiness and a low offered load.

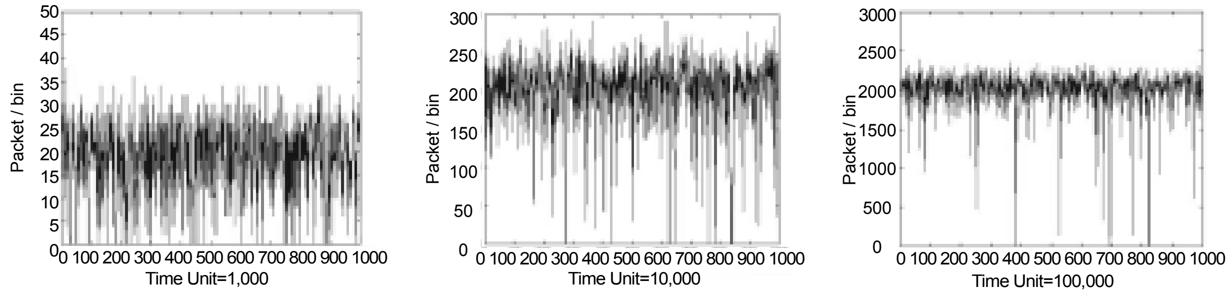
Figure 19 compares the average timer operation frequency of the timer-count algorithm and the proposed algorithm. The timer-count algorithm periodically aggregated input IP packets using the timer, so several bandwidth-requests at the



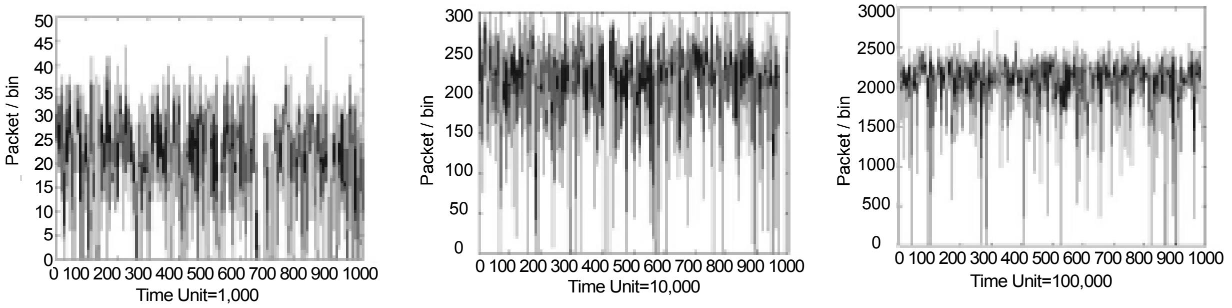
(a) Traffic 1 (Poisson traffic)



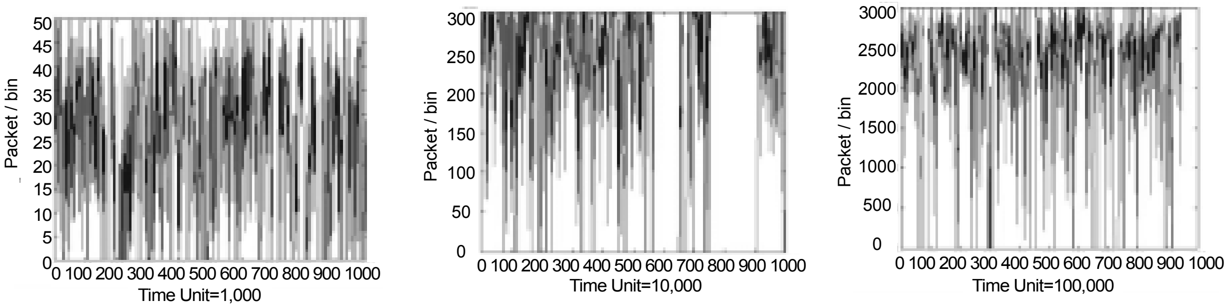
(b) Traffic 2 (H=0.6)



(c) Traffic 3 (H=0.7)



(d) Traffic 4 (H=0.8)



(e) Traffic 5 (H=0.9)

Fig. 13. Count process for five different traffic models.

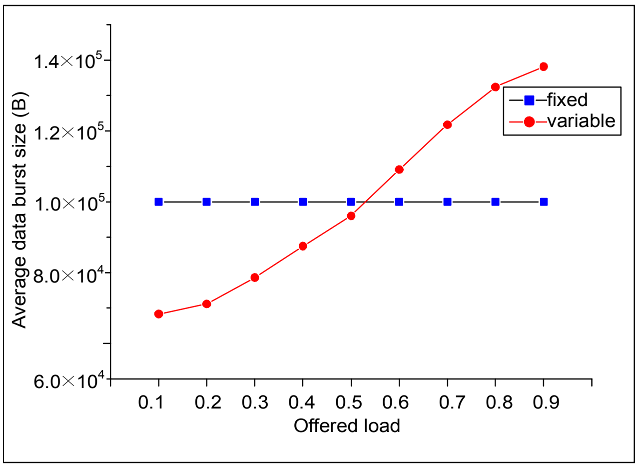


Fig.14. Average data burst size of fixed, variable data burst size for poisson traffic model (Traffic 1).

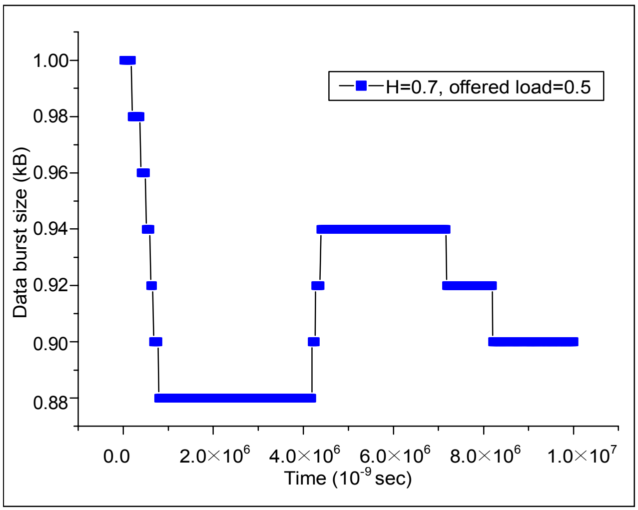


Fig.15. Data burst size transition (H=0.7, offered load=0.5).

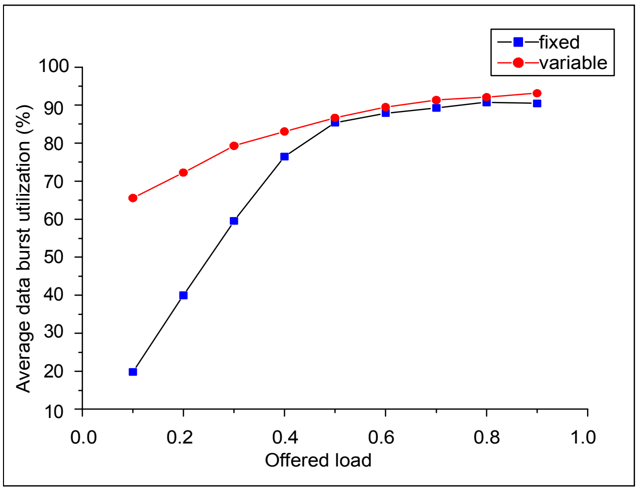


Fig. 16. Comparison average data burst utilization for fixed and variable data burst size. (Traffic model 1).

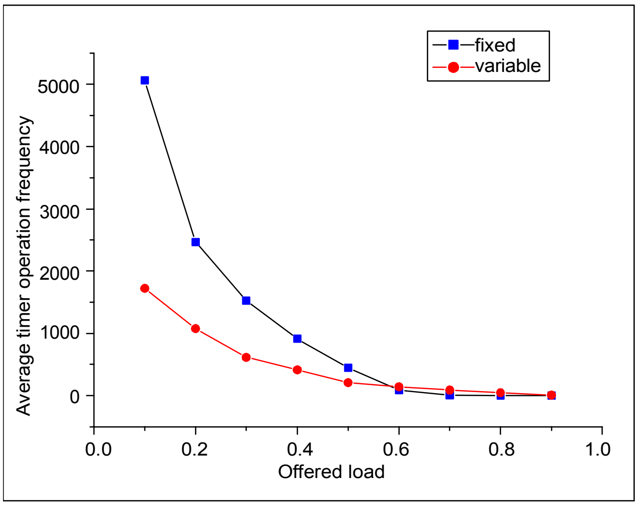


Fig. 17. Comparison average timer operation frequency of fixed, variable data burst size. (Traffic model 1).

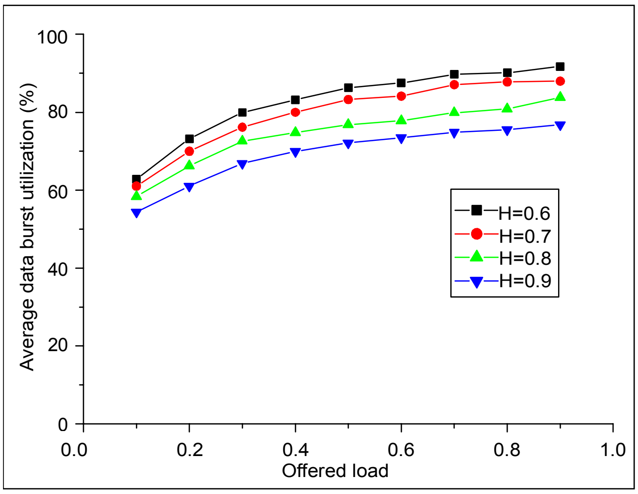


Fig. 18. Average data burst utilization for self-similar traffic. (H=0.6 to H=0.9).

intermediate node were nearly synchronized. However, the proposed algorithm assembled multiple IP packets non-periodically. We can see that the proposed algorithm had a lower average timer operation than the timer-count algorithm, so it had a lower continuous blocking probability in bandwidth reservation requests.

Figure 20 compares the average delay for different traffic models with a timer and without a timer. The data burst generation algorithm using a timer resulted in a low average delay as anticipated. Interestingly, with more burstiness there is less average delay (Fig. 21), although the difference is rather small. This is because bursty traffic brings a more frequent timer operation with low data burst utilization. In other words, the average delay trades off the data burst utilization.

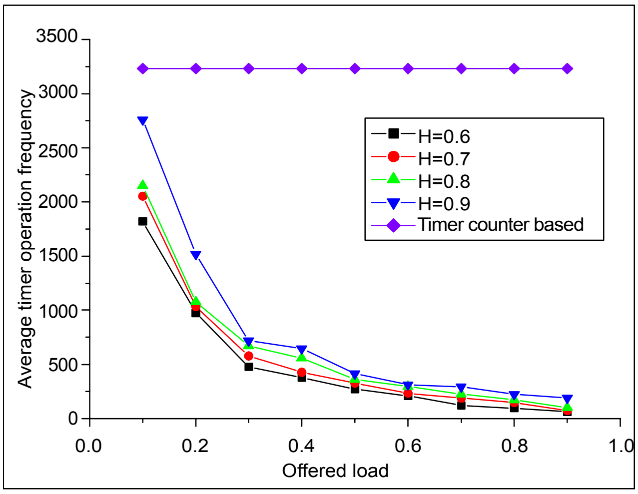


Fig. 19. Comparison average timer operation times of timer-count based scheme and proposed data burst assembly algorithm for self-similar traffic. (H=0.6 to H=0.9).

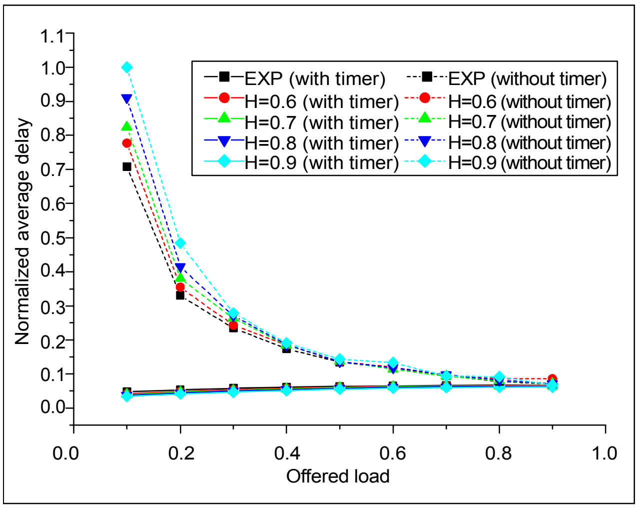


Fig. 20. Average delay for different traffic models with/without timer.

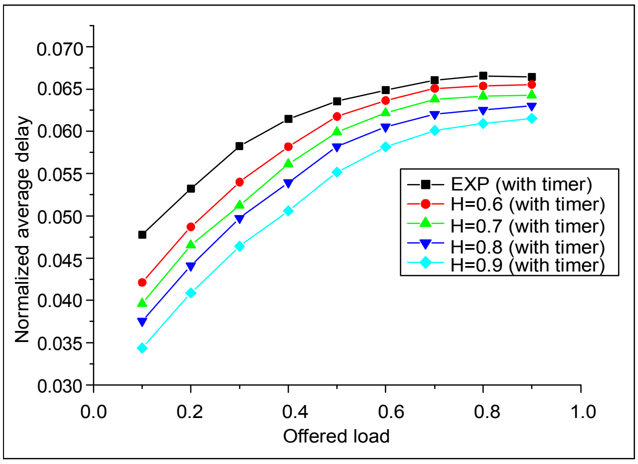


Fig. 21. Magnified average delay for different traffic models with timer in Fig. 20.

VI. CONCLUSION

We have described the basic concept of OBS and presented the ingress/core/egress functional model for optical burst switching networks. We proposed a new data burst generation algorithm at the edge router of the optical burst switching network and an OBS control packet structure based on MPLS.

We compared two data burst assembly methods: one method separates the IP packet when it is needed and the other constructs the earlier data burst with idle data and puts the IP packet in a later data burst. We found that the latter method reduces hardware and protocol system complexity.

We have verified that the proposed algorithm adaptively changes the data burst size according to the offered load and offers high average data burst utilization of over 50% of the average data burst utilization even in the worst case of high burstiness and a low offered load with a lower timer operation. It also reduces the probability of a continuous blocking problem in the bandwidth reservation request by using non-periodic data burst assembly time. Finally, we proved that the proposed algorithm limits the maximum queuing delay and minimizes the required burst size by increasing data burst utilization for bursty input IP traffic.

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